Nature

CUK-H06635-118-P20658

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

118

VOLUME CXVIII

JULY, 1926, to DECEMBER, 1926

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

London
MACMILLAN AND CO., LIMITED
NEW YORK: MACMILLAN COMPANY

[*Nature*,
February 5, 1927

PZ0658

INDEX.

NAME INDEX.

Abbot (Dr. C. G.), Solar Radiation, 280
Abbott (W. J. Lewis), The Artificial Production of Lustre on Flint Implements, 62
Abel (Prof. J. J.), awarded the Willard Gibbs gold medal for 1926, 890
Abel (Prof. R.), The Development and Present State of Public Health in Germany, 672
Abercrombie (Prof. P.), and others, The Making of the Future. The Coal Crisis and the Future: a Study of Social Disorders and their Treatment, 9
Achalme (P. and J.), The Influence of the Viscosity on the Specific Rotatory Power of certain Active Bodies, 179
Ackermann (A. S. E.), Smokeless Fuel for Power, 569
Adam (N. K.), Surfaces, Molecules, and Ions, 653
Adami (Dr. J. G.), [death], 347; [obituary articles], 453; Religion and Science, 562
Adams (Prof. E. P.), Sir J. J. Thomson's Seventieth Birthday, 879
Adams (F. D.), and R. P. D. Graham, Minerals from the Ruby Mine District of Burma, 568
Adams (L. H.), and R. E. Gibson, The Compressibilities of Dunite and of Basalt Glass and their bearing on the Composition of the Earth, 143; The Compressibility of Rocks, 354
Adcock (F.), High Frequency or Ironless Induction Furnaces, 48; Nitrogen in Iron-Chromium Alloys, 643
Adeney (W. E.), Rate of Aeration of Water, 28
Adler (S.), and O. Theodor, Identity of *Herpetomonas papatasii* and *Leishmania tropica*, 85; The Transmission of Cutaneous Leishmaniasis to Man from Artificially Infected *Phlebotomus papatasii*, 692
Ainslie (J. R.), Rainfall and Vegetation in Nigeria, 172
Akeley (C.), [death], 849
Alexander (C. P.), The Trichoceridæ (Diptera) of Australia, 574
Alexander (G. J.), Copper at Low Temperatures, 590
Alexander (J.), "Colloid Chemistry," 878
Alexanderson (E. F. W.), Propagation of Radio Waves, 28
Alford (Miss Violet), The Ritual Dance, 824
Alivisatos (A.), and F. Mercier, The Action of Crystallised Violet on the Cardio-vascular Apparatus of the Dog, 214
Allen (F.), and others, The Gustatory Sensory Reflex, 246
Allen (Miss Grace), Intelligence and Family History, 389
Allen (Prof. S. J. M.), Sir J. J. Thomson's Seventieth Birthday, 879
Alterthum (Dr. H.), Wolfram: Fortschritte in der Herstellung und Anwendung in den letzten Jahren, 80
Amar (J.), Radiations and Chlorophyll, 71
Ambard (L.), and F. Schmid, The Treatment of Respiratory Syncope by Inhaling Carbon Dioxide, 899
Ambronn (Dr. R.), Methoden der angewandten Geophysik, 620
Amery (Mr.), address at the Imperial Conference, 637
Ami (Dr. H. M.), The Canadian School of Prehistory in France, 626
Anderson (C.), C. Hedley, 811
Anderson (C. H.), A Reversion of certain Australian Rhenopodiaceæ, 719
Anderson (J.), appointed professor of philosophy in Sydney University, 897
Angeli (A.), Anomalies of certain Reactions, 35
Angles (A)., Restriction of Output, 462
Anthony (Prof. R.), The Aurignacian Human Figure from the Caverne David, Cabraret, 818
Antoniadi (E. M.), Changes recently observed on the Planet Jupiter with the 83 cm. Telescope of Meudon Observatory, 394; Mars, 495, 841
Appleton (Prof. E. V.), The Kerr Effect in Wireless Transmission, 514
Appleyard (R.), The Work of Clerk Maxwell, 743
Archbutt (S. L.), and J. W. Jenkin, Wrought Magnesium and Magnesium Alloys, 927
Arctowski (Prof. H.), and others, Meteorology and Geophysics in Poland, 134
Arkell (W. J.), The Corallian Rocks of Oxfordshire, Berkshire, and North Wiltshire, 934
Armitage (Miss Eleonora), Sterility in the Vegetable Marrow, 592
Armstrong (A. L.), Analysis of Prehistoric Bronze, 532
Armstrong (Prof. H. E.), A Half-Century of Chemistry in America: 1876–1926, 806; Dr. A. W. Rowe, 561; Education, Science, and Mr. H. G. Wells, 723; Hydrogen as Anion, 13; Prof. L. Darmstaedter, 690; The Reduction of Carbonic Oxide, 265
Arrhenius (Dr. O.), Kalkfrage, Bodenreaktion und Pflanzenwachstum, 584
Arrhenius (Prof. S.), Aus dem Schwedischen ubersetzt von Dr. Finkelstein, Erde und Weltall, 656
Ashley (Sir William), Business Economics, 835
Ashworth (Prof. J. H.), address to new students in Edinburgh University, 240; and Janet C. W. Bannerman, A Tetracotyle (*T. phoxini*) in the Brain of the Minnow, 826
Astor (Lord), and others, The Facts of Industry, 166
Atkins (Dr. W. R. G.), Penetration of Light into the Sea, 244; Plant Growth in the Sea, 746; and Dr. H. H. Poole, Photo-electric Measurements of Illumination in Relation to Plant Distribution. Part 1, 141. The Distribution of Red Algæ in Relation to Illumination, 155
Austin (L. W.), Measurements of Radio Signals made by the U.S. Bureau of Standards, 457
Avery (J. W.), and Dr. C. J. Smithells, The Effect of Working on the Physical Properties of Tungsten, 825
Awbery (J. H.), and Dr. Ezer Griffiths, The Latent Heat of Fusion of some Metals, 70
Ayrton (the late Mrs. Hertha), Primary and Secondary Vortices in Oscillating Fluids: their connexion with Skin Friction, 34
d'Azambuja (L.), and H. Grenat, The Great Activity of a Group of Sunspots followed by a Magnetic Storm and an Aurora Borealis, 791

Bagchi (Dr. H.), A Course of Geometrical Analysis, 766
Bailey (E. B.), and others, The Geology of Staffa, Iona, and Western Mull, 211
Bailey (F. W.), appointed lecturer in papermaking in Manchester University, 753
Bain (Dr. D.), appointed lecturer in technical chemistry in Edinburgh University, 680
Baines (Sir Frank), The Preservation of Ancient Cottages, 60

Baird (J. L.), Apparatus for Television, 19
Baker (E. C. Stuart), Birds. Vol. 3, second edition (The Fauna of British India, including Ceylon and Burma), 45
Baker (J. R), Natural History of the New Hebrides, 119
Baldit (A.), Magnetic Survey of France, 497
Balfour (Earl of), The Messel Memorial Lecture , presented with the Messel Memorial Medal, 128
Balfour (Sir Isaac Bayley), a memorial tablet to, in Edinburgh, 501
Ball (Dr L), appointed joint professor of medicine in Birmingham University, 68
Ball (Prof. N G), Transmission of Stimuli in Plants, 589
Ballay (M.), The Ludwig-Soret Phenomenon in Alloys, 718
Balls (Dr W. Lawrence), Cotton and Food, 616 , Possible Developments in the Cotton Industry, 456 ; The Classification of Research Work, 298 ; The State and Industrial Research Associations, 770
Baly (Prof. E. C. C), and R. W. Riding, The Occurrence of Helium and Neon in Vacuum Tubes, 625
Bamford (A. J), Cyclones over Ceylon, 390
Barcroft (Prof J), Hæmoglobin, 285
Bardet (Dr J), Atlas de spectres d'arc : tableaux d'analyse pour les recherches spectrochimiques, 509
Bargmann (Helene E.), A Half-way House of Science, 867
Barker (Dr. S. G.), appointed director of the British Research Association for the Woollen and Worsted Industries, 494
Barnard (C), Branch Fall in the Coniferales, 215
Barnard (K. H), The Eggs of the Pilot-fish (*Naucrates ductor*), 228 ; The Freshwater Isopodan and Amphipodan Crustacea of South Africa, 251
Barr (Dr. G), Electrification of Balloon Fabrics, 856
Bartelmez (Prof. C. W.), and Prof. H. M. Evans, Early Development of Human Embryo, 317
Barthe (L), and E. Dufilho, The Estimation of Sodium : Applications, 142
Bartlett (Prof H H.), to make collections of the Flora of Sumatra and Formosa, 130
Bartlett (R. J), Judging Intelligence, 687 , The Judgment of Value of Individual Advertisements, 462 ; What is Mind ? 549
Barton (Capt. F. R.), Development of the Use of Nickel in Coinage, 466
Barton (Helen), Generalisation of Kronecker's Relation among the Minors of a Symmetric Determinant, 215
Barus (Dr. C.), Acoustic Pressures in Case of Soap Bubbles ; Acoustic Pressure promoted by Co-operating Quill Tubes without Pinholes, 574
Barwick (G. F), appointed editor of a Directory of Sources of Specialised Information in Great Britain and Ireland, 24
Bateman (H.), A Possible Connexion between the Wave-Theory of Matter and Electro-Magnetism, 839
Bateman (H.), and R. J. Smith, awarded the John Winbolt prize of Cambridge University, 501
Bateson (G.), appointed Anthony Wilkin student in anthropology in Cambridge University, 824
Bather (Dr. F. A.), International Code of Zoological Nomenclature, 412 ; speech at unveiling of a memorial tablet to William Smith, 93
Baum and Co., Inc. (W. A.), A New Sphygmo-manometer, 282
Bausch and Lomb, Ltd., A Wide-Field Binocular Microscope, 675
Baylis (Dr. H. A.), 'Pwdre Ser' (The Rot of the Stars), 552 ; and R. Daubney, A Synopsis of the Families and Genera of Nematoda, 44
Beaman (Sir Frank), Psychology and Crime, 707
Beard (J. R.), and T. G. N. Haldane, The Design of City Distribution Systems, and the Problem of Standardisation, 708
Beaven (Dr. E. S.), Field Trials of Cereals, 815
Beck (C.), An Accurate Method of ascertaining the Position of the Focal Point of an Optical System, 898
Beck, Ltd. (R. and J.), A Small Ultra-violet Spectroscope, 427
Bedos (P.), Some New Reactions of the Oxide of Cyclohexene, 681
Beit (Sir Otto), a further gift for Beit fellowships for scientific research, 708
Bělehrádek (Dr. J), Influence of Temperature on Biological Processes, 117 ; Protoplasmic Viscosity as determined by a Temperature Coefficient of Biological Reactions, 478
Bell (Miss Gertrude Lowthian), [death], 92 , [obituary article], 165
Bell (Prof W. Blair), A New Treatment for Cancer, 850
Belling (Dr. J), The Attractions of the Ends of Chromosomes in Trivalents and Quadrivalents, 227
Bellingham and Stanley, Ltd., Direct Reading Wavelength Spectrometers, 820
Benedetti (E.), The Action of the High Frequency Oscillating Electromagnetic Field on Vegetable Seeds, 935
Benedicks (Prof C.), H. Backstrom, and P Sederholm, Heat Conduction in Steel, 675 ; and P. Sederholm, The Anomalous Dilatation of Invar, 842
Benjamin (M. S.), The Rate of Decomposition of Commercial Calcium Cyanide, 287
Bennett (C. N.), Elements of Photogravure, Photo Printin from Copper Plates : Screen Photogravure simply explained, with full Working Instructions and an Explanatory Chapter on Modern Rotary Gravure Printing, 513
Bennett (Dr G. M.), Lengthened Chain Compounds of Sulphur, 555
Bentley (A. O.), and J. E Driver, A Text-book of Pharmaceutical Chemistry, 113
Benton (W. A), Invention as a Remedy for Unemployment, 731
Berg (Prof. L. S.), translated by J. N. Rostovtsow, Nomogenesis : or Evolution determined by Law, 617
Berger (Prof. G), Electron Displacement *versus* Alternate Polarity in Aliphatic Compounds, 734
Berry (Dr. E. W.), Pleistocene Plants from North Carolina, 893
Bertrand (G), and M. Macheboeuf, Nickel, Cobalt, and Diabetes, 394 ; The Influence of Nickel and Cobal on the action exercised by Insulin on the Dog, 250 Influence of Nickel and Cobalt on the action produced by Insulin in the Rabbit, 178 ; The Relatively High Proportion of Nickel and Cobalt in the Pancreas, 71
Besson (L.), Relation between the Temperatures of certain Months in the Year, 863
Best (E), Sickness, Death and Burial among the Maori, 567
Beveridge (Sir William), elected Vice-Chancellor of London University, 31
Bessonoff (N), The True Specific Régime of Experimental Scurvy, 899
Bhatnagar (Prof S. S), R. B. Lal, and K. N. Mathur, Effect of Polarised Radiations on Animal Metabolism, 11
Biffen (Sir Rowland), and F. L. Engledow, Modern Wheat Breeding, 281
Bigelow (Prof. R. P), Directions for the Dissection of the Cat, 407
Bigourdan (G.), A Means of improving the Lunar Coordinates deduced from the Occultations of Stars, 359 ; The Uniformity of the Earth's Rotation, 425
Billinghurst (P. E), Magnetic Alloys, 283
Bingham (Kathleen E.), Age-hardening of Aluminium Alloys, 605 ; Constitution and Age-hardening of some Ternary and Quaternary Alloys of Aluminium containing Nickel, 466
Binks (W.), The Crystalline Structure of Zircon, 755
Birge (Prof. E. A.), and C. Juday, Organic Matter in Lake Water, 818 , The Organic Content of Lake Water, 575
Birkeland (K. B.), The Whalers of Akutan : an Account of Modern Whaling in the Aleutian Islands, 620
Bjerknes (Prof. V), Theory of Sunspots, 891
Black (Dr. D.), Fossil Apes and Man, 746 ; Tertiary Man in Asia : the Chou Kou Tien Discovery, 733
Black (M.), awarded the Harkness scholarship for geology of Cambridge University, 140
Blackman (Prof. V. H.), Prof. F. G. Donnan, and Prof. F A. Lindemann, appointed members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, 424
Blakeslee (A. F), and J. L. Cartledge, Pollen Abortion in Chromosomal Types of Datura, 143

Bland (J. O. W.), elected a John Lucas Walker student in pathology in Cambridge University, 286
Bleek (D. F.), Bushmen of Central Angola, 935
Bles (Dr. E. J.), [obituary article], 90 ; the bequest of, to Cambridge University, 286
Bliss (E. W.), The Nile Flood and World Weather, 825 ; World Weather, 856
Blondel (H.), Orbit of No. 117 Lomia, 566
Blum (Dr. W.), The Manufacture of Metal Tubes and Sheets by Electrolytic Means, 423
Bodding (P. O.), The Form of Script to be used in recording the Munda Group of Languages, 889
Bode (J. E.), centenary of the death of, 742
Bogen (Dr. E.), Arachnidism, 927
Bogros (A.), The Resonance of Lithium Vapour, 358
Bohr (Prof. N.), Sir Ernest Rutherford, December 18, Suppt., 51 ; Sir J. J. Thomson's Seventieth Birthday, 879
Bonacina (L. C. W.), Seasonal Sunshine in Great Britain, 194
von Bonde (C.), The Chorology of the S. African Heterosomata with Some Relative Problems, 179 ; The Vascular System of the Plagiostomi, with Special Reference to the Common Dogfish (*Squalus acutipinnis*, Regan), 502 ; and D. B. Swart, The Structure of the Plathander (*Zenopus lævis*), Part i., 215
Bone (M. D.), awarded a Robert Blair fellowship, 176
Bone (Prof. W. A.), Moisture and Surface Action, 675 ; New Experiments on the Combustion of Carbonic Oxide, 22 ; The Burning of Carbonic Oxide, 932 ; The Supposed Law of Flame Speeds, 837
Boody (Dr. Bertha M.), A Psychological Study of Immigrant Children at Ellis Island, 406
Booker (F. W.), The Internal Structures of the Pentameridæ of N.S.W., 611
Borozdin (Prof. J.), Excavations in the Neighbourhood of Nikolaieff, 564
Borradaile (Dr. L. A.), A Manual of Elementary Zoology. Fifth edition, 513
Borthwick (Prof. A. W.), The Rôle of the University in Connexion with the Practice of Forestry, 202
Boscheron (L.), The Non-ferrous Metals Industry in the Liége District, 466
Bose (Sir Jagadis C.), elected president of the Indian Science Congress, 1927, 60 ; Plant Stimulus and Response, 94 ; The Nervous Mechanism of Plants, 654
Bosman (L. P.), The Nature of the Co-enzyme of Lipase, 502
Bostwick (A. E.), Spatial and Time Relations in Dreams, 627
Boswell (Prof. P. G. H.), The Geology of the Eastern Part of the Denbighshire Moors, 69
Bothe (Dr. W.), The Coupling between Elementary Radiation Processes, 172
Bouis (M.), The Synthesis of Allene Hydrocarbons, 358
Boulard, A Method permitting Fermentations to be arrested at Will, 107
Bouldoires (J.), The Transformations undergone by Aluminium Bronzes, 755
Boulenger (E. G.), The Vitality of Batrachians and Fishes Frozen Stiff, 457
Boulton (Prof. W.), elected dean of the faculty of science of Birmingham University, 646
Bourcart (Dr. E.), translated from the French and adapted to British Standards and Practice. Second English edition, revised and enlarged by T. R. Burton. Insecticides, Fungicides, and Weed Killers, October 16, Suppt., 24
Bourion (F.), and E. Rouyer, The Results obtained in the Quantitative Study of the Association of Mercuric Chloride, 179
Bousfield (P.), Pleasure and Pain : a Theory of the Energic Foundation of Feeling, 257
Boutaric (A.), and G. Corbet, On the Critical Temperature of Solution of Acrolein and Water and on the Molecular Mass of Soluble Acrolein Resin, 250
Bowen (I. S.), and Prof. R. A. Millikan, The Ionisation Potential of O II, 410
Bower (Prof. F. O.), Changing Aspects of Botanical Science, August 7, Suppt., 19 ; Seven Decades of Botany, 413
Bower (S. M.), Report on Winter Thunderstorms in the British Islands, Jan. 1 to March 31, 1925, 106
Bowie (Dr. J. A.), appointed director of the department of Industrial Administration in the Manchester College of Technology, 753
Boycott (Prof. A. E.), The Reaction to Flea Bites, 591
Boylan (R. K.), Atmospheric Dust and Condensation Nuclei, 177
Boys (Prof. C. V.), Liveing's Fire-Damp Indicator, 626 ; Progressive Lightning, 749
Bragg (Sir William), The Imperfect Crystallisation of Common Things, 120
Brauner (Prof. B.), The New Element of Atomic Number 61 : Illinium, 84
Bray (W. C.), and H. D. Draper, Capillary Condensation and Adsorption, 143
Breit (G.), The Electromagnetic Mass and Momentum of a Spinning Electron, 396
Bremer (Dr. W.), [death], 921
Brenner (Dr. O.), appointed part-time assistant in pathology and bacteriology in Birmingham University, 860
Bretherton (C. H.), Midas : or, the United States and the Future, 76
Breuil (Abbé H.), Scientific Neglect of the Mas d'Azil, 265 ; The Maglemose Culture, 426
Brewer (A. K.), Ionisation in Reacting Gases, 682
Bridel (M.), and C. Béguin, A New Glucoside Hydrolysable by Rhamnodiastase, extracted from the Fresh Flowers of *Ulex europæus*, 250 ; Biochemical Researches on the Composition of *Salix triandra*, 359
Brillouin (Prof. L.), The New Atomic Theory, 172
Briscoe (Prof. H. V. A.), and P. L. Robinson, The Volatility and Dissociation of Borax, 374
Broad (Dr. C. D.), Francis Bacon and Scientific Method, 487, 523
Brocklehurst (Capt. H. C.), awarded the silver medal of the Zoological Society of London, 777
de Broglie (L.), Interference and Corpuscular Light, 441
de Broglie (le Duc), Sir J. J. Thomson's Seventieth Birthday, 879
Bromwich (Dr. T. J. I'a.), An Introduction to the Theory of Infinite Series. Second edition, revised with the assistance of Dr. T. M. MacRobert, 112
Brooks (C. E. P.), Climatic Changes during Geological Times, 15, 53 ; Ice Ages, 293
Brouwer (Prof. H. A.), recorded and prepared by L. N. Gould, The Geology of the Netherlands East Indies : Lectures delivered as Exchange-Professor at the University of Michigan in 1921–22, 80
Brown (Prof. Baldwin), appointed Munro lecturer in Edinburgh University, 788
Brown (C. B.), Stone Implements from North-West Peru, 26
Brown (Prof. E. W.), Changes in the Earth's Rate of Rotation, 170
Brown (F. G. W.), Higher Mathematics : for Students of Engineering and Science, 80
Brown (J.), Teaching Science in Schools, October 16, Suppt., 28
Browne (Rev. H. C.), Optics and Poetry, 697
Brownlee (Dr. J.), Illegitimacy and Racial Invasions in Britain, 746
Brownlie (D.), Coal Blending, 607
Bruce (A. B.), and Dr. H. Hunter, Crop and Stock Improvement, 910
Bruce (J. R.), The Respiratory Exchange of the Mussel, 673
de Bruin (T. L.), The Double Normal State of the Arc Spectrum of Fluorine, 804
Brun (P.), The Miscibility of Quaternary Water-Alcohol Mixtures, 359
Bruni (G.), and A. Ferrari, Crystalline Structure of Certain Bivalent Chlorides, 503
Brunner, Mond and Co., Ltd., Nobel Industries, Ltd., the British Dyestuffs Corporation, Ltd., and the United Alkali Co., Ltd., fusion of interests of, 638
Brunt (D.), A Simple Period of Vertical Oscillation in the Atmosphere, 826 ; Periodicities in Rainfall, Pressure, and Temperature at certain European Stations, 826
Brunton (Dr. C. E.), appointed demonstrator in human physiology in Manchester University, 140
Bryan (Prof. G. H.), 'Red Rain' at Bordighera, Italy, 697

Bryson (F. F. S.), The Electrical Conductivity of Glasses at High Temperatures, 178
Buchanan (Capt. A.), Sahara, 189
Buchanan (Sir George), International Agreements affecting Port Sanitary Work, 537
Buck (Dr. P. H.), The Value of Tradition, 892
Buckley (H. E.), appointed lecturer in crystallography in Manchester University, 140; The Anomalous Optical Properties of Some New Series of Isomorphous Double Tartrates, 105
Buckman (S. S.), Jurassic Chronology, iii, 825
Bucknill (Sir John), [death], 636
Budnikoff (P.), The Activation of the Inert Varieties of Calcium Sulphate, 395
Buffington (R. M.), and W. M. Latimer, Coefficients of Expansion at Low Temperatures, 748
Burgess (M. J.), Projection of Explosive Flames, 569
Burgess (W. G.), Imperfect Crystallisation of Common Camphor, 116
Burkill (I. H.), Hawaiian Volcano Plants, 69
Burkitt (M. C.), British Late Palæolithic Industries, 833; Prehistory in Britain, 652
Busk (Sir Edward), [death], 704
Buss (A. A.), Persistent Solar Prominences, 412; Sunspots in October, 680; The Recurrence of Magnetic Storms, 769
Butler (J. A. V.), appointed a lecturer in the department of chemistry in Edinburgh University, 788
Buxton (Dr. P. A.), appointed reader in medical entomology at the London School of Hygiene and Tropical Medicine, 31; Depopulation and Disease in the New Hebrides, 62; The Relation between Malaria and Abortion, 744

Cadbury Bros., Ltd., gift of Land to Birmingham for a Hospital, 646
Caignard (L.), The Variation of the Dielectric Constant of Benzene with Pressure, 899
Caird (Prof. F. M.), [death], 740
Calderwood (W. L.), Fish Passes, 710
Caldonazzo (B.), An Extension of Bernouilli's Theorem, 719
Calkins (Prof. G. N.), The Biology of the Protozoa, 763
Callendar (Prof. H. L.), R. O. King, and C. J. Sims, Dopes and Detonation, 753
Calman (Dr. W. T.), Rev. T. R. R. Stebbing, 201; The Rhynie Crustacean, 89
Calmette (A.), J. Valtis, and M. Lacomme, The Intrauterine Transmission of the Tubercle Virus from Mother to Infant, 898
Cambage (R. H.), The Native Flora of N.S.W., Part xi., 574; Acacia Seedlings, Part xii., 467
Cambridge Instrument Co., Ltd., List of Electrometers, etc., 643
Cameron (Prof. A. E.), The Tabanidæ of the Canadian Prairie, 496
Campbell (Dr. Norman R.), Vacuum Practice, 331; and C. G. Eden, Rating Incandescent Lamps, 820
Canney (Prof. M.), Tears, 98
Carman (Dr. R. D.), [death], 347
Carobbi (G.), Some Noteworthy Vesuvian Sublimates, 935
Carpenter (Prof. H. C. H.), The Production of Single Crystals of Metals and some of their Properties, 266; and S. Tamura, Experiments on the Production of Large Copper Crystals, 717; The Formation of Twinned Metallic Crystals, 717
Carpenter (T. M.), Rectal Alimentation, 858; The Metabolic Effect of Enemata of Alcohol, Dextrose, and Levulose in Humans, 215
Carr (Prof. H. Wildon), Relativity and the Dayton Miller Experiments, 641; Truth and Tradition, 109
Carruthers (J. N.), A Novel Current Meter, 318; Bottom Currents in the North Sea, 354
Casella (C. F.) and Co., Ltd., Catalogue of Surveying Instruments, 643
Castellani (Prof. A.), Dr. G. C. Low, Dr. D. Nabarro, and Sir Ronald Ross, Apocryphal Medical Science, 518
Caton-Thompson (Miss G.), and Miss E. W. Gardner, Early Egypt and the Caucasus, 624
Caudwell (G.), Utilisation of an Aeroplane for Agricultural Spraying Operations, 239
Cave (C. J. P.), Clouds and Weather Phenomena: for Artists and other Lovers of Nature, 369; The Physical Basis of Insect Drift, 50
Chahovitch (X.), The Energy Metabolism in the Course of Experimental Survey, 107
Chamberlain (Neville), speech at laying foundation stone of the London School of Hygiene and Tropical Medicine, 92; speech at the reopening of the Wellcome Bureau of Scientific Research and the Museum of Medical Science, 887
Chambers (Surgeon Vice-Admiral Sir Joseph), Statistical Report of the Health of the Navy, 1923, 205
Channon (H. J.), appointed bio-chemist in the Department of Experimental Pathology of Leeds University, 788
Chapman (A. Chaston), Micro-organisms in Industry, 133; On the Presence of Compounds of Arsenic in Marine Crustaceans and Shellfish, 610; and H. Linden, On the Presence of Lead and other Metallic Impurities in Marine Crustaceans and Shellfish, 610; and H. J. Plenderleith, An Ancient Egyptian Cosmetic, 857
Chapman (D. L.), R. A. Goodman, and R. T. Shepherd, The Synthesis of Nitrous Oxide, 245
Chapman (Sir Frederick), The Age of the Earth, 461
Chapman (F.), Fossil Leaf-Beds in Victoria, 711
Chapman (Prof. S.), The Aurora Borealis as observed from Norway, 797
Charcot and P. Idrac, A Phenomenon of Atmospheric Depression produced by a Lofty Obstacle in the Wind, 826
Chariton and Walta, Oxidation of Phosphorus Vapour, 893
Charlier (Dr. C. V. L.), elected a foreign corresponding member of the Vienna Academy of Sciences, 96
Charlton (A. G.), [death], 92
le Chatelier (Dr. H. L.), elected a foreign member of the Académie Polonaise des Sciences, Craçow, 60
Chauchard (M. and Mme. A.), Action of Curare on the Electrical Apparatus of *Torpedo marmorata*, 250
Cheel (E.), Notes on *Melaleuca pubescens* Schauer and *M. Preissiana* Schauer, 719
Cheeseman (T. F.), Manual of the New Zealand Flora. Second edition, revised and enlarged by the author. Edited by W. R. B. Oliver, 151
Chemin (Prof. E.), Les mollusques d'eau douce, 765; and R. Legendre, The Existence of Free Iodine in *Falkenbergia Doubletii*, 899
Chesters (Miss A. E.), The Vascular Supply of the Bracts of some Species of Anemone, 934
Chevenard (P.), The Course of the Isotherms representing the Resistance and Thermo-electric Power of the Reversible Ferro-Nickels in the Interval −200° C. to 1000° C., 107; The Dilatometric Anomaly of the Paramagnetic Nickel-Chromium Alloys; an Alloy suitable for an Expansion Pyrometer, 35; Thermal Anomalies of certain Solid Solutions, 466
Childe (V. Gordon), The Dawn of European Civilisation, 401; The First Colonisation of Central Europe, 106
Chilton (Prof. C.), A New Isopod from the Chatham Islands, 243
Choucroun (Mlle.), The Radio-Chemistry of Fluorescent Bodies, 395
Chree (Dr. C.), Atmospheric Electricity, 894; The Geographical Distribution of Magnetic Observations, 273; The Recurrence of Magnetic Storms, 335, 769
Christie (Dr. G. H.), appointed lecturer in chemistry in Durham University, 68
Church (Dr. A. H.), conferment upon, of an honorary doctorate by the University of Wales, 176
Claremont (C. L.), A Practical Handbook on Rat Destruction, 407
Clark (A. H.), Animals of Land and Sea, 259
Clark (C. H. Douglas), The Basis of Modern Atomic Theory, 365
Clark (J. E.), I. D. Margary, and R. Marshall, Report on the Phenological Observations in the British Isles, 1925, 106
Clark (R. J.), Electrostatic Moments of Molecules, 555
Clark (Dr. R. S.), Rays and Skates; a Revision of the European Species, 800
Clarke (Dr. R. H.), [death], 201
Clément (A.), Roger Bacon and Gunpowder, 352

Cleminson (J.), and Prof. H. V. A. Briscoe, The Catalytic Dissociation of Carbon Monoxide, 534
Clinton (W. C.), appointed professor of electrical engineering at University College, London, 31
Clough (Dr. C. T.), and others, Memoirs of the Geological Survey of Scotland. The Economic Geology of the Central Coalfield of Scotland. Area 5. Second edition, 656
Coad-Pryor (E. A.), The Economics of the Annealing Process, 681
Coates (W. H.), The Mystery of Money, 760
Cobbett (Dr.), reappointed university lecturer in pathology in Cambridge University, 31
Cobham (Alan J.), My Flight to the Cape and Back, 189; Return from Australian Flight, 527
Cockayne (Dr. L.), Plan for a Botanical Reserve in New Zealand, 277; and H. H. Allan, The Naming of Wild Hybrid Swarms, 623
Cockcroft (J. D.), and J. A. Ratcliff, elected to the Clerk Maxwell scholarship of Cambridge University, 538
Cockerell (Prof. T. D. A.), Hunting Fossil Insects, 781; The Antiquity of the Labiatæ or Mint Family, 696; The Genetics of Evening Primroses and Mice, 914; The Training of a Sociologist, 831
Coffin (C. A.), [death], 347
Cohn (E. J.), and J. B. Conant, The Molecular Weights of Proteins in Phenol, 396, 675
Coker (Prof. E. G.), Elasticity and Plasticity (Thomas Hawksley Lecture), 743
Cole (Prof. F. N.), [death], 20
Cole (J. S.), and A. L. Hallsted, Yield and Position of Field Crops, 282
Cole (S. W.), Practical Physiological Chemistry. Seventh edition, October 16, Suppt., 27
Coleman (Prof. A. P.), Ice Ages: Recent and Ancient, 293
Collinge (Dr. W. E.), Sea-birds: their Relation to the Fisheries and Agriculture, 920
Collinson (G. A.), awarded a cancer research fellowship in Leeds University, 788
Colonnetti, Experimental Investigations on Elastic Co-actions, 323
Colwell (N. P.), Rural Schools as Centres of Medical Service and Community Life, 213
Comber (Prof. N. M.), Arrhenius's Kalkfrage, Bodenreaktion und Pflanzenwachstum, 584; The Anomalous Flocculation of Clay, 412
Compton (K. T.), Interpretation of Deviations from Ohm's Law, 682; and C. H. Thomas, Soft X-rays, 820
Comstock (Prof. D. F.), Sir J. J. Thomson's Seventieth Birthday, 880
Condon (E.), Remarks on Penetrating Radiation, 143
Constable (Dr. F. H.), On the Stability of Copper Catalysts produced by Thermal Decomposition, 790; The Structure of Catalytically Active Copper, 730
Conybeare (E. T.), awarded the university studentship in physiology of London University, 213
Cook (H. J.), The Antiquity of Man in America, 855
Cook (Prof. R. V.), Use of Pith Dust in Kundt's Tubes, 157
Cook (S. S.), The Use of High Pressures for Steam Turbine Installations, 450
Cook (W. T.), and W. R. D. Jones, The Copper-Magnesium Alloys, 466
Coope (Dr. R.), awarded the Rogers prize of London University, 213
Cooper (Sybil), and D. Denny-Brown, Responses to Rhythmical Stimulation of the Cerebral Cortex, 33
Copeland (Dr. A. J.), awarded the Raymond Horton-Smith prize of Cambridge University, 788
Copeman (P. R. v. d. R.), The Growth of Grapes, 935
Corbino (O. M.), and T. Levita-Civita, Doppler's Principle and the Ballistic Hypothesis of Light, 432
Cornish (Dr. Vaughan), Grouping of Forms in Scenery, 892; The Relation between Velocity of Wind and Wave, 665, Wind and Speed of Waves, 207
Coster (Geraldine), Psycho-Analysis for Normal People, 477
Cotton (H.), Electrical Technology: a Textbook for the following Examinations, National Certificate, City and Guilds, A.M.I.E.E., B.Sc. Engineering. In 8 Parts. Part 1, 691
Cotton (Prof. L. A.), Ages of Radioactive Minerals from Australia, 244
Coulter (Prof. J. M.), The Boyce Thompson Institute for Plant Research, 456
Cournot (J.), and J. Bary, Electrolytic Plating of Aluminium and Light Alloys, 863
Cox (Dr. H. E.), The Chemical Analysis of Foods: a Practical Treatise on the Examination of Foodstuffs and the Detection of Adulterants, 115
Cox (H. L.), awarded the Rex Moir prize of Cambridge University, 68
Coxe, Jr. (E. B.), a memorial to the late, in the Museum of the University of Pennsylvania, 780
Cramer (F.), Butterfly Migration, 191
Crawford (O. G. S.), The Last Forest Phase in Britain, 206
Crawley (Col.), The Overseas Radio Services in Great Britain, 423
Crearer (C. W.), Fish Stocking in America, 62
Cresson (E. T.), [death], 165
Crew (Dr. F. A. E.), Blood Reactions and Sex, 85; Fertility in the Domestic Fowl, 282
Crooke (W.), prepared for the press by R. E. Enthoven, Religion and Folklore in Northern India, 255
Crookshank (Dr. F. G.), Migraine and other Common Neuroses: a Psychological Study, 223
Cross (Capt. H. E.), Bot Flies of the Punjab, 62
Crowther (Prof. J. A.), Research Work in the Cavendish Laboratory in 1900–18, December 18, Suppt., 58; The Atom Again, 365; X-rays and Living Matter, 86
Crozier (W. J.), and G. Pincus, Tropisms of Mammals, 791
Cullis (Prof. W. E.), Matrices and Determinoids. Vol. 3, Part 1, 295
Cumin (G.), Geological Observations on the Island of Asinello and on Neighbouring Rocks (Carnaro), 36
Cumming (Dr. W. M.), Science and the Press, 842
Cunningham (G. H.), Gasteromycetes of Australasia (v.), 574
Cunningham (Prof. G. W.), Problems of Philosophy: an Introductory Survey, 296
Curie (Madame), International Scholarships for the Advancement of the Sciences, etc., 888; Sir J. J. Thomson's Seventieth Birthday, 880
Currie (L. D.), [obituary], 921
Curtis (Dr. W. E.), appointed professor of physics at Armstrong College, 68
Cushman (J. A.), Samoan Foraminifera, 856
Cushny (Prof. A. R.), The Secretion of the Urine. Second edition, 477
Cusworth (J. T.), The Vitality of a Frog Frozen into a Block of Ice, 457
Cutler (Dr. D. W.), The Biology of the Protozoa, 763

D'Abernon (Lord), acceptance of the chairmanship of the Industrial Fatigue Research Board, 890
Dadieu (A.), The Electromotive Behaviour of Aluminium, 827
Da Fano (Dr. C.), Neuroglia Cells, 317
Dakin (A.), Practical Mathematics, October 16, Suppt., 27
Dale (Dr. H. H.), awarded the Cameron prize of Edinburgh University, 176; and others, Lectures on certain Aspects of Biochemistry, 403
Dallmeyer, Ltd. (J. H.), A New Reflex Camera, 28
Daniel (R. J.), Hydrography of the Irish Sea, 353
Danjon (A.), Description du ciel, 620
Darbyshire (O.), The Three-dimensional Reproduction of Tracks of β-particles ejected by X-rays, 371
Darmstaedter (Prof. L.), Naturforscher und Erfinder: Biographische Miniaturen, 620
Darwin (Major L.), The Need for Eugenic Reform, 39
Darzens (G.), A New General Method for the Synthesis of the Tetrahydronaphthalene and Naphthalene Hydrocarbons, 826
Daubeny (Dr. C.), and the British Association, 239
Dauvillier (Dr. A.), Spectrographic Junction between the X-ray Region and the Extreme Ultra-violet, 551, 853; The Discovery of the Characteristic *O* and *N* Series of Low Frequency, 755
David (Sir T. W. Edgeworth), conferment upon, of an honorary doctorate by the University of Wales, 176
Davidson (A.), Intermediates for Dyestuffs, 689
Davidson (C. R.), and others, The Total Solar Eclipse of January 14, 1926, 751

Davies (S. J.), appointed reader in mechanical engineering at King's College, 176
Davies (W. M.), Collembola injuring Mangold Seedlings, 856
Davis (Dr. A. H.), and N. Fleming, The Acoustics of Buildings, 534
Davis (N. R.), and C. R. Burch, High Frequency or Ironless Induction Furnaces, 47
Davis (R.), Intermittency in Photographic Exposures, 427
Davis (Prof. T. L.), Boerhaave's Attitude toward Alchemy, 350
Davison (E. H.), Handbook of Cornish Geology, October 16, Suppt., 24
Davy (Dr. J. Burtt), Lely's The Useful Trees of Northern Nigeria, 656
Dawson (Dr. W. S.), appointed professor of psychiatry in Sydney University, 897
Day (Dr. A. L.), elected a foreign associate of the Geological Society, 96
Delaplace (R.), The Preparation of Cæsium Eosinate, 250
Delépine (M.), A supposed Isomer of Methylene-aminoacetonitrile, 250
Delsman (H. C.), The Eggs of the Sucker-fish, 805
Denigès (G.), Action of Hydrobromic Acid and of the Alkaline Bromides in Acetic Acid Solution on Cupric Bromide, 394; The Action of Concentrated Hydrobromic and Hydriodic Acids on the Cobalt Ion, 250
Deniker (Dr. J.), Les races et les peuples de la terre. Deux. édition, 545
Dennert (Prof. E.), Die intraindividuelle fluktuierende Variabilitat: eine Untersuchung uber die Abanderung des Pflanzenindividuums und die Periodizitat der Lebenserscheinungen, 873
Denning (W. F.), Abundance of Fireballs, 495; Another Detonating Fireball, 566; Fireball on August 13, 388; Giacobini's Comet and the Meteoric Display of October 9, 709; July Meteors, 170, Pons-Winnecke Comet and Meteors, 61; The August Perseids for 1926, 280; The Geminid Meteoric Shower, 854; The Meteoric Phenomena of September 6, 425, 531; Unusual Display of Large Meteors, 603
Densmore (Frances), Music of the San Blas Indians, 317
Depéret (C.), The Neolithic Layer of Glozel (Allier), 755
Descartes, René, The Geometry of, Translated by D. E. Smith and M. L. Latham. With a Facsimile of the first edition, 1637, 400
Desgrez (A.), and J. Meunier, The Detection and Determination of Strontium in Sea Water, 790; L. Lescœur, and Mlle. S. Manjean, The Influence of a Current of Inert Gas on the Decomposition of Sulphide Solutions, 681
Deslandres (Dr. H.), The Distribution in Time of Terrestrial Magnetic Perturbations, etc, 71; The Law of Distribution of Terrestrial Magnetic Storms, and the corresponding Law of Distribution of the Active Regions of the Sun, 359; The Law of Distribution in Time of Magnetic Storms, 610; The Recurrence of Magnetic Storms, 621
Dewhurst (H.), A Rapid Bolometer made by Sputtering Thin Films, 825
Diener (Prof. C.), elected a foreign member of the Geological Society, 96
Dines (H. G.), and F. H. Edmunds, The Geology of the Country around Romford, 212
Dingle (Prof. H.), The Spectrum of Fluorine (FI), 862
Dingwall (E. J.), Science and Psychical Research, 480; The "Margery" Case, 618
Dirac (P. A. M.), On Quantum Algebra, 323
Disher (M. W.), The Psychology of Amusements, 243
Ditchburn (R. W.), awarded an Isaac Newton studentship in Cambridge University, 646
Dixey (Dr. F.), The Great Rift Valley, 389
Dixon (Prof. H. B.), and W. F. Higgins, The Burning of Gases in Nitrous Oxide, 862
Dixon (Eng.-Vice-Admiral Sir Robert B.), acceptance of the presidency of the Junior Institution of Engineers, 24
Dobson (Dr. G. M. B.), The Uppermost Regions of the Earth's Atmosphere: being the Halley Lecture delivered on May 5, 1926, 221; I. O. Griffith, and Dr. D. N. Harrison, Photographic Photometry: a Study of Methods of Measuring Radiation by Photographic Means, 689
Dodd (A. P.), New Species of Australian Proctotrypoidea, with Revisional Notes, 323
Dollman (J. G.), A supposed New 'Mutation' in the Rabbit, 69
Donati (G. B.), centenary of the birth of, 850
Donkin (Sir Bryan), Science and Psychical Research, 480, 658
Doodson (Dr. A. T.), Tide-predicting Machines, 787
Dorsey (Dr. N. E.), Lightning, 190, 482
Dorward (A. J.), appointed University lecturer in moral science in Cambridge University, 31
Douglas (C. K. M.), awarded the Buchan prize of the Royal Meteorological Society, 924
Dowd (Mary T.), and Jean D. Jameson, Food, its Composition and Preparation. a Textbook for Classes in Household Science. Second edition, 909
Dowling (J. J.); the Writer of the Note, Operation for Fog-Signals from a Distance, 265
Downie (A. M.), appointed assistant lecturer in bacteriology in Manchester University, 753
Doyle (Sir Arthur Conan), Science and Psychical Research, 370, 553, 659; The History of Spiritualism. 2 Vols., 147
Doyle (J.), The Ovule of Larix and Pseudotsuga, 70
Doyle (Prof.), and Miss Phyllis Clinch, Pentosans and Cold Resistance in Plants, 567
Drain (Prof. B. D.), Essentials of Systematic Pomology, 368
Drever (Dr. J.), Psychological Aspects of our Penal System, August 7, Suppt., 18, 446
Dreyer (Dr. J. L. E.), [obituary article], 454
Driberg (J. H.), Didinga Witchcraft, 710
von Drygalski (Dr. E.), awarded the gold medal of the American Geographical Society, 316
Drzewiecki (S.), A New Representation of a Gas, 862
Drzewina (Mme. Anna), and G. Bohn, The Activation by Light of the Effects of Silver on Convoluta, 756; The Antagonistic Action of Metallic Silver and Tin on Living Beings, 681
Dubois (Dr.), The "Pithecanthropus Skull" obtained at Trinil, Java, 887
Dubreuil (Prof. G. J.), Sôma, 460
Dubrisay (R.), Researches on Surface Actions, 142; The Action of Heat on the Superficial Properties of Kaolin, 862
Duerden (Prof. J. E.), Spirals and Waves in Wool, 153
Dufay (J.), The Operation of Lightning, 71
Duffendack (O. S.), and G. W. Fox, Energy Levels of the Carbon Monoxide Molecule, 12
Dumanois (P.), The Importance of the Combustion Yield in Internal Combustion Engines, 718; The Possibility of Realising High Compressions without Antidetonants, 106; The Retarded Inflammation Effect produced by Antidetonants, 179; and P. Laffitte, Influences of the Pressure on the Formation of the Explosive Wave, 394
Dumont (J.), The Separation of the Finer Particles and Colloidal Constituents of the Soil by Centrifugation, 358
Dunkerly (Prof. J. S.), Biological Research in the Tropics, 662
Dunoyer (L.), translated by J. H. Smith, Vacuum Practice, 331
Durand (Prof. W. F.), Science and Engineering, 387
Durell (C. V.), and R. M. Wright, An Introduction to the Calculus, 513
Durham (Earl of), elected president of the Philosophical Society of the University of Durham, 781
Duthie (Dr. Georgiana M.), awarded a cancer research fellowship in Leeds University, 788
Duval (J.), Le problème de chimie: recueil de problèmes inédits avec leurs solutions à l'usage de la Classe de mathématiques spéciales des candidats au S.P.C.N., au M.P.C., au Baccalauréat (M.E.), aux Grandes Écoles et à divers concours. Lois générales, métalloïdes, chimie organique, 691
Dye (D. W.), The Piezo-electric Quartz Resonator and its Equivalent Electrical Circuit, 70
Dymond (E. G.), Scattering of Electrons in Helium, 336

Eales (Dr. N. B.), The Anatomy of the Elephant, 282
East (Prof. E. M.), and Prof. W. H. Weston, Jr., A Report on the Sugar-cane Mosaic Situation in February, 1924, at Soledad, Cuba, 45

Eastman Kodak Co., A Universal Colorimeter, 30
Eberth (Prof. C. J.), [obituary article], 921
Eccles (Dr. W. H.), elected president of the Institution of Electrical Engineers, 169; The Present-day Position of Electrical Industry in Great Britain, 637
Eckart (C.), The Solution of the Problem of the Simple Oscillator by a Combination of the Schroedinger and the Lanczos Theories, 396
Eckersley (T. L.), Magnetic Storms and Wireless Communication, 803
Eddington (Prof. A. S.), The Reflection Effect in Eclipsing Variables, 170
Edgell (Dr. B.), Mental Life: an Introduction to Psychology, 549
Edser (E.), General Physics for Students: a Text-book on the Fundamental Properties of Matter. Reprinted, with additions, 800
Edwardes (S. M.), Deccan Village Life in the Eighteenth Century, 243
von Eiselsberg (Prof. A. F.), awarded the Lister medal of the Royal College of Surgeons of England, 96
Eitel (Prof. W.), Physikalisch-chemische Mineralogie und Petrologie: die Fortschritte in den letzten zehn Jahren, 152
Ekman (Prof. V. W.), A Current Meter for Deep Water, 354
Ekstrom (Dr.), Rural Electrification in Sweden, 815
Elam (C. F.), Tensile Tests of large Gold, Silver, and Copper Crystals, 717
Elderton (Miss Ethel M.), Relative Value of Factors Influencing Infant Welfare, 98
Eliot (Dr. C. W.), [death], 313; [obituary article], 346
Elliot (T. G.), and G. B. Willey, Resistant Steels, 283
Ellis (A. E.), British Snails: a Guide to the Non-Marine Gastropoda of Great Britain and Ireland, Pliocene to Recent, 909
Ellis (J. W.), The Molecular Spectrum of Carbon Dioxide, 82
Elvins (O. C.), and Prof. A. W. Nash, The Reduction of Carbon Monoxide, 154
Elwell (C. F.), The Past, Present, and Future of Radio, 93
Emeléus (H. J.), The Inhibition of the Glow of Phosphorus, 319
Emerson (O. H.), Block Lava and Ropy Lava, 533
Emschwiller (G.), The Action of Magnesium on Methylene Iodide, 755
Engledow (F. L.), The Problem of the Adaptation of Varieties, 815
Epstein (Dr. P. S.), Schroedinger's Quantum Theory and the Stark Effect, 444
Ericsson (J.), a memorial monument to, 240
Estanave (Dr. E.), Demonstration of a Photographic Plate showing Picture in Stereoscopic Relief, 167
Eucken (Prof. A.), translated and adapted by Dr. E. R. Jette and Prof. V. K. Lamer, Fundamentals of Physical Chemistry: for Students of Chemistry and Related Sciences, 42
Eucken (Prof. R.), [death], 490
Evans (Sir Arthur), The Shaft Graves of Mycenæ and their contents in relation to the Beehive Tombs, 313
Evans (A. E.), Technical and Intellectual Values, 119
Evans (E. J.), The Current-voltage Characteristics of Electrostatic Machines when Supplying Current to Non-inductive Loads and to a Coolidge X-ray Tube, 70
Evans (G.), Chromosome Complements in Grasses, 841
Evans (I. H. N.), Antiquities from Kedah, 460
Evans (Dr. J. W.), The Structure of the Continents, 697
Evans (U. R.), Oxidation, Passivity, and Corrosion, 51
Evers (N.), The Chemistry of Drugs, 113
Ewing (Sir James Alfred), elected president of the Royal Society of Edinburgh, 672
Exner (Dr. F.), [death], 921

Faber (R.), Cholesterol Allophanate and its Use in Biological Chemistry, 756
Fabry (Prof. C.), The Hurter and Driffield Memorial Lecture, 128
Fage and Simmons, Vortex Distribution behind an Aerofoil, 605
Fairgrieve (J.), Geography in School, 45
Fantham (Prof. H. B.), Heredity in Man: Some Factors in Eugenics, together with Notes in some South African Cases, 101
Farran (G. P.), Copepods in the Bay of Biscay, 318
Favaro (G. A.), Solar Activity during 1925, 641
Fawcett (Prof. H. S.), Citrus Diseases and their Control, with Sections on Oriental Citrus Diseases, by H. A. Lee, 655
Fawcett (W.), [death], 276; [obituary article], 347
Fell (E. W.), awarded a Robert Blair fellowship, 176
Fell (Major-Genl. Sir Matthew H. G.), appointed Director-General, Army Medical Services, 84
Fenning (R. W.), Detonation Temperatures in Closed Vessel Explosions, 245, Gaseous Combustion at Medium Pressures, 427
Ferguson (E. W.), Revision of Australian Syrphidæ. Part 1, 251
Fermi (Prof. E.), Quantum Mechanics and the Magnetic Moment of Atoms, 876
Ferrar (W. L.), On the Cardinal Function of Interpolation Theory, 178
Fessenkoff (B.), The Atmosphere of Mars, 25
Fewkes (Dr. J. W.), Louisiana Mound Builders, 171
Fibiger (Prof. J.), awarded the Nobel prize for medicine, 778
Field (Prof. J. C.), Philosophy of Emergence of New Qualities, 582
Fieldner (Dr. A. C.), The Future of Petroleum Supply in America, 423
Finch (G. I.), and L. G. Cowen, Combustion under Direct Electrical Discharge, 100
Finnemore (H.), appointed lecturer in pharmacy in Sydney University, 897
Finzi (N. S.), elected president of the Röntgen Society, 316
Fiock (E. F.), and W. H. Rodebush, Thermal Properties of Potassium and some Alkali Halides, 857
Firth (Edith M.), F. W. Hodkin, M. Parkin, and Prof. W. E. S. Turner, The Influence of Moisture on the Rate of Melting and on the Properties of Soda-lime Glasses, 178
Fishenden (Dr. M.), The Low Temperature Carbonisation Problem, 430
Fisher (Dr. A. A.), Statistics of Field Experiments in Agriculture, 497; and E. B. Ford, Variability of Species, 515
Fitzgerald (W.), The Historical Geography of Early Ireland, 334
Flatterly (F. W.), Abnormal Venous Circulation in a Frog, 50
Fleming (A. P. M.), High Voltage Laboratories, 167
Fleming (Dr. J. A.), conferment upon, of the title of emeritus professor, 176, retirement and work of, 126; the portrait of, to be painted by Sir William Orpen, 705
Fletcher (J. J.), [obituary article], 20
Fletcher (Sir Walter), Research and Citizenship, 887
Fleure (Prof. H. J.), Racial Characters of the Human Skin, etc. (Malcolm Morris Memorial Lecture), 815; The Regional Balance of Racial Evolution, August 7, Suppt., 18, 380
Flinn (Dr. D. E.), [death], 313
Flint (Dr. H. T.), The New Atomic Theory, 172; appointed reader in physics at King's College, London, 646
Florey (W. H.), elected a fellow of Gonville and Caius College, Cambridge, 753
Flusin (G.), and H. Giran, The Estimation of Calcium Carbide in Calcium Cyanamide, 214
Forbes (Prof. G.), The Wonder and the Glory of the Stars, 512
Forbes (Prof. S. A.), The Lake as a Microcosm, 204
Forrer (R.), The Structure of the Atomic Magnet, 179
Foster (Dr. J. S.), and Miss M. Laura Chalk, Observed Relative Intensities of Stark Components in Hydrogen, 592
Fowler (Prof. A.), The Analysis of Line Spectra, August 7, Suppt., 15, 593; The Ionisation Potential of O II, 410
Fowler (A.), The Geology of Berwick-on-Tweed, Norham, and Scremerston, 211
Fowler (R. H.), General Forms of Statistical Mechanics, with Special Reference to the New Quantum Mechanics, 861; and Dr. E. K. Rideal, On the Rate of Maximum Activation by Collision for the Complex Molecules, with Applications to Velocities of Gas Particles, 861

Fox (C. S.), The Crystalline Nature of the Chief Constituent of Ordinary Coal, 913
Franck (Prof. J. and Prof. Hertz), awarded the Nobel prize for physics for 1925, 741
Francks (W. Temple), [death], 92
Franco (Major), and Capt. Ruiz de Alda, "de Palos al Plata," 315
Frassetto (F.), Relations between Stature and Chest-girth Formula of Normality and Normal Values, 791
Frazer (Sir James George), The Worship of Nature. Vol. 1, 4
Freedman (P.), Equations for Thermionic Emission, 193
French (Dr. J. W.), Glass Annealing, 681; Science and Psychical Research, 589
Friauf (J. B.), The Crystal Structure of Magnesium Plumbide, 390
Friend (Rev. H.), Gift to Birmingham University, 646
Friend (Dr. J. Newton), Science in Antiquity, 236
Fromageot (C.), The Oxidation of Pyruvic Acid by Ceric Ions, 107
Frost (E. B.), S. B Barrett, and O. Struve, Radial Velocities of 368 Helium Stars, 143
Frouin (A.), [death], 201
Fuchs (Dr. E.), elected an honorary member of the Vienna Academy of Sciences, 96
Fuller (Col. J. F. C.), Atlantis: America and the Future, 76
Furley (Dr. P. H.), The Gang Age: a Study of the Preadolescent Boy and his Recreational Needs, 257
Fürth (Prof. O.), Lehrbuch der physiologischen und pathologischen Chemie in 75 Vorlesungen: für Studierende, Ärtze, Biologen und Chemiker. Zweite Auflage. Band 1, Lief. 1, Vorl. 1 bis 16, 800

Galloway (Sir W.), External Capillary Action, 300; Liveing's Fire-damp Indicator, 735
Gamble (Prof. F. W.), [death], 455; [obituary article], 490
Gamble (S. G.), A Practical Treatise on Outbreaks of Fire, 728
Ganesan (A. S.), The "H and K" Bands of Carbon, 842
Gardiner (J. H.), Glass-making in Ancient Egypt, 389
Gardner (G. A.), Another Patagonian *Lusus Naturæ*, 262
Gardner (J. A.), Oxygen Requirements of Fish, 98
Garner (Dr. W. E.), and others, Explosions in Gaseous Media, 29; F. C. Madden and J. E. Rushbrooke, Heats of Crystallisation, 712
Garrett (M. W.), Transmutation Experiments, 84
Garrod (Miss D. A. E.), The Upper Palæolithic Age in Britain, 833; and L. H. Dudley Buxton, The Recently Discovered Gibraltar Skull, 320
Garsaux, The Provision of Aeroplanes with Oxygen, 178
Garstang (Prof.), resignation of the directorship of the Department of Antiquities at Jerusalem, 814
Gatenby (Prof. J. B.), The Oogenesis of Lumbricus, 840
Gates (G. E.), Luminescence in Earthworms, 171
Gates (Prof. R. R.), Aspects of Physical and Mental Inheritance, 663; the Position of Scientific Work and Institutions in Russia, 599
Gaunt (J. A.), and A. H. Wilson, awarded the Mayhew prize of Cambridge University, 68
Geil (Dr. W. E.), The Sacred 5 of China is the 5th Book on China, 223
Gemeinhardt (Dr. K.), Die Gattung Synedra in systematischer, zytologischer und okologischer Beziehung, 729
Gemelli, Perception of the Position of the Body in Relation to the Sensation of Equilibrium of an Aeroplane Pilot, 323
van Gent (H.), The System of Castor, 280
George (W. H.), Organo-Metallic Compounds, 85
Gester (G. C.), and others, New Theories of the Mother-Rock of Californian Petroleum, 747
Gestro e Vinciguerra, Il naturalista viaggiatore. Seconda edizione, 691
Gheury de Bray (M. E. J.), Spatial and Time Relations in Dreams, 372
Ghosh (Prof. P. N.), and P. C. Mahanti, Action of Magnetic Fields on the Refractive Index of Carbon Dioxide Gas, 734
Gianfranceschi (Prof. G.), On the Law of Radiation, 302
Giao (A.), Cirrus at a Lower Level than Alto-cumulus, 49
Gibbs (R. C.), and H. E. White, Doublets of Stripped Atoms of the Potassium Type, 396; Rubidium- and cæsium-like Doublets of Stripped Atoms, 682
Gibbs (R. E.), The Polymorphism of Silicon Dioxide and the Structure of Tridymite, 718
Gibson (Dr. W.), and others, The Geology of the Country around Stoke-upon-Trent, 212
Gibson (Dr. W. H.), appointed director of research for the Linen Industry Research Association, 130
Giddings (G. W.), and G. F. Rouse, Ionisation of Mercury Vapour as a Function of the Intensity of Exciting Light, 396
Gilbert (J. J.), Loading Submarine Cables, 927
Gilchrist (Prof. J. D. F.), [death], 636, [obituary article], 776
Gill (E. L.), An Early Embryo of the Blue Whale, 215
Gillespie (L. G.), and F. P. Hall, The Palladium-Hydrogen Equilibrium, 64
Giordani (Prof. F.), Radiation Theory of Chemical Action, 712
Giraux (L.), Eskimo Engravings on Walrus Ivory, 604
Glauert (H.), Sizes of Aerodromes, 64; Theory of Airscrews, 674
Glazebrook (Sir Richard), The Cavendish Laboratory, 1876–1900, December 18, Suppt., 52
Glew (F. Harrison), [death], 92, [obituary article], 165
Glockler (G.), Electrical Conductivity of Cyanogen Bromide, 893
Glotz (Prof. G.), translated by M. R. Dobie, Ancient Greece at Work: an Economic History of Greece from the Homeric Period to the Roman Conquest, 79
Glynn (Prof. E.), Prof. J. G. Adami, 453
Gnehm (Prof. R.), [death], 276
Godlee (Lady), gift to London University for a lectureship, 932
von Goebel (Prof. K.), with Biographical Supplement by Frau Prof. Ganzenmuller. Translated by H. M. Bower, and edited botanically by Prof. F. O. Bower, Wilhelm Hofmeister: the Work and Life of a Nineteenth-Century Botanist, 473
Gold (Lt.-Col. E.), Rainfall Interception by Plants, 915; The Travel of Depressions, 63
Goldsbrough (Dr. G. R.), election to a senior research fellowship at Armstrong College, 176
Goldschmidt (Prof. R.), Sex Differentiation in Bonellia, 783
Goold (J.), [obituary], 849
Gordon (J. E.), appointed lecturer in the Department of Agriculture of Edinburgh University, 680
Gordon (Seton), The Golden Eagle, 377
Goucher (F. S.), Plastic Deformation of Single Metallic Crystals, 157
Gough (H. J.), S. J. Wright, and D. Hanson, The Behaviour of Single Crystals of Aluminium under Reversed Tortional Stresses, 466
Grabau (Prof. A. W.), awarded the Grabau medal founded by C. Y. Wang, 130
Grabham (G. W.), The Fayum Lakes, 911
Grabham (Dr. M.), Pernicious Grafting, 85
Grady (A.), and H. Hogbin, Mountain Lagoon and the Kurrajong Fault, 467
Graham (M.), and J. N. Carruthers, The Distribution of Pelagic Stages of the Cod in the North Sea in 1924 in Relation to the System of Currents, with a section by H. H. Goodchild, 356
Grant (Prof. K.), The Constitution of the Stars, 373
Gray (Prof. J. A.), Properties of High Frequency Radiations, 801
Green (T. E.), and C. N. Hinshelwood, The Catalytic Decomposition of Nitric Oxide, 427
Greenwood (Major), appointed professor of epidemiology and vital statistics at the London School of Hygiene and Tropical Medicine, 32
Gregory (Prof. W. K.), A Dinocephalian from South Africa, 353; and G. G. Simpson, Cretaceous Mammal Skulls from Mongolia, 698
Greig-Smith (R.), The Influence of Certain Colloids upon Fermentation. Part 3, 251
Grice (C. S. W.), and A. G. Gulliford, Electric Lamp Fire-damp Detector, 497
Grierson (Sir George A.), Bihar Peasant Life, being a Discursive Catalogue of the Surroundings of the People of that Province. Second edition, 472

Griffin and Sons, Ltd., and Baird and Tatlock, Ltd., Catalogue of Scientific Apparatus, mainly Physics, 131
Griffiths (Dr. E.), and J. H. Awbery, A Hygrometer employing Glycerine, 825
Griffiths (H. D.), and J. S. Taylor, Cadmium Photo-electric Cell, 283
Grignard (V.), and P. Muret, Pyrosulphuryl Chloride, 718, 826
Grindley (R.), appointed demonstrator in chemical technology in Manchester University, 140
Grogan (J. D.), Some Mechanical Properties of Silicon-aluminium Alloys, 466
Grubb, Parsons, and Co., Astronomical and Optical Instruments, 782
Gruner (P.), Twilight Phenomena, 711
Gudden (B.), and R. Pohl, Wave-length and the Photo-electric Behaviour of Crystals, 283
Guggenheim (D.), gift for the promotion of aeronautics, 563
Guilbert (G.), The Visibility of the Atmosphere, 432
Guillet (L.), The Cementation of Copper and its Alloys by Aluminium, 142; The Cementation of Copper, Nickel, and their Alloys by Tin, 106; The Cementation of Steels by Silicon, 214; The Tempering of Lead-antimony, Lead-tin, and Lead-antimony-tin Alloy, 106; and A. Roux, The Influence of Gases on the Properties of Steels, 826
Gunter (Rev. E.), Three-hundredth Anniversary of the Death of, 813
Gunther (Dr. R. T.), Rev. Edmund Gunter, 852; Richard of Wallingford and his Rectangulus, 773
Gupta (N. N. Sen), and C. P. N. Sinha, The Effect of the Group on Mental Work, 426
Gurney (R.), Prof. Labbé's Production of 'Allomorphs' by the Action of Increased Hydrogen Ion Concentration, 336
Gutbier (Prof. A.), [obituary], 636
Gwyer (A. G. C.), and H. W. L. Phillips, with an appendix by D. Stockdale and I. Wilkinson, The Constitution and Structure of the Commercial Aluminium-Silicon Alloys, 466; and others, The Alloys of Aluminium and Silicon, 498
Gye (Dr. W. E.), The Cancer Problem, 779

Haas (Dr. A.), Cosmical Creation of Matter, 319
Haber (Prof. F.), Gold from Sea-water, 23
Hackspill (L.), and H. Pinck, The Displacement of Cæsium and Rubidium by Iron, 396
Haddon (Dr. A. C.), appointed honorary keeper of the New Guinea collections in the Museum of Archæology and Ethnology, Cambridge University, 609; Sir William Ridgeway, 275
Hadfield (Sir Robert), address at the opening of new metallurgical and engineering research laboratories at the University of Sheffield, 128
Hagen (Rev. J. G.), Cepheid Variability, 25
Hahn (Prof. O.), Was lehrt uns die Radioaktivitat uber die Geschichte der Erde? October 16, Suppt., 25; and O. Erbacher, Eka-Cæsium, 534
Haldane (Prof. J. S.), Acclimatisation to High Altitudes, 702; presented with the gold medal of the Royal Society of Medicine, 853; and Dr. Y. Henderson, The Rate of Work done with an Egyptian Shadouf, 308
Hale (Prof. G. E.), Observations with the Spectrohelioscope, 420; Sir J. J. Thomson's Seventieth Birthday, 880; Some New Possibilities to Solar Research, July 3, Suppt., 1; Spiral Nebulæ, 817; Visual Observations of the Solar Atmosphere, 143
Hall (Sir Daniel), Food Supply and Population, August 7, Suppt., 20; The Relation between Cultivated Area and Population, 304
Hall (E. H.), The Temperature Relations of Photo-electric Emission and Thermionic Emission of Electrons, 574
Hall (Dr. H. R.), Prof. E. Naville, 703
Hall-Edwards (Dr. J. F.), [death], 276; [obituary article], 313
Hamer (Sir William H.), and Dr. C. W. Hutt, A Manual of Hygiene, 799
Hammar (G. W.), Diamagnetic Gases, 712
Hampson (Sir George F.), Descriptions of new Genera and Species of Lepidoptera Phalænæ of the Subfamily Noctuinæ (Noctuidæ) in the British Museum (Natural History), October 16, Suppt., 24
Hamy (A.), The Absorption of Iodine by Precipitated Magnesia, 358
Hannah (H. B.), Indian Origins, 642
Harden (Prof. A.), The Formation of Lactic Acid in Muscle, 895
Hardwick (Rev. J. C.), Religion and Science, 563
Hardy (A. C.), Herring, Mackerel, and Plankton, 281; The *Discovery* Expedition: A New Method of Plankton Research, 630
Hardy (Prof. G. H.), elected a foreign corresponding member of the Vienna Academy of Science, 96; elected president of the London Mathematical Society, 781
Hardy (G. H.), A New Classification of Australian Robber-flies belonging to the Subfamily Dasypogoninæ (Diptera, Asilidæ), 323
Hardy (Dr. T. L.), appointed assistant to the chair of Medicine in Birmingham University, 715
Hardy (Sir William B.), awarded a Royal medal of the Royal Society, 705; presented with a Royal medal of the Royal Society, 821; Properties of Thin Films, 700
Harington (Dr. C. R.), awarded the Harrison Memorial prize of the Chemical Society, 924
Harker (G.), and R. K. Newman, Reactions depending upon the Vapour at the Interface of two Immiscible Liquids, 287
Harkins (Prof. W. D.), Application of the Drop Weight Method in the determination of the Surface Tension of Colloidal Solutions, 732; and H. A. Shadduck, The Synthesis of Disintegration of Atoms as revealed by the Photography of Wilson Cloud Tracks, 875
Harling (W. H.), Drawing Instruments, 208
Harman (Cadet B. W.), awarded the Howard prize of the Royal Meteorological Society, 130
Harris (Rt Hon. F. Leverton), bequest to the Fitzwilliam Museum, Cambridge, 897
Harris (J. A.), and B. S. Hopkins, and L. F. Yntema, Element 61, 319
Harris (L.), The Absorption Spectrum of Formic Acid Vapour in relation to Molecular Associations, 482
Harrison (B.), a memorial tablet to, 94
Harrison (Dr. Heslop), Inheritance of Melanism in Lepidoptera, 747
Harrower (Dr. G.), Craniometry of Singapore Coolies, 243
Hartley (Dr. P.), awarded the William Julius Mickle fellowship of the University of London, 933
Hartree (D. R.), Some relations between the Optical Spectra of different Atoms of the same Electronic Structure, II., 323
Hartung (E. J.), The Photochemical Decomposition of Silver Iodide, 245
Hartshorn (L.), The Input Impedances of Thermionic Valves at Low Frequencies, 934
Harvey (L. A.), The Oogenesis of Lumbricus, 803
Hasche (R. L.), The Rate of Reaction of Nitric Oxide and Oxygen, 748
Haslam (Prof. R. T.), and Prof. R. P. Russell, Fuels and their Combustion, 905
Hasunuma (S.), Finlay's Comet, 97
Hatch (Dr. F. H.), The Petrology of the Igneous Rocks. Eighth edition, revised with the assistance of Dr. A. K. Wells, 8
Haughton (S. H.), The River System of S. W. Gordonia, 251
Havighurst (R. J.), The Absorption of X-rays in Crystalline Compounds, 574; The Effect of Crystal Size upon the Intensity of X-ray Reflection, 215; The Intensity of Reflection of X-rays by Lithium, Sodium, and Calcium Fluorides, 215
Hay (J. M.), appointed lecturer in mechanical engineering and machine design in University College, Dundee, 609
Hay (P. S.), Dust in Mines, 245
Hazen (Al), translated by Dr. K. Kohl, The Light of the Moon, 782
Hazlitt (Victoria), Ability: a Psychological Study, October 16, Suppt., 21
Headicar (B. M.), The Disposal of Scientific Journals, 10

Heaton (N.), Volatile Solvents and Thinners used in the Paint and Varnish Industries, 114
Heberlein (Prof.), Discovery of a Skull of the Type *Pithecanthropus erectus*, 491
Hedley (C.), [obituary article], 811
Hegner (Prof. R. W.), Experiments with Intestinal Protozoa, 855; Host-parasite Specificity, 784; The Protozoa of the Pitcher Plant, 926
Heile (Dr. P.), Nachschlagebuch der Nachschlagewerke fur die Wirtschaftspraxis, 279
Helmholtz's Treatise on Physiological Optics. Translated from the third German edition. Edited by Prof. J. P. C. Southall. Vol. 3: The Perceptions of Vision, 74
Hemmelmayr (F.), and J. Strehly, Our Knowledge of Skoparion, 288
Hempelmann (Prof. F.), Tierpsychologie: vom Standpunkte des Biologen, 867
Henri (Prof. V.), and S. A. Schou, A New Type of Absorption Spectrum: Double Rotational Quantification in Formaldehyde, 225; The Ultra-violet Absorption Spectrum of the Vapour of Formaldehyde, 214
Henry (Prof. A.), and Marion McIntyre, The Swamp Cypresses, 63
Hepburn (H. C.), Electro-endosmosis and Electrolytic Water Transport, 934
d'Herelle (Dr. F.), Translated by Dr. G. H. Smith, The Bacteriophage and its Behaviour, 183
Hering (Dr. M.), Biologie der Schmetterlinge, 43
Heron-Allen (E.), presentation of collection of Foraminifera to the British Museum (Natural History), 924
Herrera (L. A.), Chemotaxis and Phagocytosis in Imitation of Leucocytes, 935
Herrick (Prof. C. J.), Brains of Rats and Men: a Survey of the Origin and Biological Significance of the Cerebral Cortex, October 16, Suppt., 21
Herrick (Rev. J. C.), The Conservation of Mass and Energy, 851
Herskovits (M. J.), Social Selection in a Mixed Population, 791
Hertel (K. L.), Effects of an Electric Field upon the Radiating Hydrogen Atom, 396
Hertz (Prof.), and Prof. J. Franck, awarded the Nobel prize for 1925, 741
Herzog (Prof. T.), Geographie der Moose, 260
Hessle (C.), Herrings along the Baltic Coast of Sweden, 321
Hetherington (Prof. H. J. W.), appointed Vice-Chancellor of Liverpool University, 860
von Hevesy (Prof. G.), invited to the chair of physical chemistry in the Technische Hochschule, Hanover, 715
Hevesy (Dr. G.), and Dr. F. Paneth. Translated by Dr. R. W. Lawson, A Manual of Radioactivity, 475
Hewett (D. F.), Oil and Coal Resources of the Oregon Basin, Wyoming, 784
Hewlett (Prof. R. T.), Prof. C. J. Eberth, 921
Heyrovsky (J.), and B. Souček, The Electrolytic Potential of Iron Amalgam, 358
Hickson (Prof. S. J.), presentation to, 104
Higgins (W. F.), Spirit Thermometers, 390; Thermometry, 565
Hiley (W. E.), Values of Scots and Corsican Pines, 642
Hilger, Ltd. (Adam), Improved Spectrographs and Spectrometers, 785
Hill (Prof. A. V.), A Mumetal Magnetic Shield, 319; awarded a Royal medal of the Royal Society, 705; presented with a Royal medal of the Royal Society, 821
Hill (C. C.), Studies on a Parasite of the Hessian Fly, 207
Hill (Prof. L.), Sunshine and Open Air: their Influence on Health, with special reference to the Alpine Climate. Second edition, 330; Ventilation and Heating, 431
Hill (R.), The Chemical Nature of Hæmochromogen and its Carbon Monoxide Compound, 790
Hills (W. D.), Mechanics and Applied Mathematics: Statics—Dynamics—Hydrostatics. Part 2: Applied Mathematics, October 16, Suppt., 27
Hinton (M. A. C.), Monograph of the Voles and Lemmings (Microtinæ), Living and Extinct, vol. 1, 579
von Hippel (A.), Cathode Sputtering, 605
Hirst (Dr. E. L.), appointed a lecturer in chemistry in Birmingham University, 860
Hobbs (Prof. W. H.), Mathematical Proof *versus* Observation, 915; Report of the Greenland Expedition of the University of Michigan, 707; The Glacial Anticyclones: The Poles of the Atmospheric Circulation, 111
Hobson (Prof. E. W.), The Theory of Functions of a Real Variable and the Theory of Fournier's Series. Second edition, vol. 2, 112
Hodge (A. E.), and A. Derham, Goldfish Culture for Amateurs: How to Breed and Rear Goldfish in Aquaria and Ponds, October 16, Suppt., 23
Hodges (F.), Economics of the Coal Industry, 217
Hodgson (Prof. C. V.), First Order Triangulation, 458
Hodgson (Dr. H. H.), appointed head of the departments of Colour Chemistry and General Chemistry at the Huddersfield Technical College, 32
Hodsman (H. J.), Coal Ash and Clean Coal, 345
Hodson (T. C.), appointed reader in ethnology in Cambridge University, 176
Hogarth (Dr. D. G.), presidential address to the Royal Geographical Society, 23; The Twilight of History, 529
Holdsworth (Prof. W. S.), an honorary degree conferred upon, by Cambridge University, 565
Holland (Sir Thomas), Man and Method in Scientific Education, August 7, Suppt., 20; International Interests in Raw Materials, 887
Hollander (Dr. B.), Life and Mind, 778
Hollingworth (J.), Polarisation of Wireless Waves, 409
Holmes (Dr. A.), Geological Time, 27; made professor of geology in Durham University, 68; Tectonic Features of New Guinea, 848; The Structure of the Continents, 586; and Dr. R. W. Lawson, Calculation of the Ages of Radioactive Minerals, 478
Holmyard (E. J.), Alchemy and Mysticism, 869; An Arabic Treatise on Alchemy, 534; Science: an Introductory Textbook, 297; The Influence of Science, 547
Holweck, The Spectrometry of the *K* Series of the Light Elements, 250
Honda (Prof. K.), A Comparison of Static and Dynamic Tensile and Notched-bar Tests, 466
Honoré (F.), Le radium: découberte de la radioactivité et du radium, origine de l'énergie radioactive, le radium dans la nature, ses emplois usuels, 9
Hopfield (Prof. J. J.), and G. H. Dieke, Absorption Spectrum of the Hydrogen Molecule, 592
Hopkins (D. L.), The Effect of Hydrogen-ion Concentration on Locomotion and other Life-processes in *Amœba proteus*, 143
Hopkins (Sir Frederick), awarded the Copley medal of the Royal Society, 705; elected a foreign member of the Académie Polonaise des Sciences, Cracow, 60; presented with the Copley medal of the Royal Society, 821; Dr. E. J. Bles, 90
Hopkinson (A.), reappointed demonstrator in anatomy in Cambridge University, 321
Hori (T.), and others, Spectra of Exploded Metals, 28
Horn-D'Arturo (G.), The Theory of Flying Shadows, 142
Hose (Dr. C.), elected to an honorary fellowship at Jesus College, Cambridge, 788
Housman (W. B.), The Magnetic Storm and Aurora of October 14-15, 679
Hovgaard (W.), Bending of a Curved Tube of Circular Cross Section, 215
Howard (A.), and Gabrielle L. C., Pernicious Grafting, 373
Howell (Dr. O. R.), appointed lecturer in applied chemistry in Manchester University, 140
Howes (F.), The Borderland of Music and Psychology, 407
Howitt (J. R.), Liver Extracts in the Treatment of Malignant Disease, 263
Hubble (Dr.), The Problem of 'Island Universes,' 388
Huber-Stockar (Dr.), The Electrification of Railways, 492
Hudson (Principal J. F.), The Supply of Literature in Scientific and Technical Departments of Colleges, 573
Hughes (I. T.), Prehistoric Earthworks in North Cardiganshire, 98
Hull (J. W.), elected president of the Newcomen Society, 814
Hulme (E. Wyndham), Patent Law and Unemployment, 694, 840

Humberstone (T. Ll.), Reconstruction of the University of London, 37
Humphrey (W. A.), An Occurrence of Diamonds near Port Nolloth ; The Changed Conditions of Namaqualand, 179
Humphreys (C. B.), The Southern New Hebrides : an Ethnological Record, October 16, Suppt., 22
Humphreys (G. N.), Expedition to Ruwenzori, 528
Hunter (Dr. H.), The Barley Crop : a Record of some Recent Investigations, 871
Hurst (Dr. H. E.), Report of the Physical Department of the Ministry of Public Works, Egypt, 1923–24, 279
Huse (E.), and C E. Meulendyke, Silver Iodide in Gelatin Iodo-bromide Emulsions, 64
Hussey (Prof. W. J.), [death], 672 ; [obituary article,], 740
Hutchinson (A.), elected professor of mineralogy in Cambridge University, 31
Hutchinson (H. P.), awarded a Frank Smart prize by Cambridge University, 104
Hutton (R. G.), H. Wormald, and A. W. Witt, Burr-Knots on Apple and Crown Gall, 496
Huxley (Prof. J. S), appointed Fullerian professor of physiology at the Royal Institution, 853 ; Biological Synthesis : Hopes and Obstacles, 902 ; Biology and Human Life (Norman Lockyer Lecture), 814, 844 ; Broadcasting Birth-control, 771 ; Studies in De-differentiation, 206

Idrac (P), Records of the Electrical Field of the Atmosphere up to a Height of 20,000 Metres, 214
Iljin (Dr. V. S.), Starch Formation in the Presence of Different Salt Ratios, 747
Imms (Dr. A. D), The Biology of Lepidoptera, 43
Inge (Very Rev. W. R.), Science and Ultimate Truth : Fison Memorial Lecture, 1926, 109
Ingham (A. E), appointed reader in mathematical analysis in Leeds University, 176
Ipatief (V), and A. Andreevsky, The Displacement of Platinum by Hydrogen under High Pressures, 250 ; and B. Dolgof, The Hydrogenation of Triphenylcarbinol and of Phenylfluorenecarbinol under Pressure, 395
Iredale (Dr. T), appointed lecturer in chemistry in Sydney University, 897 ; The Drop-weight Method of Measuring Surface Tension, 48
Ishikawa (M), The Statocysts of Cephalopods, 926
Issatchenko (Prof. B. L.), The Source of Hydrogen Sulphide in the Black Sea Waters, 26
Iwata (I.), Determining the Sex of Carrier Pigeons, 892

Jækel (Prof O), elected a foreign associate of the Geological Society, 96
Jackson (Prof. C. M.), The Effects of Inanition and Malnutrition upon Growth and Structure, 152
Jackson (Dorothy J.), The Inheritance of Brachypterous and Macropterous Wings in *Sitona hispidula*, 192
Jackson (Admiral Sir Henry), awarded the Hughes medal of the Royal Society, 705 , presented with the Hughes medal of the Royal Society, 822
Jackson (Dr. J.), International Longitude Determinations, 891
Jackson (J. F.), The Junction-bed of the Middle and Upper Lias on the Dorset Coast, 69
Jackson (Dr. L. C.), Investigations on Paramagnetism at Low Temperatures (Part ii.), 33 ; Kaufmann's Experiment and the Spinning Electron, 263
Jacques (A.), and J. S. Morgan, Rotation and Relativity, 194
James (R. W.), The Intensity of Reflexion of X-ray from Crystals at Low Temperatures, 862
James (Lt.-Col. S. P.), and P. G. Shute, Report on the First Results of Laboratory Work on Malaria in England, 452
Jeaffreson (J. W), Stress and Rhythm in Speech, 928
Jeans (Dr J. H), Recent Developments of Cosmical Physics, December 4, Suppt., 29
Jefferies (Richard), The Work and Influence of, 422
Jeffreys (Dr. H.), On Compressional Waves in Two Superposed Layers, 790 ; The Constitution of the Interior of the Earth, 131 ; The Nature of Isostasy, 461 ; The Structure of the Continents, 443
Jellinek (S.), A Biological Sign marking the Return of Spontaneous Respiration in Cases of Apparent Death, 863
Jenkins (C. H. M.), Constitution and the Physical Properties of the Alloys of Cadmium and Zinc, 466
Jenness (D.), An Early Eskimo Culture in Alaska, 710
Jespersen (P.), and A. V. Tåning, Mediterranean Sternoptychidæ, 99 , and Dr. Degner, Luminous Fishes and Cephalopods of the Mediterranean, 133
Jevons (Dr. W.), The More Refrangible Band System of Cyanogen as developed in Active Nitrogen, 33
Job (A.), and A. Cassal, The Fixation of Carbon Monoxide on an Organic Magnesium Compound by means of Chromic Chloride, 250 ; Preparation of a Chromecarbonyl by the Intermediary of a Magnesium Compound, 396
Job (P.), Some Applications of the Spectrographic Method to the Study of Complexes in Solution, 214
Joel (Dr. E.), Das kolloide Gold in Biologie und Medizin : die Goldsolreaktion in Liquor Cerebrospinalis, 77
Johnson (J. W. H.), A Critical Review of the Methods of Analysing Waters, Sewages and Effluents, with Suggestions for their Improvement, 755
Johnson (L. R), appointed assistant lecturer in agricultural zoology in Leeds University, 176
Johnson (M. C.), The Distribution of Intensity in a Positive Ray Spectral Line. Part 2, 754
Johnson (Dr. R. O.), Energy Levels of the Carbon Monoxide Molecule, 50
Johnson (W. E.), reappointed Sidgwick lecturer in moral science in Cambridge University, 680
Johnson (W H.), Cotton and its Production, 765
Johnston (H. B.), New Facts regarding the Phases of Migratory Locusts, 10
Johnstone (Prof. J.), A Study of the Oceans, 78
Jolly (W. A.), On the Rhythmical Functions of the Spinal Cord, 467
Jones (D. T.), and others, Rural Scotland during the War, October 16, Suppt., 24
Jones (E), Velocity of Detonation for Explosives, 134
Jones (Prof. F. Wood), The Mammals of South Australia. Part 3, 477
Jones (Dr. W. Tudor), Nature, Thought, and Personal Experience, 189
Joseph (Dr. A. F.), The Action of Silica on Electrolytes, 878
Joyce (T. A.), Physical Anthropology of the Pamirs and Amu-Daria Basin, 783
Judd (Prof. C. H.), The Psychology of Social Institutions, 585
Judge (A. W.), Stereoscopic Photography : its Application to Science, Industry, and Education, 185
Jumella (H.), New Observations on Tombak Tobaccos, 718 ; Ravenea, Madagascar Palm Trees, 681

Kahanowicz (M.), Spectrum of the Pickering Type in Argon, 935
Kailan (A.), The Chemical Effects of the Penetrating Radium Radiation, 899
Kammerer (Dr. P.), [death], 490, 555 ; [obituary article], 635
Kano (Y.), and B. Yamaguti, Helium in Natural Gases of Japan, 64
Karantassis (T.), Double Decompositions between the Halogenides of Phosphorus, Tin, Arsenic, Antimony, Lead, Bismuth, Silicon, Titanium, Zirconium, and Thorium, 107
Karpinski (Prof. L. C.), The History of Arithmetic, 407
Karrer (Prof. P.), Einführung in die Chemie der polymeren Kohlenhydrate : ein Grundriss der Chemie, der Starke, des Glykogens, der Zellulose und anderer Polysaccharide, 77
Kastler (A.), The Study of Pollucite, 35
Kato (Prof. G.), The Further Studies on Decrementless Conduction, 476
Kauffmann (Prof. O. J.), proposed conferment of the title of emeritus professor upon, by Birmingham University, 715

Kayser (Prof. H.), Tabelle der Hauptlinien der Linienspektra aller Elemente nach Wellenlange geordnet, 509
Keartland (G. A.), [death], 165
Kearton (R.), A Naturalist's Pilgrimage, October 16, Suppt., 23
Keeble (Sir Frederick), acceptance of appointment with the Synthetic Ammonia and Nitrate Co., 313 ; Life of Plants, 297
Keen (Dr.), Use of the Dynamometer in Soil Cultivation Studies, 96
Keenan (G. T.), Optical Properties of Sugars, 785
Keesom (Prof. W. H.), The Solidification of Helium, 58, 81, 600 ; The Curve of Fusion of Helium, 359
Keith (Sir Arthur), elected an honorary member of the Yorkshire Philosophical Society, 781
Kellum (L. B.), Tertiary Marls in North Carolina, 643
Keltie (Sir John Scott), and S. C. Gilmour, Adventures of Exploration. Book 5 : Australia and New Zealand, 910
Kemp (Prof. J. F.), [death], 921
Kemp (Dr. S.), The *Discovery* Expedition, 628
Kennard (A. S.), and B. B. Woodward, Synonymy of the British Non-Marine Mollusca (Recent and Post-Tertiary), 656
Kennelly (Prof. A. E.), The Law of Speed Records, 711
Kenner (Prof. J.), Molecular Structure, 857
Kenneth (Dr. J. H.), Spatial Relations in a Dream, 194
Kerr (Prof. J. Graham), A Gigantic Poison Fang of a Snake obtained from the (?) Pleistocene of the Gran Chaco, 71 ; Biology and the Training of the Citizen, August 7, Suppt., 16, 229 ; Evolution, 329
Kettle (Mr.), The Future of Electricity Supply in Ireland, 742
Kidson (Dr. E.), Abnormal Rates of Ascent of Pilot Balloons in the Lower Levels of the Atmosphere at Melbourne, 106 ; Some Periods in Australian Weather, 99
Killip (E. P.), leading a botanical exploring expedition to Colombia, 744
Kindle (E. M.), Contrasted Types of Mud-Cracks, 208
King (Prof. L. V.), Radiation without Quanta, 354
King (W. V.), and G. H. Bradley, Dusting by Aeroplane against Mosquitoes, 26
Kingslake (R.), extension to, of a Beit fellowship, 176 ; The Analysis of an Interferogram, 754
Kirkpatrick (Prof. P.), The Damping of Pendulous Jets, 261
Kirrmann (A.), Magnesium Reactions starting with 1 : 3 Dibrompropylene, 214 ; and H. Volkringer, The Absorption in the Ultra-violet of Two Isomers, 142
Klein (Dr. O.), The Atomicity of Electricity as a Quantum Theory Law, 516
Kleinmann (Dr. E.), The Growth of Surface Tension in Solutions of Common Salt, 245
Kleintitschen (Rev. P. A.), Mythen und Erzahlungen eines Melanesierstammes aus Paparatava, Neupommern, Sudsee : gesammelt und versehen mit Einleitungen und Erklarungen, 688
Knight (Dr. R. C.), Problems of Vegetative Propagation, 784 ; and R. G. Hatton, Pernicious Grafting, 372
Knipp (Prof. C. T.), Sir J. J. Thomson's Seventieth Birthday, 881
Knowlton (Dr. F. H.), A Tertiary Inter-basaltic Flora from Western America, 747
Kofoid (Prof. C. A.), and Dr. O. Swezy, Nuclear Division in *Entamœba histolytica*, 926
Kohn-Abrest (E.), and S. Kawakibi, Nitrates in Animal and Vegetable Tissues, 611
Kolhorster (W.), and G. von Salis, Variation of Penetrating Radiation on the Jungfrau, 518
Koller (J.), A New Synthesis of Conine, 682
Komuro (H.), Effect of X-rays on *Vicia Faba*, 819
Konovalov (D. P.), The Heats of Combustion of Some Hydrocarbons, 250
Korczynski (A.), and B. Fandrich, The Preparation of Nitriles by the Diazo Reaction, 432
Korn (Prof. A.), Die Konstitution der chemischen Atome : mechanische Theorien in Physik und Chemie, 365
Korsunski (M.), and N. Seljakow, Dwi-Manganese in Native Platinum, 263
Kovarik (Prof. A. F.), Sir J. J. Thomson's Seventieth Birthday, 881
Krieger (H.), The Pit-house Sites of the Old Yakima and Klickitat Indians of the Columbia River Region, 59
Kriloff (Prof. A.), Prof. V. A. Steklov, 91
Krishnamurti (K.), Behaviour of Silicic Acid Gel during the Drying-up Process, 843
Kriss (M.), and others, The Nutrition of Cattle, 713
Kroeber (A. L.), Pottery from Chancay, Peru, 132
Kronig (R. de L.), The Dielectric Constant of Symmetrical Polyatomic Dipole-gases on the New Quantum Mechanics, 791 ; and I. I. Rabi, The Symmetrical Top in the Undulatory Mechanics, 805
Kukenthal (Prof. W.), Herausgegeben von Dr. T. Krumbach. Handbuch der Zoologie : eine Naturgeschichte der Stamme des Tierreiches. Dritter Band : Tardigrada, Pentastomida, Myzostomida, Arthropoda : Allgemeines, Crustacea, Arachnoidea. Erste Lief. Zweite Lief. Funfter Band : Solenogastres, Mollusca, Echinodermata. Erste Lief., 114
Kuznecov (Prof. N. I.), Asiatic and American Elements in the Lepidopteran Fauna of Polar Europe, 98

L. (W. W.), Science and Psychical Research, 588, 693
Laborde (E.), J. Bressolles and L. Jaloustre, The Influence of some Radioactive Elements on the Catalytic Activity of certain Proteo-bismuth Precipitates, 395
Lacey (J. M.), Hydrology and Ground Water : a Practical Text-book for the Use of Civil Engineers, Surveyors, Students, and all those who deal with the Control of Water, 440
Lacoste (J.), Earthquakes observed in Central France in 1925, 35
Ladd-Franklin (Christine), The Reddish-blue Arcs and the Reddish-blue Glow of the Retina, 215
Laing (Miss M. E.), appointed to the staff of Stanford University, 458
Lake (P.), reappointed reader in geography in Cambridge University, 680
Lallemand (C.), A World-wide Scheme for Measurements of Longitude, 862
Lamb (Dr. C. G.), reappointed reader in electrical engineering in Cambridge University, 680
Lamb (Prof. H.), elected president of the Cambridge Philosophical Society, 744 ; reappointed Rayleigh lecturer in mathematics in Cambridge University, 680 ; The Oscillations of Superposed Fluids, 915
Lambert (B.), and K. T. Hartley, The Effects of Variations in the Radiation Factor on the Efficiency of Dewar Vessels, 34
Lambert (R. S.), University Tutorial Class (Extra-mural) Teaching, 249
Lamplugh (G. W.), [death], 562 ; [obituary article], 634
Lang (Archbishop), Religion and Science, 562
Lang (Sir Peter Scott), [death], 92 , [obituary article], 164
Lang (Dr. R. J.), Series Spectra of the First Long Period, 119
Lang (W. D.), *Naos pagoda* (Salter) : the Type of a New Genus of Silurian Corals, 69
Lang (Prof. W. H.), The Old Red Sandstone Flora of Scotland, iii., iv., v., 70
Langevin (Prof. P.), Sir J. J. Thomson's Seventieth Birthday, 881
Langworthy (Florence), Reflections on the Structure of the Atom, October 16, Suppt., 26
Laporte (M.), and M. A. da Silva, The Mobility of the Negative Ions and Ionisation Currents in Pure Argon, 394
Larmor (Sir Joseph), Early History of Gaseous Adsorption, 586 ; James Clerk Maxwell, December 18, Suppt., 44 ; Magnetic Storms and Wireless Communication, 662 ; Oceanic Isostasy in Relation to Geological Tectonic, 375
Latch and Batchelor, gift to Birmingham University 646
La Touche (T. H. D.), A Bibliography of Indian Geology. Part IV., Palæontological Index, 334
Latter (Miss J.), Genetics of the Sweet Pea, 171
Latter (O. H.), Biology, 513
Laurie (Prof. A. P.), The Theory of Colour and its Application to Painting, 743 ; and J. Milne, The Evaporation of Water and Salt Solutions from Surfaces of Stone, Brick, and Mortar, 826

Laver (Capt H. E.), bequest to Cambridge University Museum of Archæology and Ethnology, 140
Lawson (Dr. R. W.), The Occurrence of Helium and Neon in Vacuum Tubes, 838
Lea (A. M.), On some Australian Curculionidæ, 719
Leathes (Prof J. B), Function and Design, August 7, Suppt, 18, 519
Lebeau (P.), and A Damiens, Carbon Tetrafluoride, 28
Lebedef (P), Traduit de russe par T. Kousmine, Pression de la lumière, 45
Le Bel (J. A.), The Stereochemistry of the Ethylene Derivatives, 899
Lecat (M.), Azeotropism, particularly of Binary Systems with Closely Chemically Related Constituents, 899
Lee (Dr. G W), and others, The Geology of the Country around Golspie, Sutherlandshire, 211
Lee (Dr. W. T), [death], 347
Le Guyon (R. F), A New General Analytical Method Volumetric Analysis, using a Centrifuge, 395
Lehmann (Prof. R.), Physische Erdkunde: die Gestaltung der Erdoberflache, 656
Lely (H. V), The Useful Trees of Northern Nigeria, 656
Lennard-Jones (J. E.), and Miss B M. Dent, The Forces between Atoms and Ions (ii), 34
Lennox (R. N), [death], 704
Lesné (E), and S. Simon, The Anti-rickets Factor of Cod-liver Oil, 10
Lessing (Dr. R), Coal Ash and Clean Coal, 345
Levy (Dr. S I), An Introduction to Industrial Chemistry, 548
Levyns (M. R.), The Genus Lobostemon (Lehm), 934
Lewis (F.), An Endemic Flora, 604
Lewis (G.), [death], 636
Lewis (Prof. G. N.), The Conservation of Photons, 874, The Path of Light Quanta in an Interference Field, 396
Lewis (W. K), and Prof A H. Radasch, Industrial Stoichiometry: Chemical Calculations of Manufacturing Processes, 905
Lindemann (Prof. F A), Meteors and the Constitution of the Upper Air, 195
Lintner (Prof. C. J.), [obituary article], 20
Little (O H.), The Geography and Geology of Makella (South Arabia) With two Appendices by Prof. G. Stefanini and P. Pallary, 332
Liversidge (Prof A.), The Movements of Molecules, 303
Lloyd (Dr. Dorothy Jordan), Chemistry of the Proteins and its Economic Applications, 910
Lloyd (F. G.), and Dr. J. Waterston, a Camberwell Beauty Butterfly near London, 781
Lobban (Dr C. H.), appointed reader in civil engineering at King's College, London, 646
Lobo (Da Costa), Correlation between the Solar Prominences and the Filaments, 359
Lockyer (Dr. W. J S.), The Spectrum of β Persei, 459
Loder (J de V.), The Problem of Peopling Australia, 639
Lodge (Sir Oliver), Religion and Science, 563; Science and Psychical Research, 622; Sir J. J Thomson, December 18, Suppt., 49, Supplementary Note on Radiation, 81, the meeting of the British Association at Oxford in 1894, 204
Loeb (E. M), The Ghost Dance Religion among the Pomo of California, 818
Loewe (S), and E. Spohr, Detection and Determination of Contents of the Female Oestral Hormone in the Female Organs of the Vegetable Kingdom, 899
Lohest (Prof. M.), elected a foreign associate of the Geological Society, 96
Loney (Prof. S. L.), Solutions of the Examples in a Treatise on Dynamics of a Particle and of Rigid Bodies, 656
Loomis (Prof F. B.), The Evolution of the Horse, 873
Lorentz (Prof. H. A.), elected a foreign member of the Académie Polonaise des Sciences, Cracow, 60
Lotsy (Dr. J. P.), Science and Psychical Research, 370
Lowery (H.), appointed head of the physics department of the Huddersfield Technical College, 788
Lowndes (A. G), Prof. Labbé's Production of "Allomorphs," 551
Lowry (Prof. T. M), and W. R. C. Coode-Adams, Optical Rotatory Dispersion (Part 3), 861
Lucas (Miss C L. T.), awarded a post-graduate travelling studentship by London University, 68
Lucas (R.), The Rotary Power of Tartaric Acid, 250
Luck (C C.), The Origin of the Masai and the Wild Tribes of Borneo, 567
Ludlam (Dr. E B.), and L. H Easson, Active Nitrogen, 590
Lumière (A.), and F. Perrin, A New Class of Hypnotics, 718
Lummer (Prof O), The Life and Work of, 530
Lundgren (A.), Testing on Hardening Steel, 605
Lunt (Dr J.), and others, Novæ, 61
Lutembacher (R), and L. Gaumont, The Application to Teaching Purposes of the Optical Recording of Sound, combined with the Kinematograph, 791
Lwoff (A.), and Mlle. Nadia Roukhelman, The Variations of Some Forms of Nitrogen in a Pure Culture of Infusoria, 359
Lyman (Dr. G. R), [death], 92
Lyman (Prof. T), Sir J. J. Thomson's Seventieth Birthday, 882, The Reversal of the Hydrogen Series in the Extreme Ultra-violet, 156
Lyons (Sir Henry), Ancient Surveying Instruments, 923

M (L. C), Modern Photometry, 771
Macalister (Prof R. A. S), Fitzgerald's The Historical Geography of Early Ireland, 334
Macaulay (J. M), The Polishing of Surfaces, 339
McBain (Prof. J. W), appointed to Stanford University, 457; and Dr. D G. Hopkins, Adhesives and Adhesive Action, 320
MacBride (Prof. E. W.), Kammerer's Alytes, 264, 661
MacCarthy (G. R), Colours due to Iron in Minerals and Rocks, 208
Maccoll (J. W.), elected to a Beit fellowship, 176
MacCurdy (J. T), elected a fellow of Corpus Christi College, Cambridge, 715
MacDonald (A), Proposals for the Extension of Anthropological Studies, 349
Macdonald (Prof. J S), Prof. J G Adami, 453
Macdonald (W. M), Pernicious Grafting, 303
MacDougal (Dr D. T.), Long-lived Plant Cells, 856
McDowall (Prof. R J. S.), and Dr. H M. Wells, The Skin Constrictor (Psychogalvanic) Reflex, 644
McGaffin (R. C), and E. Newbury, Single Potential of the Copper Electrode, 179
MacGregor (M E.), Medical Entomology and the Tropical Field Worker, 338
Mach (Prof. E.), translated by Dr. J. S. Anderson and Dr. A. F. A. Young, The Principles of Physical Optics: an Historical and Philosophical Treatment, 437
Machin (A), The Ascent of Man by Means of Natural Selection, 506
M'Intyre (G. D.), Development of the Vascular System in the Human Embryo Prior to the Establishment of the Heart, 71
Mackay (E.), The 'A' Cemetery at Kish, Mesopotamia, 532; The Oxford University and Field Museum Expedition to Kish, 349, to work in the Indus Valley under the Archæological Survey of India, 708
Mackenzie (D. A), The Migration of Symbols: and their Relations to Beliefs and Customs, 476
Mackintosh (N. A.), The *Discovery* Expedition: Work of the Marine Station at Grytviken, 629
Maclaren (N.), Development of Cavia. Implantation, 178
MacLean (Prof. H), Modern Views on Digestion and Gastric Disease, 439
McLennan (Prof. J. C), H. J. C. Ireton, and K. Thompson, On the Phosphorescence of Nitrogen, 408; and A B. McLay, On the Structure of the Arc Spectrum of Gold, 33, J. H McLeod, and W. C McQuarrie, On the Oxygen Spectral Line $\lambda = 5577{\cdot}35$ A.U., 441; and H. G Smith, On the Series Spectra of Palladium, 33
McLuckie (J), and A. H. K Petrie, An Ecological Study of the Flora of Mount Wilson (Part iii), 215
MacNair (W. A.), The Fine Structure of Certain Lines and Energy Levels of Cadmium, 682
Maggini (M), Interferometric Measurements on the Four Large Satellites of Jupiter, 719

Magrou (J.), *Bacterium tumefaciens* in the Tissues of Plant Cancers, 863
Magson (Dr. E. H.), How we Judge Intelligence: an Investigation into the Value of an Interview as a Means of Estimating General Intelligence, 687
Maguire (Dr. C. C. W.), appointed honorary demonstrator in anatomy in Birmingham University, 715
Mair (D. B.), Fourfold Geometry: being the Elementary Geometry of the Four-Dimensional World, 368
Makiyama (J.), Tertiary Molluscan Fossils from Korea, 426
Malinowski (Dr. B.), Anthropology and Administration, 768; Anti-Fundamentalism, 506
de Mallemann (R.), Magnetic Rotatory Dispersion and the Dispersion of Electric Double Refractions, 250; The Dispersion of Electrical Double Refraction of Camphor, 179
Mallet (L.), Luminescence of Water and Organic Substances submitted to γ-radiation, 394
Mallock (A.), Curved Path of Wireless Waves, 443, Muscular Action, 46
Malzev (V.), Luminous Night Clouds, 14
Manley (J. J.), Invar Steel Balance Beams, 674; The Union of Mercury and Helium, 276
Manley (G.), appointed assistant lecturer in geography in Birmingham University, 860
Marcelet (H.), Oils Extracted from the Head of a Dolphin (*Delphinus Delphis*), 107
Marchant (Prof. E. W.), and J. L. Miller, The Loss of Energy in Metal Plates of Finite Thickness, due to Eddy Currents produced by Alternating Magnetic Fields, 34
Marconi (Senatore G.), elected an honorary member of the Institution of Electrical Engineers, 708; The James Forrest Lecture, 669
Marett (Dr. R. R.), appointed Frazer lecturer in anthropology in Cambridge University, 897
Marie (C.), and J. Bertheloot, Two Causes of Error in the Electrolytic Determination of Nickel in the Presence of Iron, 863
Markgraf (Dr. F.), Kleines Praktikum der Vegetationskunde, 766
Marmer (H. A.), The Tide, 907
Marret (L.), Les fleurs de la Côte d'Azur (De Toulon à Menton), 9
Marsden (Dr. E.), appointed secretary of the New Zealand Industrial and Scientific Research Department, 202
Marsh (T. A.), Combustion in the Power Plant: a Coal Burner's Manual. Second printing, 9
Marshall (Miss D.), Heat Loss and Frictional Resistance in Air Currents, 748
Marshall (Major W. E.), [death], 562
Martin (Dr. C. J.), and Sir F. G. Hopkins, appointed members of the Medical Research Council of the Committee of the Privy Council, 530
Martin (G. C.), Mesozoic Geology of Alaska, 711
Martin (Dr. L. C.), Optics—Pure and Allied, 437; The Distribution of Light in Elementary Optical Images, 35
Marvin (C. F.), and H. H. Kimball, Solar Radiation and Weather Forecasting, 817
Marvin (F. S.), Dr. Seton-Watson's Sarajevo, 619; History and Evolution, 187
Masaki (O.), Photography at Low Pressures, 748
Mason (Dr. F. A.), appointed lecturer in Tinctorial Chemistry and Dyestuffs in Manchester University, 753
Masson-Oursel (P.), Comparative Philosophy, 297
Masters (Miss Helen), appointed head of the Domestic Science Department, etc., of the Battersea Polytechnic, 213
Mathur (Prof. K. K.), and V. S. Dubey, Post-Cretaceous Igneous Activity in Western India, 769
Matsumoto (Prof.), Japanese Extinct Mammals, 353
Matsumura (A.), Physical Anthropology of the Japanese, 426
Matthews (Rev. Dr. W. R.), God and Evolution, 543
Matthieu (M.), Egyptian Antiquities from Southern Russia, 855
Maudslay (Dr. A. P.), awarded a Rivers memorial medal of the Royal Anthropological Institute, 814
Maulik (S.), The Fauna of British India, including Ceylon and Burma. Coleoptera: Chrysomelidæ (Chrysomelinæ and Halticinæ), October 16, Suppt., 23
Mawson (Sir Douglas), Australasian Antarctic Expedition, 1911–14, Scientific Reports, Series B. Vol. 2, Part I. Records of the Aurora Polaris, 366
Maxwell (Sir Herbert), Television or Teleoptics? 194
Maxwell (L. R.), The Mean Free Path of Electrons in Mercury Vapour, 575
Mayet (L.), The Fossil Men of the Denise, 395
Mazza (L.), Products formed during the working of Lead Accumulators, 682
Meek (C. K.), The Northern Tribes of Nigeria: an Ethnographical Account of the Northern Provinces of Nigeria, together with a Report on the 1921 Decennial Census. 2 Vols., 219
Meinesz (Dr. F. A. V.), Gravity Determinations at Sea, 497
Meissner (W.), Supraconductivity, 675
Meitner (Fraulein L.), and K. Freitag, Range of α-Rays of Thorium C+C′, 208
Menzel, Coblentz, and Lampland, Lunar and Planetary Temperatures, 205
Menzies (W. J. M.), Literature of Salmon Fisheries, 642
Mercier (Col. E.), The 60,000-volt Underground Network of the Union d'Electricité, 923
Merton (G.), The Comet Grigg-Skjellerup, 891
Meunier (L.), and G. Rey, The Action of Ultraviolet Light upon Wool, 718
Meyer (A.), The Catalytic Rôle of Mercury in the Sulphonation of Anthraquinone, 611
Meyerhof (Prof.), The Formation of Lactic Acid in Muscle, 895
Meyerhof (M.), Le monde islamique, October 16, Suppt., 21
Michelson (Prof. A. A.), Sir J. J. Thomson's Seventieth Birthday, 882
Michelson (Dr. T.), expedition to the reservation of the Fox Indians at Tama, Iowa, 95; The Fox Indians, 132
Mill (Dr. H. R.), Aspects of the Oceans, 78; Atlantic Oceanography, 497
Millard (W. A.), Internal Rust Spot of Potatoes, 804
Miller (C. C.), The Slow Oxidation of Phosphorus Trioxide, 245
Miller (G. A.), Postulates in the History of Science, 682
Miller (Prof. F. R.), and Dr. N. B. Laughton, The Rôle of the Cerebellum in the Co-ordination of Animal Movement, 516
Miller (Prof. W. J.), An Introduction to Historical Geology; with special reference to North America. Second edition, 189
Millikan (Prof. R. A.), Recent Fundamental Work in Physics, 893; Sir J. J. Thomson's Seventieth Birthday, 882
Millington (W. E. W.), and Prof. F. C. Thompson, Plastic Deformation of Single Metallic Crystals, 409
Milne (Prof. E. A.), Some Recent Advances in Astrophysics, 738
Miner (J. R.), Winter Climate and the Incidence of Pulmonary Tuberculosis, 206
Mirvish (L.), and L. P. Bosman, The Calcium Content of Blood, 215
Mitchell (C. Ainsworth), Vinegar: its Manufacture and Examination. Second edition, 834
Mitchell (G. H.), elected to a Beit fellowship, 176
Mitchell (Prof. S. A.), and others, Modern Astronomy, 745
Mohler (F. L.), A Photo-ionisation Experiment with Hydrogen, 575
Moir (J.), Colour and Chemical Constitution. Part xxii., 467
Moir (J. Reid), A Glaciated Ochreous Flint from Cromer, 445; Science and Psychical Research, 694
Molinari (Prof. E.), [death], 849
Molliard (M.), The Dimorphism determined in the Gall of *Mikiola Fagi* by a Secondary Parasite, 755
Mond (Sir Alfred), elected president of the Institution of Fuel Technology, 204
Mondain-Monval (P.), The Thermal Properties of the Various Varieties of Selenium, 142
Monypenny (J. H. G.), Stainless Iron and Steel, 3
Morant (G. M.), The Chancelade Skull, 132
Mordoff (R. A.), Climate of New York State, 319

Morgan (Prof. A. E.), appointed principal of University College, Hull, 68
Morgan (Prof. C. Lloyd), Life, Mind and Spirit: being the Second Course of the Gifford Lectures delivered in the University of St. Andrews in the year 1923 under the general title of "Emergent Evolution," 582
Morgan (Prof. G. T.), and D. D. Pratt, Complex Aromatic Hydrocarbons in Low-Temperature Tar, 805
Morgan (Prof. T. H.), The Theory of the Gene, 435
Morice (Rev. F. D.), [obituary article], 562
Morini (Prof. F.), Fungal Symbiosis, 710
Morishita (K.), Nematodes from Japanese Frogs and Toads, 892
Morison (Sir Theodore), The Training of Engineers, 742
Morrell (Dr. R. S.), and H. R. Wood, The Chemistry of Drying Oils, 79
Morrison (F. R.), The Fixed Oil of the Kidney Fat of the Emu, 467
de Mottoni (G.), A New Method for Measuring Microscopic and Ultramicroscopic Distances by Means of Diffraction Gratings, 432
Moullin (E. B.), On Some Resistance Properties of a Certain Net-work containing Inductances and Capacities, and their Analogies in a Mechanical System, 323
Moureu (C.), C. Dufraisse, and M. Badoche, Autoxidation and Antioxygen Action, 432; (XIX.), 790; (XX.), 898; C. Dufraisse, and C. L. Butler, Rubrene Peroxide: New Experiments, 358; C. Dufraisse, and P. M. Dean, A Coloured Hydrocarbon: Rubrene, 142; A Dissociable Organic Peroxide: Rubrene Peroxide, 214; and A. Lepape, Proportions of Krypton and of Xenon in the Atmosphere, 318; The Determination of Krypton and Xenon in Atmospheric Air, 359
Mouriquand (G.), M. Bernheim, and Mlle. Theobalt, The Antirachitic Power of Wood's Light, 142
Moynihan (Sir Berkeley), resignation of the professorship of surgery in Leeds University, 932
Mukerji (S. K.), The Vegetation of Kashmir, 70
Mukherjee (Prof. J. N.), The Action of Silica on Electrolytes, 517
Muller (Dr. J. J. A.), Dutch Pendulum Observations in the Atlantic and the Pacific, 930
Muller (H.), and A. J. Bradley, Copper Hydride and its Crystal Structure, 427
Mulliken (Dr. R. S.), Systematic Relations between Electronic Structure and Band-spectrum Structure in Diatomic Molecules, III., 143
Mummery (J. H.), [obituary article], 454
Munro (Dr. J. W.), British Bark-Beetles, 819
Murdock (C. C.), The Location of the Electromotive Force in a Photoactive Cell containing Fluorescent Electrolyte, 575
Murray (C. D.), The Physiological Principle of Minimum Work, ii., 143
Murray (E. G. D.), elected a research fellow of Christ's College, Cambridge, 897
Murray (Miss M. A.), Royal Costume and Race in Ancient Egypt, 206
Murray (P. D. F.), An Experimental Study of the Development of the Limbs of the Chick, 251
Murray (W. S.), Superpower: its Genesis and Future, 334
Muspratt (Sir Max), Engineering and the Chemical Industry, 166
Muszyński (Prof. J.), The Medicinal Herb Fair at Vilna, 457
Myers (Dr. C. S.), and F. C. Bartlett, A Text-book of Experimental Psychology: with Laboratory Exercises. Third edition. Part 2: Laboratory Exercises, 729
Mynors (H. C. B.), elected a fellow of Corpus Christi College, Cambridge, 715
Myres (Prof. J. L.), appointed Sather professor of classical literature for 1926–27 in California University, 852

Nadson (G. A.), and M. N. Meisl, The Mechanism of the Action of Chloroform on Living Matter, 250; The Mechanism of the Action of Chloroform on the Protoplasm, the Nucleus, and the Chondriome of the Cells of *Allium cepa*, 358
Nagaoka and Nishima, Spectra of Heavy Metals, 784
Nall (G. H.), Scottish Sea Trout, 206
Namikawa (I.), The Fall of Floral Organs, 784
Nansen (Dr. F.), installation of, as Rector of St Andrews University, 715
Nath (Prof. V.), The Golgi Origin of Fatty Yolk in the Light of Parat's Work, 767; and Tasdique Husain, Origin of Yolk in the Eggs of Scolopendra, 660
Natta (G.), and A. Reina, Oxides and Hydroxides of Cobalt, 503; and F. Schmid, Oxides and Hydroxides of Cobalt, ii., 719
Naville (Prof. E.), [death], 686; [obituary article], 703
Nelson (A.), 'Hard Seeds' in Leguminosæ, 804
Němec (A.), Chemical Methods for determining if Agricultural Soils are in Need of Nitrogenous or Potash Manures, 59[illegible]
Newbegin (A. M.), Large Solar Prominence, 131
Newbold (Prof. W. R.), [death], 740
Newman (Prof. H. H.), The Gist of Evolution, 543
Newnham (E. V.), The Tropical Cyclone, 524
Newton (E. T.), re-elected president of the Palæontographical Society, 565
Newton (Sir Isaac), Forthcoming Two-hundredth Anniversary of the Death of, 813
Newton and Wright, Ltd., List of Electrical Apparatus, 925
Nicholson (E. M.), Birds in England: an Account of the State of our Bird Life and a Criticism of Bird Protection, October 16, Suppt., 23
Nicholson (Dr. G. W.), The Nature of Tumour Formation: the Erasmus Wilson Lectures delivered before the Royal College of Surgeons of England, on February 23, 25, and 27, 1925, 404
Nicholson (S. B.), Sunspots and Magnetic Storms, 495
Nicol (Miss P.), The Optical Properties of Selenium in the Conducting Form, 288
Nicolle (C.), and C. Anderson, Recurrent Fever transmitted both by Ornithodorus and by Lice, 142
Niewodniczánski (Dr. H.), The Fluorescence of Superheated Mercury Vapour, 877
Nilsson (Dr. M. P.), Primitive Time Reckoning and the Calendar, 103
Nipher (Prof. F. E.), [death], 740
Noack, The Function of Chlorophyll, 786
Noble (Dr. G. K.), Kammerer's Alytes, 209, 518
Nodon (Dr. A.), A Colloid Condenser, 35; Éléments d'astrophysique: introduction à l'étude de l'énergétique solaire et stellaire, 8
Nordenskiold (Baron), The Peruvian Quipus, 26
Norris (Dr. F. W.), appointed lecturer in the Department of Brewing of Birmingham University, 646
Norris (Miss M. H.), appointed to the staff of Stanford University, 458
Notcutt (Prof. H. C.), The Universities of South Africa, 753
Novák (Prof. V.), Sir J. J. Thomson's Seventieth Birthday, 882
Novi (Prof. I.), The supposed Regeneration of Enzyme Activity, 712
Nowell (W.), appointed director of the Amani Institute, 781
Noyes (A.), The Assaying of Brabantius, 363
Nunn (Prof. T. P.), Anthropomorphism and Physics, 923
Nuttall (Prof. G. H. F.), C Warburton, and Dr. L. E. Robinson, Ticks: a Monograph of the Ixodoidea. Part 4: The Genus Amblyomma, Dr. L. E. Robinson, 151

Oakley (H. B.), The Anomalous Flocculation of Clay, 661
Oberguggenberger (V.), The Scintillation of the Stars, 251
O'dell (G. F.), Automatic Telephone Working, 889
Ogilvy and Co., Catalogue of Microscopical Illuminating Apparatus, 816
Okland (F.), The Species Concept, 493
Oldham (R. D.), Depth of Origin of the Earthquake of August 15, 302; The Depth of Origin of Earthquakes, 27
Oliver (Prof. F. W.), conferment upon, of an honorary doctorate by Aberdeen University, 104
Oman (Sir Charles), Castles, 115
Ono (S.), The Atomic Nucleus, 99
Onslow (Lord), Plea for the Presentation of Ethnographical Specimens, 94

Oppenheimer (J. R.), On the Quantum Theory of the Problem of the Two Bodies, 323; On the Quantum Theory of Vibration-rotation Bands, 323; Quantum Theory and Intensity Distribution in Continuous Spectra, 771
Orcel (J.), An Attempt at the Classification of the Chlorites, 395
Ormsby-Gore (Hon. W.), The Economic Development of Tropical Africa, August 7, Suppt., 16
Orton (Dr. J. H.), A Breeding Ground of the Nursehound (*Scyliorhinus stellaris*) in the Fal Estuary, 732; and others, Marine Biology at Plymouth, 714
Osborn (Prof. H. F.), Discoveries in the Gobi Desert by the American Museum Expeditions, 418; Evolution and Religion in Education: Polemics of the Fundamental Controversy of 1922 to 1926, 652; Methods and Results of the American Museum Expeditions in the Gobi Desert, 1922–25, 198; Modern Aspects of Evolution, 617; The Geologic Antiquity and Creative Evolution of Man, 59; The Problem of the Origin of Species as it appeared to Darwin in 1859 and as it appears to us To-day, 270, 591
Osborne (Prof. G. D.), Stratigraphical and Structural Geology of the Carboniferous Rocks in the Mt. Mirannie and Mt. Dyrring Districts, near Singleton, N.S.W., 574
Osgood (Prof. W. F.), Advanced Calculus, October 16, Suppt., 27
Ostroga (F. M.), Chrome-cobalt Steels, 899
Otani (B.), Silumin and its Structure, 466
Ozawa (Y.), Permo-Carboniferous Fauna of Japan, 856

Page (H. W.), [death], 562
Paget (Sir R. A. S.), The Jolly Electron, 885
Pagliarulo (Maria Luigia), Rotatory and Refractive Dispersion of Aqueous Solutions of Dextro-rotatory Tartaric Acid, 682
Palazzo (Dr. L.), Magnetic Variation in North Africa, 134
Paneth (Prof. F.), and Prof. K. Peters, Reputed Transformation of Hydrogen into Helium, 455, 526
Parker (A.), Coal Blending, 607
Parker (G. H.), The Growth of Turtles, 396; The Inquiline Fish Fierasfer at Key West, Florida, 396
Parkes (A. E.), A Simple Method of Testing for Sulphites in Foods, 755
Parkin (J.), Sterility in the Vegetable Marrow, 697; The "Bleeding" of Trees through Injury, 878
Parmelee (Prof. C. W.), and P. W. Ketchum, Translucency of Porcelains, 100
Parsons (Hon. Sir Charles), presentation to, of the Kelvin medal, 678
Pascal (Prof. P.), Explosifs, poudres, gaz de combat: leçons professées à la Faculté des Sciences de Lille, 150
Patchin (G.), appointed principal of the Sir John Cass Technical Institute, 104
Paterson (D.), and J. F. Smith, Modern Methods of Feeding in Infancy and Childhood, 439
Paton (Prof. D. Noel), The Physiology of the Continuity of Life, 902
Patton (Dr. W. S.), appointed Dutton professor of entomology in Liverpool University, 860
Pavlov (Prof. V. I.), and A. I. Leipunsky, Critical Potentials of the Vapours of Mercuric Halides, 843
Pavlovsky (Prof. E. N.), and Prof. E. J. Zarin, The Alimentary Canal of Scorpions, 132
Peacock (A. D.), appointed professor of natural history in University College, Dundee, 32; The Reaction to Flea Bites: Anaphylaxis and Louse Infestation, 696
Pearl (Prof. R.), Cultivation of Drosophila for Laboratory Purposes, 282
Pearsall (Dr. W. H.), Forest in Relation to Humus, 642
Pearson (Prof. Karl), The Mode of Distribution of the Constants of Samples taken at Random from a Bivariate Normal Population, 33
Pease (F. G.), Design of a 25-foot Reflector, 531
Pease (M. S.), Genetics of the Cabbage Tribe, 27
Pécheux (H.), The Dielectric Constants of Petrols and Paraffins, 681
Peddie (Prof. W.), Physiological Optics and Psychology, 74
Peek (B. M.), Mutual Eclipses of Jupiter's Satellites, 170
Peers (C. R.), elected an honorary member of the Yorkshire Philosophical Society, 781
Pélabon (H.), Detection of Electromagnetic Waves by Metallic Contacts, 214; Rectifying Contacts, 610
Penfold (A. R.), The Essential Oil of *Zieria macrophylla* (Bonpland) and the Presence of a New Cyclic Ketone, 467; The Essential Oils from some Cultivated Eucalypts, 287; The Essential Oils of *Leptospermum lanigerum*, Smith, Part 1, 324; and R. Grant, The Germicidal Values of some Australian Essential Oils and their Pure Constituents. Part 4, 935
Pennin (J.), and Mlle. Choucroun, The Parallelism between the Fluorescent Power and Velocity of Reaction, 395
Penning (Dr. F. M.), Scattering of Electrons in Ionised Gases, 301
Perfect (D. S.), The Immutability of Transmissive Factors with Reversal of Light, 141
Perkin (Prof. A. G.), conferment upon, of the title of emeritus professor, 646
Perrier (Col. G.), The Regular Triangulation of Morocco, 898; The New Map of France, 461
Perrin (Prof. J.), awarded the Nobel prize for physics for 1926, 741
Perrot (E.), and A. Rouhier, Yocco, a New Drug containing Caffeine, 142
Perucca (E.), The Cause of "Flying Shadows," 35
Petavel (Capt.), A Co-operative Colony of Home-crofters near Calcutta, 286
Peters (W. J.), and C. C. Ennis, Recurring Magnetic Disturbances, 533
Petersen (Dr.), and Dr. Blegvad, Fisheries Investigations in Denmark, 282
Pethybridge (Dr. G. H.), Mycology and Plant Pathology, 640; Parasitic Fungi in Britain, 244
Petrie (Sir Flinders), Early Egypt and the Caucasus, 514; Early Egypt and the Fayum, 696; Egyptian History, 157; Glass in Early Ages, 178; Surveys of the Great Pyramid, 226; To Excavate Egyptian Remains in Palestine, 709; Work of the British School of Archæology in Egypt, 59; Miss Gardner, and Miss Caton-Thompson, Early Egypt and the Caucasus, 463
Phaff (Rear-Admiral), Investigation of Harmonic Constants, Prediction of Tide and Current, and their Description by Means of these Constants, October 16, Suppt., 25
Pfaff (Dr. F.), [death], 740
Pfeil (L. B.), The Effect of Occluded Hydrogen on the Tensile Strength of Iron, 34
Philiptschenko (Prof. J.), and others, Biometric Work on Variability, 99
Phillips (E. P.), South African Grasses, 934
Phillips (G. B.), The Primitive Copper Industry of America. Part 2, 467
Phillips (H.), Some Academic Horizons, 716
Phillips (J.), Faurea McNaughtonii Phill. ("Terblanz"), its Ecology and Distribution, 934; Rainfall Interception by Plants, 837
Phillips (J. B.), Climatology of Falmouth, 390
Phillips (Prof. R. W.), [death], 849
Pia (J.), Pflanzen als Gesteinsbildner, 585
Piazzi (G.), Centenary of the Death of, 126
Piccard (A.), and E. Stahel, Michelson's Experiment, realised in a Free Balloon, 432
Piccardi (G.), Ionisation of Potential Silver, 35
Pickering (Prof. W. H.), Mars, 709
Pickworth (Dr. F. A.), appointed honorary director of the Joint Board of Research for Mental Disease, Birmingham, 816
Picotti (M.), Results of the Physico-chemical Investigations made in the Italian Cruiser *Marsigli* in the Straits of Messina, 935
Pilcher (Mrs.), offer of the late Prof. Lewis's house to Cambridge University, 31
Pilon (H.), and A. Laborde, The Immersion of Metals in Homogeneous Media Opaque to the X-rays, 755
Pilsbry (Dr. H. A.), Land Mollusca of Panama and Costa Rica, 426
Piney (A.), A Method of Silver Impregnation of Zenker-fixed Sections, 718; Liver Extracts in the Treatment of Malignant Disease, 374

Pinkerton (A), and W H. Tait, Season-cracking in Arsenical Tubes, 466
Pittard (Prof E), translated by V. C. C. Collum, Race and History: an Ethnological Introduction to History, 545
Pocklington (Dr. H. C.), The Imaginary Roots of Equations, 627, 735
Poggi (R), and A. Polverini, The Determination of Phosphorus and Arsenic in Organic Substances, 935
Pollard (Prof. A. F. C.), Subject Index to the *Transactions of the Optical Society*. Vols 1-25, 350
Pollard (S), On the Descriptive Form of Taylor's Theorem, The Summation of a Fourier Integral of Finite Type, 790
Polson (C J), appointed assistant lecturer in Chemical Pathology in Manchester University, 753
Potts (H. E), Instruction in Bibliographical Technique for University Students, 573
Poucher (W. A), Perfumes, Cosmetics, and Soaps, with Especial Reference to Synthetics. 2 Vols., 113
Prévost (C), A New Erythrite, 358
Price (H), Science and Psychical Research, 553
Priestley (Joseph), visit to the grave and former home of, 422
Priestley (R E.), elected secretary of the General Board of the Faculties of Cambridge University, 753
Prins (J. A), and Dr. D. Coster, Higher Order X-ray Reflections from Fatty Acids, 83
Prior (Dr G. T.), On the South African Meteorites, Vaalbult, Witklip, and Queen's Mercy, 105
Proudman (Prof. J.), Tides and Sea Seiches, 568
Pruvost (Prof P.), elected a foreign associate of the Geological Society, 96
Przibram (Prof H.), Kammerer's Alytes, 210; Prof. Paul Kammerer, 555; Sir J. J. Thomson's Seventieth Birthday, 883
Przibram (K.), An Artificial Blue Colouration of Rock Salt at Room Temperature, 827
Punnett (Prof. R. C.), Sex-linked Inheritance in Fowls, 819; The Theory of the Gene, 435
Pycraft (W. P.), Camouflage in Nature, 795

Quercigh (E.), The Nature of Stibiobismuthinite, 503
Quilico (A), Rontgenographic Investigation of Metallic Hydrides: Copper Hydrides, 503

Rabi (I. I.), Spinning Electrons, 228
Radcliffe (W.), Fishing from the Earliest Times. Second edition, 907
Radcliffe-Brown (Prof.), The Family 'Trinity,' 496
Raleigh, Sir Walter, The Letters of (1879–1922), edited by Lady Raleigh. 2 Vols., 7
Raman (Prof. C V.), The Birefringence of Crystalline Carbonates, Nitrates, and Sulphates, 264; and K. S. Krishnan, The Electrical Polarity of Molecules, 302
Ramanathan (Dr. K. R.), Intensity and Polarisation of Skylight at Sunrise and Sunset, 337
Ramon y Cajal (Dr. S), elected a foreign corresponding member of the Vienna Academy of Sciences, 96
Rand (H W), J. F. Bovard, and D. E Minnich, Localisation of Formative Agencies in Hydra, 682, and Amy Browne, Inhibition of Regeneration in Planarians by Grafting. Technique of Grafting, 682; and Mildred Ellis, Inhibition of Regeneration in Two-headed or Two-tailed Planarians, 682
Randoine (Mme. L.), and R. Lecoq, Do the Water-soluble Vitamins (B) contained in Beer Yeast exist beforehand in the Culture Medium? 179, The Inequality of the Proportion of Water-soluble Vitamins (B) in Yeast Extracts of Different Origin, 107
Rankine (Prof A. O.), The Sensitivity of Selenium Cells, 13
Rasetti (F), Activated Fluorescence and Doppler Effect, 47
Rastall (Dr. H. R.), elected a supernumerary fellow of Christ's College, Cambridge, 860; presented with the William Bolitho gold medal of the Royal Geological Society of Cornwall, 816
Ratcliffe (J. A.), elected to the Stokes studentship for research in physics at Pembroke College, Cambridge, 609
Rawling (S. O), and J. W. Glassett, Hydrogen Concentration and Photographic Emulsions, 893, 927
Rawnsley (W. F.), Edward Thring, maker of Uppingham School, Headmaster 1853 to 1887, 729
Rây (Sir P. C), and K. C. Bose-Rây, Lengthened Chain Compounds of Sulphur, 283; The Discovery of Oxygen, 172
Ray (S. H.), Melanesian Mythology, 688
Rayleigh (Lord), Further Spectroscopic Studies on the Luminous Vapour distilled from Metallic Arcs, 33; Sir William Crookes and Spiritualism, 843, The Continuous Spectrum of Mercury, 767
Rayner (J. F), Alien Plants in the Isle of Wight, 567
Read (Dr. H. H.), and others, The Geology of Strath Oykell and Lower Loch Shin, 211
Reed (F. R. Cowper), Some New Ordovician and Silurian Fossils from Girvan, 71
Regan (C. Tate), The Pediculate Fishes of the Suborder Ceratioidea, 774
Reilly (Prof. J.), Morrell and Wood's The Chemistry of Drying Oils, 79; Tinkler and Masters' Applied Chemistry. Vol. 2: Foods, 8, and Miss H. E. Bastible, The Velocity of Formation of 3-5-dimethylpyrazole-4-diazonium Chloride, 142; and G T. Pyne, Studies in Peat. Part 1, 141; Prof W. N Rae, and Dr. T. S. Wheeler, Psychico-chemical Methods, 908
Reinach (Prof S), Archæological Discoveries at Glozel, 600
Reiss (Dr. P.), Le *pH* intérieur cellulaire, 836
Relf and Lavender, Flow past a Rotating Cylinder, 819
Rendle (Dr A. B), The Need for Precision in Botanical Terminology, 103
Repossi (E), and V. Gennaro, The Minerals of the Serpentine of Piossasco (Piedmont), 719
Research Association of British Paint, Colour, and Varnish Manufacturers, A Licence issued to the, 640
Resegotti (G.), Crystallographic Study of Certain Aromatic Nitroderivatives, 682
Reynolds (Prof. S. H.), The Lower Carboniferous (Avonian) Rocks of England and Wales, August 7, Suppt, 15
Richard of Wallingford, Commemoration of, 812
Richards (F. S.), Surveys of the Great Pyramid, 226
Richards (W. J.), The Effect of α-rays on Supersaturated Solutions, 718
Richardson (H), Boody's Psychological Study of Immigrant Children at Ellis Island, 406
Richardson (L. F.), D. Proctor, and R. C Smith, Upper Wind Variations, 893
Richardson (Prof. O. W.), Structure in the Secondary Hydrogen Spectrum (v.), 861, The Secondary Hydrogen Spectrum, 116
Richet (Prof. C), Psychical Phenomena and their Interpretation, 876, and P. Lassablière, The Protective Effects of Chloralose in Chloroform Anæsthesia, 359; The Protective Effects of Preliminary Saline Injections on Chloroform Anæsthesia, 178, and Oxner, The Accommodation of Salt-water Fish to Supersaturated Waters, 755
Richter (Dr. O), elected a foreign corresponding member of the Vienna Academy of Sciences, 96
Richmond (Dr Winifred), The Adolescent Girl: a Book for Parents and Teachers, 257
Rideal (Dr. E. K.), An Introduction to Surface Chemistry, 653; Contact Catalysis, 285
Ridgeway (Sir William), [obituary article], 275; bequest to Cambridge University, 538
Riecke (Prof. E), The Life and Work of Prof O. Lummer, 530
Riley (A.), appointed assistant lecturer in textile engineering in Manchester University, 753
Riley (H. L), and H. B. Baker, The Atomic Weight of Silver, 857
Rimington (C.), elected Benn W. Levy student in biochemistry in Cambridge University, 788
Ritchie (Dr. J.), Bird Protection in Great Britain, 73; The Protection of Wild Life in Australia, 218
Rivet (Dr. P.), Pre-Hispanic Jewelry in Colombia, 352; The Australians and South America, 317
Roberts (F.), Inheritance of Fleece Characters, 783
Roberts (Prof. Maria M.), and Prof. Julia T. Colpitts, Analytic Geometry. Second edition, October 16, Suppt., 28

Roberts (Morley), Malignancy and Evolution: a Biological Inquiry into the Nature and Causes of Cancer, 404
Robertson (H. M.), elected a research student in economics at Emmanuel College, Cambridge, 609
Robertson (Sir John), Injury done by Smoke in obstructing the Sun's Rays, 430
Robertson (Dr. J. M.), The Caryophyllene Alcohols and their Occurrence in Nature, 156
Robinson (Dr. H.), X-Rays—Internal Absorption and 'Spark' Lines, 224
Robinson (J. J.), Dr. Jeans and the 'Disease' of Life, 877
Robinson (P. L.), and H. C. Smith, The Absolute Density and Coefficient of Expansion of Silicon Tetrachloride, 303; The Atomic Weight of Silicon, 319
Robinson (Prof. R.), awarded the Longstaff medal of the Chemical Society, 924; Some Recent Advances in Organic Chemistry, 862; The Influence of General Electron Displacement on the Reactivity of Conjugated Systems in the Molecules of Carbon Compounds, 627
Robinson (R. L.), elected president of the Society of British Foresters, 602
Robinson (Dr. W.), appointed professor of botany in University College, Aberystwyth, 321
Robson (E. I.), The Reaction to Flea Bites, 843
Robson (G. C.), Light-Organs in Littoral Cephalópoda, 554
Robson (J.), Smoke in Bengal, 430
Roebling (W. A.), [death], 636
von Rohr (M.), Joseph Fraunhofer and the Development of Optical Instruments, 141
Rolla (L.), and L. Fernandes, Isolation of Illinium, 820; The Element of Atomic Number 61, 681; and Piccardi, Ionisation Potential and the Periodic System, 820
Rolleston (Dr. J. D.), Alcoholism in Classical Antiquity, 601
Ronchi (V.), The Limit of Resolution of Spectroscopic Apparatus, 286
Rose (D. C.), The Scattering of Alpha Particles through Small Angles, 34
Rose (W.), and J. Hewitt, A New Species of Xenopus from the Cape Flats, 502
Rosenhain (Dr. W.), and A. J. Murphy, The Metallography of Solid Mercury and Amalgams, 717; Microstructure of Mercury, 261
Ross (Dr. J. D. McBeath), appointed lecturer in physical chemistry in University College, Dundee, 609
Rothé (E.), Earthquakes in France, 784; J. Lacoste, and Mme. A. Hée, Earthquakes in France in 1925, 395; Le tremblement de terre, 223
Rothe (H.), Electron Emission Energy with Oxide Cathodes, 64
Roughley (T. C.), Cause of an Oyster Mortality on the George's River, N.S.W., 1924–25, 827
Roughton (F. J. W.), and H. Hartridge, Improvements in the Apparatus for Measuring the Velocity of very Rapid Chemical Reactions (n.), 790
Roussy (B.), Psychic Facts manifested by a Series of Spiders of the Genus *Epeira diadema* for keeping their Webs in a Vertical Plane, 395
Rouyer (E.), The Determination of Some Double Salts in Solution by the Boiling Point Method, 250
Rowe (A.), Archæological Discoveries at Beisan, 492; Identification of Two Philistine Temples, 315
Rowe (Dr. A. W.), [death], 455; [obituary article], 561
Rowell (H. S.), The Egyptian Shadouf and the Rate of Human Work, 481
Ruiz (C.), New Investigations on Barytes from Racalmuto, Sicily, 36
Rupp (Rev. H. M. R.), A New Species of Diuris from Barrington Tops, N.S.W., 719; Further Notes on the Genus Pterostylis, 251
Ruska (Prof. J.), Tabula Smaragdina, 352
Russ (Prof. S.), F. Harrison Glew, 165; Dr. J. F. Hall-Edwards, 313
Russell (Major A. J. H.), Vital Statistics of Southern India, 352
Rutherford (Sir Ernest), an honorary degree conferred upon, by Cambridge University, 565; elected a foreign member of the Académie Polonaise des Sciences, Cracow, 60; Electric Waves and their Propagation, 809; recommended for re-election as president of the Royal Society, 705
Ryan (Prof. H.), Peat Investigation in Canada, 859; J. Keane, and B. O'Donoghue, Some Derivatives of α-piperonylidene-methylethylketone, 177; Some Derivatives of γ-piperonylidene-methyl-ethylketone, 177
Ryde (J. W.), Opal Glass, 178
Rydmann (G.), The Formation of Organs from Adventitious Buds in *Tolmiea Menziesii*, 251

Sabatier (Prof. P.), awarded the Albert medal of the Royal Society of Arts, 24; presented with the Albert medal of the Royal Society of Arts, 169
du Sablon (L.), Vitalism and Mechanism, 244
Saffy (J. F.), Influence of Prolonged Maintenance at a Red Heat on the Resilience of Some Metals used for Exhaust Valves, 899
Saha (Prof. Meghnad), Explanation of the Spectra of Metals of the Second Group, 695
St. Maracineanu (Mlle.), Special Actions of the Sun on the Radioactivity of Polonium and Lead, 395
Salaman (Dr. R. N.), awarded the Snell memorial medal of the National Institute of Agricultural Botany, 96
Salant (E. O.), On the Heat Capacity of Non-polar Solid Compounds, 143
Salermo, Ltd., Low Temperature Carbonisation and the Salermo Process, 569
Sampson (Dr. J.), Welsh Romani, 657, 805; The Dialect of the Gypsies of Wales; being the Older Form of British Romani preserved in the Speech of the Clan of Abram Wood, 291
Sampson (Prof. R. A.), Photographic Theory, 374
Samsoen (M.), The Expansion of Commercial Glasses, 106
Sandford (K. S.), The Climate of North-East Land, 460
Sandved (K.), The Potentiometric Titration of Tin with Potassium Bromate, 610
Santayana (G.), Dialogues in Limbo, 188
Sarasola (Father), West Indian Hurricanes, 207
Satina (Sophia), and Blakeslee, Biochemical Differences between the Sexes of Mucors, 63
Saunders (Miss E. R.), The Origin of the Double Garden Stock, 934
Savage (R. E.), Herring and Plankton, 353
Savory (T. H.), British Spiders: their Haunts and Habits, October 16, Suppt., 22; The Ancestral Third Claw of a Spider: *Clubiona interjecta*, 157
Scagliarini (G.), Analogy of Behaviour and Isomorphism between Cerium and Thorium, 682; and M. Monti, Additive Compounds of Halides of Tin and Titanium with Organic Bases (ii.), 682
Schaeffer (Prof. A. A.), Taxonomy of the Amebas, 536
Schindler (Miss E.), Abnormal Fern Prothalli, 710
Schirmer (O.), Arabic Astronomy, 352
Schlesinger (Prof. F.), Accurate Square Roots, 338; Names for Companion Stars, 49
Schmidt (L.), and R. Stohr, Two Substances similar to Stearine from *Asclepias syriaca*, 288
Schmidt (Prof. W.), Der Massenaustausch in freier Luft und verwandte Erscheinungen, October 16, Suppt., 26
Schoch (C.), Researches on Ancient Eclipses, 566
Schoeller (W. R.), and C. Jahn, Investigations into the Analytical Chemistry of Tantalum, Niobium, and their Mineral Associates, vi., 755
Schofield (Dr. R. K.), appointed lecturer in physics in Durham University, 68
Schonland (B. F. J.), and J. Craib, Measurements of the Electric Fields of Thunderstorms, 251
Schotz (Dr. S. P.), Synthetic Rubber, 510
Schuster (Sir Arthur), awarded the Rumford medal of the Royal Society, 705; presented with the Rumford medal of the Royal Society, 821; Lord Rayleigh, December 18, Suppt., 47
Schwarz (Prof. E. H. L.), The Kalahari or Thirstland Redemption, 423; The Planetismal Hypothesis, 339
Scott (Dr. D. H.), awarded the Darwin medal of the Royal Society, 705; presented with the Darwin medal of the Royal Society, 822
Sears (J. D.), Baxter Basin Gas-field, Wyoming, 390
Seligman (Prof. C. G. and Mrs.), The Rainmaker among the Lotuko, S. Sudan, 673

Sen (K. C.), Antagonistic Action of Electrolytes and Permeability of Membranes, 481
Sen (S. K.), Insects and the Transmission of Rinderpest, 460
Senderens (J. B.), and J. Aboulenc, The Etherification of the Hydroaromatic Alcohols, 898
Serebrovsky and Wassina, Factors of the Sex Chromosomes in Fowls, 819
Seton-Watson (Dr. R. W.), Sarajevo: a Study in the Origins of the Great War, 619
Seward (Prof. A. C.), The Cretaceous Plant-bearing Rocks of Western Greenland, 808
Shaw (Sir Napier), The Cavendish Laboratory as a Factor in a Counter-Revolution, 885
Shaw (Prof. P. E.), The Electrical Charges from Like Solids, 659
Shearer (Prof. E.), Agricultural Education and the Community, 609
Shepardson (Prof. G. D.), [death], 165
Shepherd (Dr. S. E.), Adsorption of Dyes to Silver Halides, 913
Sheppard (T.), Catalogue of Shipping and Fisheries Exhibits at Hull, 316
Sherrington (Sir C. S.), The Assaying of Brabantius and other Verse, 363
Shinoda (O.), Intestinal Secretion of Insects, 460
Short (W. F.), Atomic Volumes of Carbon and Hydrogen, 445
Shotton (F. W.), awarded the Wiltshire prize of Cambridge University, 140
Siddons (A. W.), and R. T. Hughes, Practical Geometry: based on the Various Geometry Books by Godfrey and Siddons, October 16, Suppt., 28; Theoretical Geometry: based on the Various Geometry Books by Godfrey and Siddons, October 16, Suppt., 28
Simon (E. D.), and Miss Marion Fitzgerald, New Housing Schemes, 430
Simpson (Dr. G. C.), Ice-Domes and the Atmosphere, 111; Lightning, 191, 482
Singer (K.), Physiological and Pathological Chemistry of the Brain, I., 827
Skinner (Dr. H.), [death], 20
Skobeltzyn (Dr. D.), Distribution of Intensity in the Spectrum of γ-Rays, 553
Slater (Dr. F. P.), Recent Industrial Research in Cotton, 786
Sleggs (Prof. G. F.), Biological and Hydrographical Research in Newfoundland Fishery Grounds, 493
Sloley (R. W.), The Groma: an Ancient Surveying Instrument, 303
Smeeth (Dr. W. F.), Archæan Rocks of Southern India, 533
Smit (B. J.), and T. J. Naude, Fumigation with Hydrocyanic Acid, 534
Smith (A. D. Buchanan), Inbreeding, 856
Smith (Miss Annie Lorrain), A Monograph of the British Lichens: a Descriptive Catalogue of the Species in the Department of Botany, British Museum. Part 2. Second edition, 440
Smith (C. S.), and C. R. Hayward, The Action of Hydrogen in Hot Solid Copper, 466
Smith (D. M.), The Spectrum of Zinc, 592
Smith (Dr. E. F.), Priestley's Life in America, 744; The History of Chemistry in America, 461
Smith (Lieut.-Comdr. E. H.), A Practical Method for determining Ocean Currents, 538
Smith (Miss E. Philip), appointed lecturer in botany in University College, Dundee, 32
Smith (F. E.), appointed a member of the Explosives in Mines Research Committee, 241
Smith (Prof. G. Elliot), the archæological discoveries at Glozel, 600; The Origin of American Culture, 314; The Races of Mankind, 545; to deliver the Huxley lecture for 1927 in Birmingham University, 860
Smith (Dr. N. J. G.), appointed professor of botany in the Rhodes University College, Grahamstown, 393
Smith (O.), [death], 636
Smith (Prof. S. I.), [death], 20
Smith (T.), Reflection as a Special Case of Refraction; on the Light transmitted and reflected by a Pile of Plates, 141; The Stationary Value of Axially Symmetric Functions: the Criterion for the Best Position of Focus, 35. Part 2, 754
Smith (William), a memorial tablet to, 93
Smithells (Dr. C. J.), H. P. Rooksby, and W. R. Pitkin, The Deformation of Tungsten Crystals, 466
Smith-Rose (Dr.), Direction Finding by Radio, 100
Smits (Prof. A.), Allotropy, 916
Smock (Prof. J. C.), [death], 165
Smyth (H. D.), and C. J. Brasefield, The Secondary Spectrum of Hydrogen and the Occurrence of H_3+, 396
Snell (Sir John), Position and Prospects of Electricity Supply, August 7, Suppt., 17
Snyder (Dr. T. E.), The Prevention of Damage by Termites, 171
Soddy (Prof. F.), Wealth, Virtual Wealth, and Debt: the Solution of the Economic Paradox, 760
Sokolska (Mme. Julia), Spermatogenesis in Spiders, 207
Sollas (Prof. W. J.), River Terraces of the Euphrates, 692
Sommerfeld (Prof. A.), Electronic Structure of the Atom and the Quantum Theory, 785; Sir J. J. Thomson's Seventieth Birthday, 883
Sorenson (Prof. S. P. L.), The Hugo Müller lecture, 670
Sorley (Prof. W. R.), Tradition: the Herbert Spencer lecture delivered at Oxford, May 19, 1926, 110
Souèges (R.), The Embryogeny of the Liliaceæ, 359
Soulier (P.), Le Relief de la terre: ses origines, ses lois, son évolution; principes nouveaux de géographie physique, 259
Southern (R.), and A. C. Gardiner, The Seasonal Distribution of the Crustacea of the Plankton in Lough Derg and the River Shannon, 391
von Soxhlet (Prof. F.), [obituary], 20
Spegazzini (Prof. C.), [obituary], 704
Spencer (Dr. L. J.), A Sperrylite Crystal from the Transvaal, 105; Lead Hydrogen Arsenate as a Mineral, 411; Schultenite, a New Mineral from South-West Africa; Aramayoite, a New Mineral from Bolivia, 754
Sperry (E. A.), awarded the John Fritz gold medal, 744
Spielman (Miss W.), Recent Progress in Vocational Selection, 462
Spielmann (Dr. P. E.), The Earliest Human Knowledge of Copper, 410
Spiers (F. S.), proposed memorial to, 95
Sponer (Dr. H.), Absorption Bands in Nitrogen, 696
Sprague (T. A.), The Taxonomic Position of the Adoxaceæ, 70
Springer (F.), Unusual Forms of Fossil Crinoids, 27
Stamp (Sir Josiah), appointed Rede lecturer in Cambridge University, 788; Inheritance as an Economic Factor, August 7, Suppt., 17
Stapf (Dr. O.), New Plant Illustrations, 496
Steavenson (Dr. W. H.), elected president of the British Astronomical Association, 708; Mars in 1926, 666
Stebbing (Prof. E. P.), The Practice of Forestry in the British Empire, 145
Stebbing (Rev. T. R. R.), [death], 92; [obituary article], 201
Stechow (Prof. E.), Hydroids of the *Valdivia* Expedition, 926
Steele (R.), The Early Days of Chemistry, 315
Steenwijk (Dr. J. E. de Vos van), Proper Motions of Southern Stars, 242
Steers (J. A.), Changes in the Coastline between Hunstanton and the Orwell-Stour Estuary, 779
Stekhoven, Jr. (Dr. J. H. S.), and H. Priesner, The Insect Fauna of the Dutch East Indies, 673
Steklov (Prof. V. A.), [obituary article], 90
Stempell (W.), Zoologie im Grundriss. Dritte, vierte, und fünfte Lief., 835
Stephenson (A.), Accidents in Industry, 462
Stephenson (Dr. K.), and Prof. Pavillard, Amphipods and Diatoms from the Danish Oceanographical Expedition, 133
Sterkers (E.), and R. Bredeau, Study of Reactions between Solid Bodies reduced to the Colloidal State, 179
Sterling (Dr. M. W.), the expedition of, to New Guinea, 167
Stern (C.), An Effect of Temperature and Age on Crossing-over in the First Chromosome of *Drosophila melanogaster*, 575
Stevenson (R. E.), awarded the John Bernard Seely prize of Cambridge University, 68
Steward (G. C.), Note on the Petzval Optical Condition, 790

Stewart (H. F.), Francis Jenkinson, Fellow of Trinity College, Cambridge, and University Librarian: a Memoir, 476

Stiles (Dr. C. W.), Zoological Nomenclature: Hübner's (1806) 'Tentamen,' 591; Suspension of *Sarcoptes*, type *passerinus*, in favour of Sarcoptes, type *scabiei*, 339; The Zoological Names *Simia*, *S. satyrus*, and *Pithecus*, and their Possible Suppression, 49

Stillwell (F. L.), On the Nature of Berthierite, 105

Stocks (Dr. P.), appointed reader in medical statistics at University College, London, 646; and N. Karn, Sanatorium Treatment of Pulmonary Tuberculosis, 171

Stopes (Dr. Marie C.), The Crystalline Nature of the Chief Constituent of Ordinary Coal, 413; The Human Body, 115

Størmer (Prof. C.), Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 4, No. 7: Résultats des mesures photogrammétriques des Aurores boréales observées dans la Norvège méridionale de 1911 à 1922, 797

Stott (V. H.), D. Turner, and H. A. Sloman, Effects of Thermal Treatment on Glass as shown by Precise Viscometry, 34

Strahan (Sir A.), G. W. Lamplugh, 634

Strangeways (T. S. P.), and Honor B. Fell, Experimental Studies on the Differentiation of Embryonic Tissues growing *in vivo* and *in vitro* (ii.), 35

Stuart (Dr. M.), The Geological Search for Oil, 500

Stubblefield (C. J.), and O. M. B. Bulman, The Shineton Shales of the Wrekin District, etc., 934

Subramanian (G.), Aluminium Anode Film Dielectric, 245; and G. Gunnayia, The Determination of γ by the Method of Clement and Desormes, 712

Sucksmith (W.), and H. H. Potter, Magnetic Properties of Single Crystals of Nickel, 730

Suk (Prof. V.), Effects of Mental Work, 132

Sullivan (J. W. N.), Three Men discuss Relativity, 80

Surun (P.), The Adsorption of Some Organic Acids by Two Activated Carbons of Different Origin, 179

Susman (Dr. W.), appointed lecturer in morbid anatomy and histology in Manchester University, 753

Sutherland (Miss Christiana H.), appointed assistant in natural history in the United College, St. Andrews, 32

Sutton (L. J.), The Climate of Helwan, 133

Svedberg (Prof. T.), awarded the Nobel prize for chemistry for 1926, 741

Swinton (A. A. Campbell), Electric Television, 590, Science and Psychical Research, 299, 442, 553, 659, 692

Swirles (Miss B.), The Polarisabilities of Atomic Cores, 323

Tait (J.), Experiments and Observations on Crustacea. Part vii., 177

Takamine (Dr. T.), Electric Discharge through Helium, 857

Tamm (O.), and C. Malstrom, Forest Ecology in Sweden, 532

Tams (Prof. E.), Die Frage der Periodizitat der Erdbeben: eine Darstellung des gegenwartigen Standes der einschlagigen Untersuchungen, 5

Tandy (G.), Abnormal Fruiting Branches of Sweet Chestnut (*Castanea vulgaris*), found by Mr. W. P. J. Le Brocq near Brecon, 790

Tankard (A. R.), and D. J. T. Bagnall, The Examination of Fish for Formaldehyde, 610

Taradoire (F.), The Rapid Oxidation of Drying Oils and Antioxygens, 611

Tassilly (E.), and R. Savoire, The Spectro-photometric Determination of Nitrites and Nitrates by Diphenylamine Sulphate, 899

Tattersfield (F.), C. T. Gimingham, and H. M. Morris, New and Little-known Insecticides, 642

Taylor (Prof. G. I.), and C. F. Elam, The Distortion of Iron Crystals, 717

Taylor (Dr. H. S.), Fourth Report of the Committee on Contact Catalysis, 285

Taylor (Prof. H. S.), The Reported Conversion of Hydrogen into Helium, 852

Taylor (J. B.), Magnetic Moments of Alkali Metal Atoms, 643

Taylor (Prof. L. W.), A Numerical Drill Book on Physics, October 16, Suppt., 26

Taylor (W.), Chlorine Gas Filters in Relation to Reaction Velocity, 697

Taylor (W. W.), Ferric Hydroxide Sol and the Lyotrope Series: a Theory of von Weimarn, 71

Teeple (Dr. J.), awarded the Perkin medal, 781

Teggart (Prof. F. J.), Theory of History, 187

Terenin (Dr. A.), Optical Excitation of the Vapours of Mercuric Halides, 843

Thalbitzer (Dr. S.), translated by M. G. Beard, Emotion and Insanity, 405

Thirring (Prof. H.), Prof. Miller's Ether Drift Experiments, 81

Thomas (J. M.), Conformal Invariants, 215

Thomas (J. S.), The Action of Sulphur Chloride on Mercaptan, 467

Thomas (L. H.), elected a fellow at Trinity College, Cambridge, 609; Kaufmann's Experiment and the Spinning Electron, 374

Thomas (O.), and M. A. C. Hinton, The Zoological Names *Simia*, *S. satyrus*, and *Pithecus* and their Possible Suppression, 411

Thomas (Dr. W. N.), Surveying. Second edition, 440

Thompson (A. Beeby), Surface Indications of Petroleum, 851

Thompson (H.), Haddock Biology, 783

Thompson (T. W.), Gypsy Marriage in England, 673

Thomson (Prof. G. P.), An Optical Illusion Due to Contrast, 323

Thomson (Sir J. J.), congratulatory dinner to, 922; Retrospect, December 18, Suppt., 41; The Mechanics of the Electric Field (Kelvin Lecture), 342; University Laboratories and Research, 772

Thomson (W. R.), appointed director of propaganda for calcium cyanamide in Ceylon by Fertilisers Sales, Ltd., 530

Thoraeus (R.), Spectrographic Junction between the X-ray Region and the Extreme Ultra-violet, 771

Thorburn (A.), British Birds. New edition. In 4 Vols. Vol. 3, 585

Thorne (P. C. L.), Colloid Chemistry, edited by J. Alexander. Vol. 1, 585; "Colloid Chemistry," 878

Thorpe (Sir Edward), assisted by eminent contributors. Vol. 6, revised and enlarged edition, October 16, Suppt., 26

Thorpe (Prof. J. F.), appointed chairman of the Explosives in Mines Research Committee, 241; Intermediates, 698, The Scope of Organic Chemistry, August 7, Suppt., 15, 483

Tilden (Sir William), [death], 890

Tillyard (Dr. R. J.), Science and Psychical Research, 147, 300, 370, 587, 735; The Progress of Economic Entomology (with special reference to Australia and New Zealand), 888; Upper Permian Insects of N.S.W. Part ii., 323

Tinkler (Prof. C. K.), and Helen Masters, Applied Chemistry: a Practical Handbook for Students of Household Science and Public Health. Vol. 2: Foods, 8

Tocher (Dr. J. F.), Address at the School of Pharmacy of the Pharmaceutical Society, 564

Tolman (R. C.), and M. Mott-Smith, The Inertia of the Electric Carrier in Copper, 785; and S. Smith, On the Nature of Light, 143

Tomkeieff (S. I.), On some Chloritic Minerals Associated with the Basaltic Rocks of Derbyshire, 105

Tomlin (J. R. le B.), and H. C. Burnup, South African Mollusca, 317

Tompkins (C. M.), Potato Mosaic and Temperature, 711

Tondera (F.), The Mechanism of Geotropic Curvature, 673

Topley (B.), The Size of the Iodine Molecule, 802

Topley (Prof. W. W. C.), appointed professor of bacteriology and immunology at the London School of Hygiene and Tropical Medicine, 32

Topping (J.), elected to a Beit fellowship, 176

Toulaikoff (N. M.), Agriculture in Arid Lands, 63

Toussaint (A.), and E. Carafoli, The Study of the Plane-flow of Fluids, 35

Towler (E. C.), The British Patent Office, 517

Tradescant (J.), memorial to, 813

Travers (A.), and Houot, The Tempering of Type-metal Alloys, 214; The Thermal Study of Electrolytic Lead, 395; and Malaprade, Constitution of Solutions of Molybdic Acid, 394, The Constitution of the Molybdates, 681

Trillat (J. J.), The Action of X-rays of Long Wave-length on Micro-organisms, 718; X-ray Examination of Long-chain Compounds, 568
Trotter (A. P.), Modern Photometry, 770
Tucker (Lieut.-Col. E. F G.), and L. H. Gilbert, Promiscuity and Primitive Marriage, 783
Turner (A. J.), Revision of Australian Lepidoptera: Drepanidæ, Limacodidæ, Zygaenidæ, 827
Turner (C.), [death], 636
Turner (Dr. J. E), A Theory of Direct Realism: and the Relation of Realism to Idealism, 438
Turner (Prof R. L.), An Indian Clan in Wales, 291, Welsh Romani, 657, 805
Turner (S), bequest to Liverpool University, 538
Turner (Prof. T.), work and impending retirement of, 277
Turner (Prof W. E. S), The Physical Properties of Glasses, 569
Turrill (W. B.), Studies on the Origin of Cultivated Plants, 392
Twyman (F.), awarded the Duddell medal of the Physical Society, 922
Tyndall (Prof. A. M), and L. R. Phillips, The Mobility of Ions in Air (Part iii), 33
Tyrrell (Dr. G. W.), The Rocks of Jan Mayen, 674

Unna (P. J H.), The Egyptian Shadouf and the Rate of Human Work, 481
Unwin (R), and Poynton-Taylor, The Problem of the Domestic Fire, 431
Uribe (C.), Nuclear Division in the Trophozoites of *Endamœba histolytica*, 143

Vallois (H. V), Physical Characters of the Franks, 281
Van Vleck (Dr. J. H.), Magnetic Susceptibilities and Dielectric Constants in the New Quantum Mechanics, 226; Quantum Principles and Line Spectra, 129, The Postulates of the Matrix Quantum Dynamics, 215
Vaughan (W), Foraminifera from the Upper Eocene Deposits of the Coast of Eucador, 575; The Stratigraphic Horizon of the Beds containing *Lepidocyclina chaperi* on Haut Chagres, Panama, 575
Vavilov (Prof N.), The Origin of Cultivated Plants, 392
Vavon (G.), and Jakes, The Catalytic Hydrogenation of Conjugated Double Bonds, 394
Vegard (Prof. L), Luminescence from Solid Nitrogen, and the Auroral Spectrum, 801
Vellinger (E), The Rotatory Dispersion of Tartaric Acid, 826, The Rotatory Power of Organic Bodies as a Function of the *p*H: Glucosamine, 214
Verney (E. B), appointed professor of Pharmacology at University College, London, 176
Vernon (C. G.), An Introduction to Chemistry, October 16, Suppt., 26
Vernon (H. M), and T. Bedford, assisted by C. G Warner, A Physiological Study of the Ventilation and Heating in certain Factories, 536
Véronnet, Extension of Stokes's Theorem, 791
Verschoyle (T. T. H.), Isotherms of Hydrogen, of Nitrogen and of Hydrogen-nitrogen Mixtures at 0° and 20° C. up to a Pressure of 200 Atmospheres, 34
Viger (A.), [death], 201
Vincent (G. E.), The Rockefeller Foundation, 853
Vincent (H.), The General Properties of the Cryptotoxins, in particular Tetanus Cryptotoxin, 71
Visco (S), The Behaviour of the Hepatic Glycogen in Fasting Animals Treated with Insulin, 719
Volkringer (H.), The continuous Spectrum of Mercury, 862
Volmar, The Photolysis of the Alcohols, 214
Volterra (Prof. V.), Fluctuations in the Abundance of a Species considered Mathematically, 558
Votoček (E.), and F. Valentin, The Optical Inverse of Natural Rhamnose, 250

Wace (A J. B), Discovery of Mycenæan Treasure in Greece, 424
Wagner (Dr. P. A.), Ancient Bronze from the Transvaal, 496, Platinum in South Africa, 568
Waite (A. E.), The Secret Tradition in Alchemy: its Development and Records, 869
Waldo (Prof. C. A.), [death], 740
Wales (Prince of), Scientific Research and Service, August 7, Suppt., 9; speech at opening of the Ross Institute and Hospital, 125
Walker (Sir Gilbert T.), and Dr. J. C. Kamesvara Ray, Cold Weather Rains in India, 172
Walker (Sir James), awarded the Davy medal of the Royal Society, 705; presented with the Davy medal of the Royal Society, 822
Walker (M. N), The Possible Identity of Different Mosaic Diseases, 747
Walker (Dr. N.), An Introduction to Practical Biology: a Course of Work based chiefly upon the Plant and arranged for use without Special Apparatus in either the Class-room or the Home, 440
Walker (P. B), awarded the Busk studentship in Aeronautics in Cambridge University, 213
Wall (E. J), The History of Three-Color Photography, 185
Waller (Dr. I.), awarded an honorary research fellowship in Physics in Manchester University, 753
Wallis (T. E.), conferment upon, of the title of reader in Pharmacognosy in London University, 31
Walls (N. S.), and Prof. R. V. Wheeler, W Rintoul and A. G. White, Ignition of Gases, 461
Walsh (Dr J J.), Roman Catholic Priests and Scientific Research, 851
Walsh (J W. T.), Photometry, 581; and W. Barnett, The Effect of Slightly Selective Absorption in the Paint used for Photometric Integrators, 898
Walshe (Dr F. M. R), Reflex Regulation of Posture, 736
Walton (A), Preservation of Mammalian Spermatozoa, 265
Warburg (Dr. O.), Cancer Causation: Importance of Cell Physiology, 284
Ward (Prof. R. De C), Long-range Weather Forecasting, 386
Warner (Dr. F.), [obituary article], 704
Warren (Prof. E), Craniometrical Data of an Immature Skull of a Female Chimpanzee, 855, Fertility with Common Mule, 746, Spermatogenesis in Spiders, 207
Washington (Dr. H. S.), Spanish Petrology, 674
Wataghin (G.), The Aberration of Light and the Theory of Relativity, 935, The Ballistic Hypothesis and the Doppler Effect, 719
Watanabé (M.), Velocities of Diffusion in Gels, 748
Waters (H. J), and F G. King, Animal Husbandry, 766
Waterston (D), Development of the Hypophysis Cerebri in Man, with a Note upon its Structure in the Human Adult, 826
Watson (D. J), awarded a Frank Smart prize by Cambridge University, 104
Watson (D Milne), address to the Association of British Chemical Manufacturers, 127
Watson (H.), elected president of the Conchological Society of Great Britain and Ireland, 601
Watson (J. M.), Science as Revelation, 543
Watts (Prof. W W), Address at Jubilee Celebration of the Mineralogical Society, 535
Wayland (E. J.), The Stone Age of Ceylon, 193
Weaver (Prof. J. E), Root Development of Field Crops, 258
Webb (Beatrice), My Apprenticeship, 831
Webb (T. J), On the Free Energy of Hydration of Ions, 575
Wedmore (E. B.), Magnetic Properties of Single Crystals of Iron, 14
Weekes (Rev G. A), elected Vice-chancellor of Cambridge University, 538
Wegemann (Dr. G), Grundzuge der mathematischen Erdkunde, 513
Weidlein (Dr.), The Administration of Industrial Research, 57
Weiss (Prof P.), et G. Foex, Le magnétisme, 584
Welch (M. B.), The Wood Structure of certain Eucalypts belonging chiefly to the Ash Group, 611
Wells (H. G.), Mr Belloc objects to "The Outline of History," 872; Scientific Neglect of the Mas-d'Azil, 228; The Outline of History a Plain History of Life and Mankind. New edition, fully revised. Parts 1-24, 872, The World of William Clissold: a Novel at a New Angle, 723
Wenley (Dr. R. M.), Dr. C. W. Eliot, 346
Werner (S), The Spark Spectrum of Lithium, 154

Westermarck (Prof. E.), awarded a Rivers Memorial Medal of the Royal Anthropological Institute, 814
Wetmore (A.), Birds in South America, 26
Wheatcroft (E. L. E.), appointed professor of Electrical Engineering in Leeds University, 538
Wheeler and Grice, Protection against Ignition by Perforated Plates, 100
Whelpley (Dr. H. M.), [death], 165
Whipple (F. J. W.), Audibility of Explosions and the Constitution of the Upper Atmosphere, 309
Whipple (R. S.), A Royal Collection of Scientific Instruments, 896
Whitbeck (Prof. R. H.), Economic Geography of South America, 115
White (C. T.), Plants from the Rigo District, Papua, 574
Whittaker (J. M.), On a Polarised Light Quantum, 71
Wilcox (W. M.), appointed head of the Electrical Engineering Department of the Huddersfield Technical College, 789
Wilder (Prof. H. H.), The Pedigree of the Human Race, 260
Wilkins (V. E.), Research and the Land: an Account of Recent Progress in Agricultural and Horticultural Science in the United Kingdom, 799
Willey (E. J. B.), Active Nitrogen, 735; and Dr. E. K. Rideal, Active Nitrogen, 427
Williams (C. B.), Migrations of Butterflies, 118
Williams (Sir John), bequests to the University College of Wales and the National Library of Wales, 393
Williams (May M.), The Cytology and Phytogeny of the Siphonaceous Algæ, (2), 323
Williams (S.), A Critical Examination of the Vittarieæ, 70
Williamson (J. W.), The State and Industrial Research Associations, 676
Willis (Miss Margaret S.), appointed assistant lecturer in Geography in Manchester University, 140
Wills (Sir George), gift to Bristol University, 68
Willstatter (R.), Technique in Enzyme Investigation, 785
Wilson (A. H.), elected an honorary research student in Mathematics in Cambridge University, 609
Wilson (Prof. E.), The Corrosion Products and Mechanical Properties of certain Light Aluminium Alloys as affected by Atmospheric Exposure, 754
Wilson (E. B.), and C. R. Doering, The Elder Peirce's, 396
Wilson (G. Fox), Spraying Crops from Aeroplanes, 412
Wilson (Prof. G. M.), Motivation of Arithmetic, 393
Wilson (J. G.), gift to London University, 932
Wilson (Canon J. M.), Christianity in the Light of the Idea of Evolution, 778
Wilson (Dr. K. M.), and others, Vertebrate Development, 353
Winans (J. G.), Collisions of the Second Kind with Excited Mercury Atoms in the $2p$ State, 46
Winckworth (C. P. T.), elected Eric Yarrow lecturer in Assyriology in Cambridge University, 286
Winogradsky (S.), The Decomposition of Cellulose in the Soil, 790
Wirtz (C.), The Polar Compression of Uranus, 25
Wissler (Prof. C.), The Relation of Nature to Man in Aboriginal America, 260
Withers (T. H.), British Museum (Natural History) Catalogue of the Machaeridia (Turrilepas and its Allies) in the Department of Geology, 512
Withycombe (Dr. C. L.), elected university lecturer in advanced and economic Entomology in Cambridge University, 286; [death], 921
Witts (Dr. J. L.), elected a John Lucas Walker student in Pathology in Cambridge University, 286
Wood (Prof. T. B.), conferment upon, of an honorary doctorate by Aberdeen University, 104
Woodruff (F. M.), [death], 347
Woods (Prof. F. S.), Advanced Calculus: a Course arranged with special reference to the Needs of Students of Applied Mathematics, October 16, Suppt., 27
Woolavington (Lord), gift to Edinburgh University, 601
Wormell (T. W.), appointed observer in Meteorological Physics at the Solar Physics Observatory, Cambridge, 715

Yapp (Prof. W. W.), and Prof. W. B. Nevens, Dairy Cattle: Selection, Feeding and Management, 765
Yardley (K.)., X-ray Examination of Aramayoite, 754; The Structure of Baddeleyite and of Prepared ZrO$_2$, 755
Yarrow (Sir Alfred), gift to the British Association, 705
Yokoyama (Prof. M.), Pleistocene and Tertiary Mollusca of Japan, 819; Tertiary Fossils from Japan, 389
Yonge (Dr. C. M.), The Digestive Diverticula in Lamellibranchs, 855
Yoshida (U.), and K. Tanaka, Laue-Photograph taken with a Long Slit, 912
Young (G. A.), Economic Geology of Canada, 711
Young (J. S.), appointed lecturer in experimental Pathology and assistant director of Cancer Research in Leeds University, 788
Young (R. R. T.), The Determination of Nicotine in Tobacco, 610
Yovanovitch (D. K.), and Mlle. A. Dorabialska, A New Method for Measuring the Absorption of the β- and γ-radiation of Radioactive Bodies, 142

Zambonini (F.), The Presence in the Products of Vesuvius of a Cassiferous Variety of Potassium Fluoborate, 286; and G. Carobbi, Presence of Sodium and Potassium Fluosilicates among the Products of the Present-day Activity of Vesuvius, 681; and S. Restaino, Cerous-thallous Sulphates, 681; Double Sulphates of the Rare Earths and Alkali Metals, vi., 502
Zeeman (Prof. P.), Sir J. J. Thomson's Seventieth Birthday, 883
Zehrer (E.), Diamagnetic Gases, 712
Zeleny (Prof. J.), Sir J. J. Thomson's Seventieth Birthday, 884
Zeller (S. M.), The Infection of Tree Roots by ***Armillaria mellea***, 747
Zernike (Prof. F.), The Anomalous Dilatation of Invar, 662
von Zittel (Prof. A.), Neubearbeitet von Prof. F. Broili und Dr. M. Schlosser, Grundzüge der Palaontologie (Paläozoologie). Abt. 1: Invertebrata. Sechste verbesserte und vermehrte Auflage. Abt. 2: Vertebrata. Vierte vermehrte und verbesserte Auflage, 368
Zoltai (Dr. L.), The Hungarian Bronze Age, 281
Zook (G. F.), The Functions of Municipal Universities, 465
Zsigmondy (Prof. R.), awarded the Nobel prize for Chemistry for 1925, 741; und P. A. Thiessen, Das kolloide Gold, 77
Zvjaginstsev (O.), Dwi-manganese in Native Platinum, 262
Zwicky (F.), The Quantum Theory and the Behaviour of Slow Electrons in Gases, 396

TITLE INDEX.

Aberdeen University, conferment of doctorates on Prof. F. W. Oliver, Prof. T. B. Wood, and J. E. Humphries, 104
Aberystwyth, University College, Dr. W. Robinson appointed professor of Botany in, 321
Ability: a Psychological Study, Victoria Hazlitt, October 16, Suppt., 21
Acacia Seedlings, Part xii, R. H. Cambage, 467
Académie Polonaise des Sciences, Sir Ernest Rutherford, Sir Frederick Hopkins, Prof. H. A. Lorentz, and Dr. H. L. le Chatelier elected foreign members of the, 60
Accidents in Industry, A. Stephenson, 462
Acclimatisation to High Altitudes, Dr. J. S. Haldane, 702
Acetic Acid and Methyl Alcohol, The Manufacture of, 168
Acoustics of Buildings, The, Dr. A. H. Davis and N. Fleming, 534
Acrolein and Water, On the Critical Temperature of Solution of, and on the Molecular Mass of Soluble Acrolein Resin, A. Boutaric and G. Corbet, 250
Activated Carbons of Different Origin, The Adsorption of Some Organic Acids by Two, P. Surun, 179
Adhesives and Adhesive Action, Prof. J. W. McBain and Dr. D. G Hopkins, 320
Administration, Anthropology and, Dr. B. Malinowski, 768
Adolescent Girl, The: a Book for Parents and Teachers, Dr. Winifred Richmond, 257
Adoxaceæ, The Taxonomic Position of the, T. A. Sprague, 70
Adult Education, Journal of, No. 1, 715
Advertisements, Individual, Judgment of Value of, R. J. Bartlett, 462
Aeration of Water, Rate of, W. E. Adeney, 28
Aerodromes, Sizes of, H. Glauert, 64
Aeronautics, gift for the promotion of, D. Guggenheim, 563
Aeroplane: Flight to and from Australia, Sir Alan Cobham's, 527; Pilot, Perception of the Position of the Body in Relation to the Sensation of Equilibrium of an, Gemelli, 323, Use of the, for Spraying Purposes in Agriculture, G. Caudwell, 239
Aeroplanes with Oxygen, The Provision of, Garsaux, 178
Africa, Extinct Volcanoes in, 314
African: Languages and Cultures, The International Institute of, 707; Natives and European Civilisation, 289
Agricultural: Research, Official Publicity for, 799; Soils, Chemical Methods for determining if, are in Need of Nitrogenous or Potash Manures, S. Němec, 502
Agriculture: Field Experiments in, Statistics of, Dr. R. A. Fisher, 497, in Arid Lands, N. M. Toulaikoff, 63
Air: Currents, Heat Loss and Frictional Resistance in, Miss D Marshall, 748, Pollution and its Prevention, 212
Aircraft Research, 741
Airscrews, Theory of, H Glauert, 674
Alaska, Mesozoic Geology of, G. C. Martin, 711
Albert medal of the Royal Society of Arts, the, presented to Prof P. Sabatier, 169
Alchemy: An Arabic Treatise on, E. J. Holmyard, 534; and Mysticism, E J. Holmyard, 869; The Secret Tradition in, its Development and Records, A. E. Waite, 869
Alcohol, Dextrose and Levulose in Humans, The Metabolic Effect of Enemata of, T. M. Carpenter, 215
Alcoholism in Classical Antiquity, Dr. J. D. Rolleston, 601
Alcohols, The Photolysis of the, Volmar, 214
Algæ, Siphonaceous, Cytology and Phylogeny of the (2), May M. Williams, 323
Aliphatic Compounds, Electron Displacement *versus* Alternate Polarity in, Prof. G. Berger, 734
Alkali Metal Atoms, Magnetic Moments of, J. B. Taylor, 643
Allen's Commercial Organic Analysis, edited by C. S. Sadtler, Dr. E. C. Lathrop, and C. A Mitchell. Vol 4. Fifth edition, 222
Allene Hydrocarbons, The Synthesis of, M. Bouis, 358
'Allomorphs,' Prof. Labbé's Production of: by the Action of Increased Hydrogen Ion Concentration, R. Gurney, 336; A. G. Lowndes, 551
Allotropy, Prof. A. Smits, 916
Alpha Particles, The Scattering of, through Small Angles, D. C. Rose, 34
Aluminium: Alloys: Age-hardening of, Kathleen E. Bingham, 605; The Corrosion Products and Mechanical Properties of Certain Light, as affected by Atmospheric Exposure, Prof. E. Wilson, 754; and Light Alloys, Electrolytic Plating of, their Adherence and Resistance to Corrosion by Sea Water, J. Cournot and J. Bary, 863; and Silicon, The Alloys of, Dr. A. G C. Gwyer, H. W. L. Phillips, and others, 498; Anode Film Dielectric, Subramanian, 245; Bronzes, The Transformations undergone by, J. Bouldoires, 755; Constitution and Age-hardening of Some Ternary and Quaternary Alloys of, containing Nickel, Kathleen E. Bingham, 466; Silicon Alloys, The Constitution and Structure of the Commercial, A G C. Gwyer and H. W. L. Phillips; with Appendix by D. Stockdale and I. Wilkinson, 466, Single Crystals of, under Reversed Tortional Stresses, Some Further Experiments on the Behaviour of, H. J. Gough, S. J. Wright, and D. Hanson, 466; The Electromotive Behaviour of, A. Dadieu, 827.
Alytes, Kammerer's: Dr. G. K. Noble, 209, 518; Dr. H. Przibram, 210; Prof. E. W. MacBride, 264, 661
Amani Institute, W. Nowell appointed director of the, 781
Amebas, Taxonomy of the, with Descriptions of Thirty-nine New Marine and Freshwater Species, Prof. A. Schaeffer, 536
America, The Future of, 76
American: Culture, The Origin of, Prof. G. Elliot Smith, 314; Geographical Society, award of the gold medal of the, to Dr. E. von Drygalski, 316; Museum Expeditions in the Gobi Desert, 1922–25, Methods and Results of the, Prof. H. F. Osborn, 198
Amœbæ, Classification of, 536
Amœba proteus, Locomotion and other Life-processes in, Effect of Hydrogen-ion Concentration on, D. L. Hopkins, 143
Amphipods and Diatoms from the Danish Oceanographical Expedition, Dr. K. Stephensen, 133
Amusements, The Psychology of, M. W. Disher, 243
Analysing Waters, Sewages, and Effluents, A Critical Review of the Methods of, with Suggestions for their Improvement, J. W. H Johnson, 755
Analyst, Decennial Index of the, 854
Analytical Method: A New General, Volumetric Analysis, using a Centrifuge, R. F. Le Guyon, 395
Anemone, Some Species of, The Vascular Supply of the Bracts of, Miss A. E. Chesters, 934
Animal: Breeding: and Genetics, 464; Research Department, the University, Edinburgh, Fifth Annual Report, 464; Husbandry, H. J. Waters and F. G. King, 766; Coloration in the Struggle for Existence, The Significance of, 795; Metabolism, Effect of Polarised Radiations on, Prof. S. S. Bhatnagar, R. B. Lal, and K. N. Mathur, 11; Movement, Co-ordination of, The Rôle of the Cerebellum in the, Prof. F. R. Miller and Dr. N. B. Laughton, 516
Animals of Land and Sea, A. H. Clark, 259
Anion, Hydrogen as, Prof. H. E. Armstrong, 13
Annealing Process, The Economics of the, E. A Coad-Pryor, 681
Annual Register, The: a Review of Public Events at Home and Abroad for the Year 1925, edited by Dr. M. Epstein, 260
Antarctic: Flora, An, 567; Weather, 488
Anthraquinone, Sulphonation of, The Catalytic Rôle of Mercury in the, A. Meyer, 611
Anthropological Studies, Plea for the Extension of, A. MacDonald, 349
Anthropology: and Administration, Dr. B. Malinowski, 768; in Australia, The Study of, 669
Anthropomorphism and Physics, Prof. T. P. Nunn, 923
Antidetonants, The Retarded Inflammation Effect produced by, Dumanois, 179
Anti-Fundamentalism, Dr. B. Malinowski, 506

Arabian Astrophysics, Early, Al Hazen, translated by Dr. K. Kohl, 782
Arabic Astronomy, O. Schirmer, 352
Arachnidism, Dr. E. Bogen, 927
Aramayoite, X-ray Examination of, K. Yardley, 754
a-Rays, Effect of, on Supersaturated Solutions, W. J. Richards, 718
Argon: Pure, Mobility of the Negative Ions and Ionisation Currents in, M. Laporte and M. A. da Silva, 394; Spectrum of the Pickering Type in, M. Kahanowicz, 935
Aristotle, The Works of, translated under the editorship of Prof. W. D. Ross. Categoriæ and De Interpretatione, by E. M. Edghill; Analytica Priora, by A. J. Jenkinson; Analytica Posteriora, by G. R. G. Mure, 152
"Arithmetic:" Motivation of, Prof. G. M. Wilson, 393; The History of, Prof. L. C. Karpinski, 407
Armillaria mellea, The Infection of Tree Roots by, S. M. Zeller, 747
Armstrong College: appointment of Dr. W. E. Curtis as professor of physics, 68; appointment of Dr. G. R. Goldsbrough to a senior research fellowship, 176
Army Medical Services, Major-Genl. Sir Matthew H. G. Fell appointed Director-General of the, 24
Aromatic Nitroderivatives, Crystallographic Study of certain, G. Resegotti, 682
Arsenic in Marine Crustaceans and Shellfish, On the Presence of Compounds of, A. Chaston Chapman, 610
Arsenical Tubes, Season-cracking in, A. Pinkerton and W. H. Tait, 466
Asclepias syriaca, Two Substances similar to Stearine from, L. Schmidt and R. Stohr, 288
Ashmolean Museum, Old, Postcards of Objects of Interest in the, 129
Asinello, Geological Observations on the Island of, and on Neighbouring Rocks (Carnaro), G. Cumin, 36

ASTRONOMICAL NOTES.

Comets:
  Pons-Winnecke Comet and Meteors, W. F. Denning, 61; Finlay's Comet, S. Hasunuma, 97, Kopff's Periodic Comet, 131; Finlay's Comet, 242; Suspected Comet, 388; Mr. Wilk's Comet Announcement, 425; Comets, 459, 603, 709; Giacobini's Comet and the Meteoric Display of October 9, W. F. Denning, 709; Comet Comas Sola, 745, 782, 817, 854; Comet Grigg-Skjellerup, G. Merton, 891
Instruments:
  The Simeis Observatory Reflecting Telescope, 97; Design of a 25-foot Reflector, F. G. Pease, 531; British Telescopes, 782
Meteors:
  Pons-Winnecke Comet and Meteors, W. F. Denning, 61; The Coming Perseids, 97; July Meteors, W. F. Denning, 170; The August Perseids of 1926, W. F. Denning, 280; Fireball on August 13, W. F. Denning, 388; The Meteoric Phenomena of September 6, W. F. Denning, 425; Abundance of Fireballs, W. F. Denning, 495, The Meteoric Phenomena of September 6, W. F. Denning, 531, Another Detonating Fireball, W. F. Denning, 566; Unusual Display of Large Meteors, W. F. Denning, 603; The Geminid Meteoric Shower, W. F. Denning, 854
Observatories:
  The New Solar Radiation Station in South Africa, 242; The Norman Lockyer Observatory, 495; Catania Observatory, 531; The Dominion Astrophysical Observatory, Victoria, B.C., 925; U.S. Naval Observatory, Washington, 925
Planets:
  The Atmosphere of Mars, B. Fessenkoff, 25; The Polar Compression of Uranus, C. Wirtz, 25; The Constitution of the Interior of the Earth, Dr. H. Jeffreys, 131; Changes in the Earth's Rate of Rotation, Prof. E. W. Brown, 170; Mutual Eclipses of Jupiter's Satellites, B. M. Peek, 170; Naming of Minor Planets, 205; Lunar and Planetary Temperatures, Menzel, Coblentz, and Lampland, 205; The Uniformity of the Earth's Rotation, Bigourdan, 425; Mars, E. M. Antoniadi, 495; Minor Planets, 566; Mars, Prof. W. H. Pickering, 709; Conjunction of Mercury and Saturn, 854
Stars:
  Cepheid Variability, Rev. J. G. Hagen, 25; Novæ, Dr. J. Lunt, and others, 61; The Reflection Effect in Eclipsing Variables, Prof. A. S. Eddington, 170; Proper Notions of Southern Stars, Dr. J. E. de Vos van Steenwijk, 242; The System of Castor, H. van Gent, 280; The Problem of 'Island Universes,' Dr. Hubble, 388; The Spectrum of β Persei, Dr. W. J. S. Lockyer, 459; Spiral Nebulæ, Dr. G. E. Hale, 817
Sun:
  Large Sunspots, 61; Large Solar Prominence, A. M. Newbegin, 131; Sunspot Activity, 205; Solar Radiation, 280; Recent Naked-Eye Sunspots, 459; Sunspots and Magnetic Storms, S. B. Nicholson, 495; C. Schoch's Researches in Ancient Eclipses, 566, Recent Sunspots and Magnetic Storm, 603; Solar Activity during 1925, G. A. Favaro, 641; Solar Radiation and Weather Forecasting, C. F. Marvin and H. H. Kimball, 817; The Total Eclipse of June 29, 1927, 854; Theory of Sunspots, Prof. V. Bjerknes, 891; Recent Sunspots, 925
Miscellaneous:
  Relativity and the Dayton Miller Experiments, Prof. H. Wildon Carr, 641; Modern Astronomy, Prof. S. A. Mitchell, and others, 745; Early Arabian Astrophysics, Al Hazen, translated, 782; International Longitude Determinations, Dr J. Jackson, 891

Astronomy, Modern, 745
Astrophysics, Some Recent Advances in, Prof. E. A. Milne, 738
Astrophysique: Éléments, introduction à l'étude de l'énergétique solaire et stellaire d', Dr. A. Nodon, 8
Atlantic: Oceanography, Dr. H. R. Mill, 497; Weather, 493
Atlantis: America and the Future, Col. J. F. C. Fuller, 76
Atmosphere, The Visibility of the, G. Guilbert, 432
Atmospheric: Depression, A Phenomenon of, produced by a Lofty Obstacle in the Wind, Charcot and P. Idrac, 826; Dust and Condensation Nuclei, R. K. Boylan, 177; Electricity, Dr. C. Chree, 894
Atom: Again, The, Prof. J. A. Crowther, 365; Electronic Structure of the, Prof. A. Sommerfeld, 785; Structure of the, Reflections on the, Florence Langworthy, October 16, Suppt., 26
Atome, chemischen: Die Konstitution der, Mechanische Theorien in Physik und Chemie, Prof. A. Korn, 365
Atomic: Cores, The Polarisabilities of, Miss B. Swirles, 323; Magnet, The Structure of the, R. Forrer, 179; Nucleus, The, S. Ono, 99; Number 61: Illinium, The New Element of, Prof. B. Brauner, 84; The Element of, L. Rolla and L. Fernandes, 681; Theory: The Basis of Modern, C. H. D. Clark, 365; The New, Prof. L. Brillouin; Dr. H. T. Flint, 172
Atoms: and Ions, The Forces between, ii., J. E. Lennard-Jones and Miss B. M. Dent, 34; the Magnetic Moment of, Quantum Mechanics and, Prof. E. Fermi, 876; The Synthesis and Disintegration of, as revealed by the Photography of Wilson Cloud Tracks, Prof. W. D. Harkins and H. A. Shadduck, 875
Aurignacian Human Figure from the Caverne David, Cabraret, The, Prof. R. Anthony, 818
Aurora: Borealis, The, as observed from Norway, Prof. S. Chapman, 797; Polaris, Records of the Australasian Antarctic Expedition, 1911–14. Scientific Reports, Series B, Vol. 2, Part 1, Sir Douglas Mawson, 366
Auroral Spectrum, Luminescence from Solid Nitrogen, and the, Prof. L. Vegard, 801
Aurores boréales observées dans la Norvège méridionale de 1911 à 1922, Résultats des mesures photogrammétriques des, Prof. C. Størmer, 797
Australasia, Gasteromycetes of, v., G. H. Cunningham, 574
Australasian: Antarctic Expedition, 1911–14. Scientific Reports, Series B, Vol. 2, Part 1, Records of the Aurora Polaris, Sir Dawson Mawson, 366; Association for the Advancement of Science, Programme of the Perth Meeting, 22

Australia: and New Zealand, Scientific and Industrial Research in, 597; Commonwealth Council for Scientific and Industrial Research, the members of the, 202; Save, a Plea for the Right Use of our Flora and Fauna. By various writers. Edited by Sir James Barrett, 218; South, The Mammals of, Prof. F. Wood Jones, Part 3, 477; The Problem of Peopling, J. de V. Loder, 639; The Protection of Wild Life in, Dr. J. Ritchie, 218; The Study of Anthropology in, 669, The Trichoceridæ (Diptera) of, C. P. Alexander, 574
Australian: Birds, 746; Curculionidæ, On Some, A. M. Lea, 719; Essential Oils, The Germicidal Values of Some, and their Pure Constituents, etc., Part 4, A. R. Penfold and R Grant, 935, Institute of Science and Industry, The Reconstitution of the, 57; Lepidoptera: Revision of, Drepanidae, Limacodidae, Zygaenidae, A. J. Turner, 827; Proctotrypoidea, New Species of, with Revisioned Notes, A. P. Dodd, 323, Rhenopodiaceæ, A Revision of certain, C. H. Anderson, 719, River Basins, 133; Syrphidæ, Revision of, Part 1, E. W. Ferguson, 251; Weather, Some Periods in, Dr. E. Kidson, 99
Australians, The, and South America, Dr. P. Rivet, 317
Automatic Telephone Working, Aspects of, G. F. O'dell, 889
Autoxidation and Antioxygen Action, C. Moureu, C. Dufraisse, and M. Badoche, 432; (XIX), 790; (XX.), 898
Autumn in Great Britain, 564
Aviation: Civil, a Report by the Joint Committee on Civil Aviation of the U.S. Department of Commerce and the American Engineering Council, 149
Axially Symmetric Functions, The Stationary Value of, T. Smith, 35; Part 2, 754
Azeotropism, particularly of Binary Systems with closely Chemically Related Constituents, M. Lecat, 899

Bacillary White Diarrhœa of Chicks, Leaflet on, 816
Bacon: Francis: and Scientific Method, Dr. C. D Broad, 487, 523; Commemoration at Cambridge, 565; Roger, and Gunpowder, A. Clément, 352
Bacteriophage, The, and its Behaviour, Dr. F. d'Herelle, translated by Dr. G. H. Smith, 183
Bacterium tumefaciens in the Tissues of Plant Cancers, J. Magrou, 863
Baddeleyite, The Structure of, and of prepared ZrO_2, K. Yardley, 755
Ballistic Hypothesis, The, and the Doppler Effect, G Wataghin, 719
Balloon: Ascent, The Registering, at Oxford on August 10, 492; Fabrics, Electrification of, Dr. G. Barr, 857
Barleycorn, John, 871
Barley Crop: The, a Record of some Recent Investigations, Dr. H. Hunter, 871
Barytes from Racalmuto, Sicily, C. Ruiz, 36
Battersea Polytechnic: Courses at the, 501; Miss Helen Masters appointed Head of the Domestic Science Department of, 213; Report for 1925–26, 897
Baxter Basin Gas-field, Wyoming, J. D. Sears, 390
Beisan, Results of Excavations at, A. Rowe, 492
Beit Fellowships for Scientific Research: elections to, 176, further gift by Sir Otto Beit, 708
Belloc, Mr., objects to "The Outline of History," H. G. Wells, 872
Bending of a Curved Tube of Circular Cross Section, W. Hovgaard, 215
Benzene, The Variation of the Dielectric Constant of, with Pressure, L. Caignard, 899
Bernoulli's Theorem, An Extension of, B. Caldonazzo, 719
Berthierite, On the Nature of, F. L. Stillwell, 105
Bibliographical Technique for University Students, Instruction in, H. E. Potts, 573
Bihar Peasant Life: being a Discursive Catalogue of the Surroundings of the People of that Province, Sir George A. Grierson. Second edition, 472
Biochemistry, Lectures on certain Aspects of, Dr. H. H. Dale and others, 403
Biological: and Hydrographical Research in Newfoundland Fishery Grounds, Prof. G. F. Sleggs, 493; Processes, Influence of Temperature on, Dr. J. Bělehrádek, 117; Research in the Tropics, Prof. J. S. Dunkerly, 662; Synthesis: Hopes and Obstacles, Prof. J. S. Huxley, 902
Biologischen Arbeitsmethoden, Handbuch der, Herausgegeben von Prof. E. Abderhalden, Lief 184. Abt. 9: Teil 2, 1 Hälfte, Heft 4, 691; Lief. 187. Abt. 2: Physikalische Methoden, Teil 2, Heft 1, P. Hirsch, Marie Anna Schirmann und H. Kessler, 437
Biology: O. H. Latter, 513, and Human Life, Prof. J. S. Huxley, 814, 844; and the Training of the Citizen, Prof. Graham Kerr, August 7, Suppt., 16, 229, Experimental, Society for, Meeting of the, 168; Practical, An Introduction to, a Course of Work based chiefly upon the Plant and arranged for use without Special Apparatus in either the Class-room or the Home, N. Walker, 440; Taxonomy in, 901, The Social Implications of, 325
"Bioplasm," Suggested Use of the Word, 494
Bird Protection in Great Britain, Dr. J. Ritchie, 73
Birds: in England: an Account of the State of our Bird Life and a Criticism of Bird Protection, E. M. Nicholson, October 16, Suppt., 23; in South America, A. Wetmore, 26
Birmingham: gift of land to, Cadbury Bros., Ltd., 646; University: conferment of degrees, Dr. L. Ball appointed joint professor of medicine, 68; gifts by Rev. H Friend and Latch and Batchelor; Prof W. Boulton elected dean of the faculty of science; F. W. Norris appointed lecturer in the Department of Brewing, 646; Dr. T. L. Hardy appointed assistant to the chair of medicine; and Dr. C. C. W. Maguire, honorary demonstrator in the Department of Anatomy; the title of emeritus professor conferred upon Prof. O. J. Kauffmann, 715; new coal-treatment laboratory of the Mining Department of, opening of the, 814; Dr. E. L. Hirst appointed a lecturer in chemistry, G. Manley, assistant lecturer in geography, and Dr. O. Brenner part-time assistant in pathology and bacteriology; Prof. G Elliot Smith to deliver the Huxley lecture, 860
Birth-control, Broadcasting, Prof. J. S. Huxley, 771
Birthdays, Contemporary, 32, 69, 105, 141, 177, 213, 249, 287, 322, 358, 394, 431, 465, 502, 539, 574, 610, 647, 716, 754, 789, 825, 861, 898, 933
Blair, Robert, fellowships, award of, to M. D. Bone and E. W. Fell, 176
'Bleeding' of Trees through Injury, The, J. Parkin, 878
Blood: Reactions and Sex, Dr. F. A E. Crew, 85; -Sucking Flies, Ticks, etc. Fifth edition, 130
Blue Whale, An Early Embryo of the, E. L. Gill, 215
Boerhaave's attitude towards Alchemy, Prof. T. L. Davis, 350
Bolitho, William, gold medal of the Royal Geological Society of Cornwall, presentation of the, to Dr. R. H. Rastall, 816
Bolometer, A Rapid, made by Sputtering on Thin Films, H. Dewhurst, 825
Bonellia, Sex Differentiation in, Prof. R Goldschmidt, 783
Books, Libraries, and Languages, 541
Borax, The Volatility and Dissociation of, Prof. H. V. A. Briscoe and P. L. Robinson, 374
Bose Research Institute, The, Calcutta, 158
Bot Flies of the Punjab, Capt. H. E. Cross, 62
Botanical: Science, Changing Aspects of, Prof. F. O. Bower, August 7, Suppt., 19; Terminology, The Need for Precision in, Dr. A. B. Rendle, 103
Botany, Seven Decades of, Prof. F. O. Bower, 413
β-particles ejected by X-rays, The Three-dimensional Reproduction of Tracks of, O. Darbyshire, 371
Brabantius, The Assaying of, and other Verse, Sir C. S. Sherrington; A. Noyes, 363
Bradford Technical College, Courses at the, 464
Brains of Rats and Men: a Survey of the Origin and Biological Significance of the Cerebral Cortex, Prof. C. J. Herrick, October 16, Suppt., 21
Brazilian Meteorology, 533
Brighton Technical College, Calendar of, 464
Bristol University, gift by Sir George Wills, 68

British : Aquarist's Exhibition, A, 528, Association : at Oxford : in 1894, Reminiscences of the meeting of the, Sir Oliver Lodge, 204 ; The, 123, 135, 161, 199, 238, 276 ; gift to the, by Sir Alfred Yarrow, 705 ; Leeds, Sectional Presidents, 850 ; Astronomical Association, Dr. W. H. Steavenson elected president of the, 708 ; Bark-Beetles, Dr. J. W. Munro, 819 ; Birds, A. Thorburn. New edition. In 4 Vols., Vol. 3, 585, Brown-Boveri Co., The *Review* of the, August, 349 ; Chemical : Industry, The, D. Milne Watson, 127 ; Plant, Exhibition of, 166 ; Empire : The Practice of Forestry in the, Prof. E. P. Stebbing, 145 ; Universities of the, 138 ; Food Manufacturers' Research Association, a Board of Trade licence issued to the, 130 ; Foresters, Society of, Inaugural meeting of the, and election of officers, 601 ; Institute in Paris, a proposed, 715 ; *Journal of Psychical Research*, No. 1, 21 ; Late Palæolithic Industries, M. C. Burkitt, 833 ; Lichens : A Monograph of the, a Descriptive Catalogue of the Species in the Department of Botany, British Museum. Part 2. Second edition, Annie Lorrain Smith, 440 ; Museum : A. Esdaile appointed secretary, 241 ; (Natural History), Catalogue of the Machæridia (Turrilepas and its Allies) in the Department of Geology, T. H. Withers, 512 ; Exhibit of Enlarged Models of Disease-carrying Insects and Ticks, 24 ; Exhibition of the Remains of a Stegosaur, 421 ; A Case Illustrating the Effect of Waste Oil from Ships on Sea-birds, 422 ; Guide to the Exhibited Series of Insects, Fourth edition, 169 ; Picture Postcards of the, 494, 708, Natural History Booklets and Postcards of the, 780 ; Non-Marine Mollusca (Recent and Post-Tertiary), Synonymy of, A. S. Kennard and B. B. Woodward, 656 ; Paint, Colour, and Varnish Manufacturers, Research Association of, A Licence granted to the, 640 ; Patent Office, The, E. E. Towler, 517 ; School of Archæology in Egypt, Work of the, Sir Flinders Petrie, 59 ; Scientific and Technical Books, A Catalogue of, Suppt., 1925, arranged by Daphne Shaw, October 16, Suppt., 28 ; Telescopes, Grubb, Parsons and Co., 782

Buchan prize of the Royal Meteorological Society, award of the, to C. N. M. Douglas, 924

Buenos Aires, Museo Nacional de Historia Natural, "Memoria Anual," 1924, 351

Building Research Station of the Industrial Research Department, Work of the, 528

Bulletin : *for International Relations*, July, 386 ; *for Scientific Relations*, The, No. 1, 348

Burr-Knots on Apple and Crown Gall, R. G. Hutton, H. Wormald, and A. W Witt, 496

Bushmen of Central Angola, D. F. Bleek, 935

Business Economics, Sir William Ashley, 835

Butterflies, Migrations of, C. B. Williams, 118 ; F. Cramer, 191

Cabbage Tribe, Genetics of the, M. S. Pease, 27

Cadmium : and Zinc, Alloys of, Constitution and the Physical Properties of the, C. H. M. Jenkins, 466 ; Photo-electric Cell, H. D. Griffiths and J. S. Taylor, 283 ; The Fine Structure of certain Lines and Energy Levels of, W. A. MacNair, 682

Cæsium : and Rubidium, The Displacement of, by Iron, L. Hackspill and H. Pinck, 396 ; Eosinate, The Preparation of, R Delaplace, 250

Calcium : Carbide in Calcium Cyanamide, Estimation of, G. Flusin and H. Giron, 214 ; Cyanide, Commercial, Rate of Decomposition of, M. S. Benjamin, 287, Sulphate, The Activation of the Inert Varieties of, P. Budnikoff, 395

Calculus : Advanced : Prof. W. F. Osgood, October 16, Suppt., 27 ; A Course Arranged with Special Reference to the Needs of Students of Applied Mathematics, Prof. F. S. Woods, October 16, Suppt., 27 ; An Introduction to the, C. V. Durell and R. M. Wright, 513

Calendar, The Reform of the, 776

Californian Petroleum, Mother-rock of, New Theories of the, 747

Camberwell Beauty Butterfly near London, The, F. G. Lloyd and Dr. J. Waterston, 781

Cambridge : Philosophical Society, election of officers, 744 ; University : award of Henry P. Davison scholarships, 31 ; gift by Mrs. Pilcher ; A. J. Dorward appointed University lecturer in moral science ; Dr. Cobbett re-elected University lecturer in pathology ; A. Hutchinson elected professor of mineralogy, 31 ; award of the Mayhew prize to J. A. Gaunt and A H. Wilson ; Rex Moir prize to H. L. Cox, and the John Bernard Seely prize to R. E. Stevenson, 68 ; award of Frank Smart prizes to D. J. Watson and H. P. Hutchinson, 104 ; bequest by Capt. H. E. Laver ; award of the Harkness scholarship to M. Black and the Wiltshire prize to F. W. Shotton, 140 ; appointment of T. C. Hodson as reader in ethnology, 176 ; award of the Busk studentship in aeronautics to P. B. Walker, 213 ; Report of Appointments Committee on teaching appointments under the new statutes ; elections of research students, the bequest of Dr. E. J. Bles, 286 ; C. P. T. Winckworth elected Eric Yarrow lecturer in Assyriology ; Dr. C. L. Withycombe elected University lecturer in advanced and economic entomology ; Dr. J. L. Wilts and J. O. W. Bland elected John Lucas Walker students in pathology, 286 ; regulations for new statutes, etc., A. Hopkinson reappointed demonstrator in anatomy, 321 ; award of the John Winbolt prize to H. Bateman and R. J. Smith, 501 ; offer from the Laura Spelman Rockefeller Memorial Trustees for a chair of political science ; Rev. G A. Weekes elected vice-chancellor, bequest by Sir William Ridgeway ; J. D. Cockcroft and J. A. Ratcliff elected to the Clerk Maxwell scholarship, 538 ; conferment of honorary degrees upon Sir Ernest Rutherford and Prof. W. S Holdsworth, 565 ; Dr. A. C. Haddon appointed honorary keeper of the New Guinea collection in the Museum of Archæology and Ethnology ; J A. Ratcliffe elected Stokes student for research in physics at Pembroke College ; proposed new statute as to emoluments, 609 ; L. H. Thomas elected a fellow of Trinity College, H. M. Robertson elected a research student in economics at Emmanuel College ; A. H. Wilson elected an honorary research student in mathematics, 609 ; R. W. Ditchburn awarded an Isaac Newton studentship, 646 ; reappointment of Dr. C. G. Lamb, W. E. Johnson, P. Lake, and Dr. H. Lamb, 680 ; T. W. Wormell appointed observer in meteorological physics at the Solar Physics Observatory ; J. T. MacCurdy and H. C. B. Mynors fellows of Corpus Christi College ; G. T. Jones awarded the Adam Smith prize, 715 ; R. E. Priestley elected secretary of the general board of the faculties ; W. H. Florey elected a fellow of Gonville and Caius College, 753 ; C. Rimington elected Benn W. Levy student in biochemistry ; Dr. A. J. Copeland awarded the Raymond Horton-Smith prize, 788 ; offer from the Empire Marketing Board for an extension of the Low Temperature Research Station ; Sir Josiah Stamp appointed Rede lecturer ; Dr. C. Hose elected an honorary fellow at Jesus College, 788 ; G. Bateson appointed Anthony Wilkin student in anthropology, 824 ; Dr. H. R. Rastall elected a supernumerary fellow of Christ's College, 860 ; bequest by the Right Hon. F. Leverton Harris ; Dr. R. R. Marett appointed to the Frazer lectureship in anthropology ; E. G. D. Murray elected to a research fellowship at Christ's College, 897

Camouflage in Nature, W. P. Pycraft, 795

Camphor : Common, Imperfect Crystallisation of, W. G. Burgess, 116 ; The Dispersion of Electrical Double Refraction of, R. de Mallemann, 179

Canada : Anthropological Research in, 203 ; Economic Geology of, G. A. Young, 711 ; The Preservation of the Buffalo in, 240

Canadian : Arctic Expedition, 1913–18, memorial tablet to the members lost, 94 ; Department of Mines, Annual Report of the Mines Branch, 279 ; School of Prehistory in France, The, Dr. H. M. Ami, 626

Cancer : Prof. W. Blair Bell's Treatment of, 850 ; Causation . Importance of Cell Physiology, Dr. O. Warburg, 284 ; International Conference on, 671 ; Problem, The, Dr. W. E. Gye, 779 ; *Review*, The, 168

Cape and Back, My Flight to the, Alan J. Cobham, 189
Capillary: Action, External, Sir W. Galloway, 300; Condensation and Adsorption, W. C. Bray and H. D. Draper, 143
Carbon: and Hydrogen, Atomic Volumes of, W. F. Short, 445; Dioxide Gas, Action of Magnetic Fields on the Refractive Index of, Prof. P. N. Ghosh and P. C. Mahanti, 734; Monoxide: Molecule: Energy Levels of the, O. S. Duffendack and G. W. Fox, 12; Dr. R. C. Johnson, 50; The Catalytic Dissociation of, J. Cleminson and Prof. H. V. A. Briscoe, 534; The Fixation of, on an Organic Magnesium Compound by means of Chromic Chloride, A. Job and A. Cassal, 250; The Molecular Spectrum of, J. W. Ellis, 82; The Reduction of, O. C. Elvins and Prof. A. W. Nash, 154; Tetrafluoride, P. Lebeau and A. Damiens, 28; The "H and K" Bands of, A. S. Ganesan, 842
Carbonic Oxide: Combustion of, New Experiments on the, Prof. W. A. Bone, 22; The Burning of, Prof. W. A. Bone, 932; The Reduction of, Prof. H. E. Armstrong, 265
Carboniferous Rocks in the Mt. Mirannie and Mt. Dyrring Districts, near Singleton, N.S.W., Stratigraphical and Structural Geology of the, G. D. Osborne, 574
Carrier Pigeons, Determining the Sex of, I. Iwata, 892
Caryophyllene Alcohols, The, and their Occurrence in Nature, Dr. J. M. Robertson, 156
Cass, Sir John, Technical Institute: G. Patchin appointed principal, 104; Department of Petroleum Technology, Report of the, 393; Inauguration of the New Session, 573
Castanea vulgaris, Abnormal Fruiting Branches of Sweet Chestnut, G. Tandy, 790
Castles, Sir Charles Oman, 115
Castor, The System of, H. van Gent, 280
Cat, Dissection of the, Directions for the, Prof. R. P. Bigelow, 407
Catania Observatory, *Annuario* for 1926, 531
Cathode Sputtering, A von Hippel, 605
Cattle, The Nutrition of, M. Kriss and others, 713
Caucasus, Early Egypt and the, Sir Flinders Petrie, Miss Gardiner and Miss Caton-Thompson, 463; Sir Flinders Petrie, 514; Miss G. Caton-Thompson and Miss E. W. Gardner, 624
Cavendish Laboratory: Research Work in the, in 1900–1918, Prof. J. A. Crowther, December 18, Suppt., 58; Sir J. J. Thomson and the, 922; as a Factor in a Counter-Revolution, Sir Napier Shaw, 885; 1876–1900, Sir Richard Glazebrook, December 18, Suppt., 52
Cavia, Development of, Implantation, N. MacLaren, 178
Cellulose in the Soil, The Decomposition of, S. Winogradsky, 790
Cementation of Copper and its Alloys by Aluminium, The, L. Guillet, 142
Central Europe, The First Colonisation of, V. Gordon Childe, 106
Cephalopoda, Light-Organs in Littoral, G. C. Robson, 554
Cephalopods, The Statocysts of, M. Ishikawa, 926
Cepheid Variability, Rev. J. G. Hagen, 25
Cereals, Field Trials of, Dr. E. S. Beaven, 815
Cerebral Cortex, Responses to Rhythmical Stimulation of the, Sybil Cooper and D. Denny-Brown, 33
Cerium and Thorium, Analogy of Behaviour and Isomorphism between, G. Scagliarini, 682
Cerous-thallous Sulphates, F. Zambonini and S. Restaino, 681
Ceylon, The Stone Age of, E. J. Wayland, 193
Chambers's Encyclopædia: a Dictionary of Universal Knowledge. New edition. Edited by Dr. D. Patrick and W. Geddie. Vol. 8, 691
Chancay, Peru, Pottery from, A. L. Kroeber, 132
Chancelade Skull, The, G. M. Morant, 132
Chatham Islands, A New Isopod from the, Prof. C. Chilton, 243
Chemical: Aspects of Life, 403; Fusion, A Large, 638; Industry, Society of, Annual Meeting and Congress of Chemists, 173; Reactions (ii.), Measuring the Velocity of very Rapid, Improvements in the Apparatus for, F. J. W. Roughton and H. Hartridge, 790
Chemie: der polymeren Kohlenhydrate: Einfuhrung in der, ein Grundriss der Chemie, der Stärke, des Glykogens, der Zellulose, und anderer Polysaccharide, Prof. P. Karrer, 77; Physiologischen und pathologischen, Lehrbuch der, in 75 Vorlesungen: fur Studierende, Artze, Biologen und Chemiker, Prof. O. Fürth. Zugleich Auflage. Band 1. Lief. 1. Vorl. 1 bis 16, 800
Chemistry: A Dictionary of Applied, Sir Edward Thorpe; assisted by eminent contributors. Vol. 6. Revised and enlarged edition, October 16, Suppt., 26; An Introduction to, C. G. Vernon, October 16, Suppt., 26; Applied: A Practical Handbook for Students of Household Science and Public Health, Prof. C. K. Tinkler and Helen Masters. Vol. 2: Foods, 8; Reports of the Progress of. Vol. 10, 1925, 583; Colloid: 77; Theoretical and Applied, collected and edited by J. Alexander. Vol. 1: Theory and Methods, 585; in America": "A Half-century of, 494; 1876–1926, Prof. H. E. Armstrong, 806; The History of, E. F. Smith, 461; Industrial: a Manual for the Student and Manufacturer. Edited by A. Rogers. Fourth edition. In 2 vols., 548; An Introduction to, Dr. S. I. Levy, 548; Modern, 548; Modern Physics in, 42; of the Brain, Physiological and Pathological (I.), K. Singer, 827; of the Proteins: Prof. S. P. L. Sørenson, 670; and its Economic Applications, Dr. Dorothy Jordan Lloyd, 910; Organic: Some Recent Advances in, Prof. R. Robinson, 862; The Scope of, Prof. J. Thorpe, August 7, Suppt., 15, 483; Physical, Fundamentals of, for Students of Chemistry and Related Sciences, Prof. A. Eucken; translated and adopted by Dr. E. R. Jette and Prof. V. K. Lamer, 42; Physiological, Practical, S. W. Cole. Seventh edition. October 16, Suppt., 27; Surface, An Introduction to, Dr. E. K. Rideal, 653; The Early Days of, R. Steele, 315
Chemotaxis and Phagocytosis in Imitation of Leucocytes, L. A. Herrera, 935
Cheshire School of Agriculture, Reaseheath, The, 609
Chick, Development of the Limbs of the, An Experimental Study of the, P. D. F. Murray, 251
Chimie: Le problème de, recueil de problèmes inédits avec leurs solutions à l'usage de la Classe de mathématiques spéciales des candidats au S.P.C.N., au M.P.C., au Baccalauréat (M.E.), aux Grandes Ecoles et à divers concours. Lois générales métalloïdes, chimie organique, J. Duval, 691
Chimpanzee, a Female, Craniometrical Data of an Immature Skull of, Prof. E. Warren, 855
China: Indemnity, The, 829; Sea, Pressure and Winds over the, 568; The Sacred 5 of, is the 5th Book on China, Dr. W. E. Geil, 223
Chloralose in Chloroform Anæsthesia, The Protective Effects of, C. Richet and P. Lassablière, 359
Chlorides, certain Bivalent, Crystalline Structure of, G. Bruni and A. Ferrari, 503
Chlorine Gas Filters in Relation to Reaction Velocity, W. Taylor, 697
Chlorites, Classification of the, J. Orcel, 395
Chloritic Minerals associated with the Basaltic Carboniferous Rocks of Derbyshire, S. I. Tomkeieff, 105
Chloroform: Anæsthesia, The Protective Effects of Preliminary Saline Injections on, Prof. C. Richet and P. Lassablière, 178; Mechanism of the Action of: on Living Matter, G. A. Nadson and M. N. Meisl, 250; on the Protoplasm, etc., of the Cells of *Allium cepa*, G. A. Nadson and N. Meisl, 358
Chlorophyll, The Function of, Noack, 786
Cholesterol Allophanate and its Use in Biological Chemistry, R. Fabre, 756
Chou Kou Tien Discovery, the, Tertiary Man in Asia, Dr. D. Black, 733
Christianity in the Light of the Idea of Evolution, Canon J. M. Wilson, 778
Chrome: -carbonyl, The Preparation of a, by the Intermediary of a Magnesium Compound, A. Job and A. Cassal, 396; -cobalt Steels, F. M. Ostroga, 899
Chromosomes in Trivalents and Quadrivalents, The Attractions of the Ends of, Dr. J. Belling, 227
Ciel, Description du, A. Danjon, 620

Cirrus at a Lower Level than Alto-cumulus, A Giao, 49
Citizen, Biology and the Training of the, Prof. J. Graham Kerr, 229
Citrus Diseases and their Control, Prof. H. S. Fawcett, with sections on Oriental Citrus Diseases, by H. A. Lee, 655
City and Guilds (Engineering) College, 632
Civil: Aviation in the United States, 149; Engineers, Institution of, awards of the, 565; List pensions, 169
Civilization Contagious? Is, Dr. B Malinowski, 385
Clay, The Anomalous Flocculation of, Dr. N. M. Comber, 412; H. B. Oakley, 661
Clement and Desormes, The Determination of γ by the Method of, G. Subrahmaniam and G. Gunnayia, 712
Climatic Changes during Geological Times, C. E. P. Brooks, 15, 53
Clissold, William, The World of, a Novel at a New Angle, H. G. Wells. 3 Vols., 723
Clouds and Weather Phenomena: for Artists and other Lovers of Nature, C. J. P. Cave, 369
Clubiona interjecta, The Ancestral Third Claw of a Spider: T. H. Savory, 157
Coal: Ash and Clean Coal, Dr. R. Lessing; H. J. Hodsman, 345; Blending, D. Brownlie; A. Parker, 607; Carbonisation Tests, 354; Industry, Economics of the, F. Hodges, 217; Ordinary, The Crystalline Nature of the Chief Constituent of, C. S. Fox; Dr. Marie C. Stopes, 913; Treatment in the United States, 569; Ways to Reconstruction, being a sequel to "The Coal Crisis and the Future," 334
Coastline between Hunstanton and the Orwell-Stour Estuary, Changes in the, J. A. Steers, 779
Cobalt: Ion, Action of Concentrated Hydrobromic and Hydriodic Acids on the, G. Denigès, 250; Oxides and Hydroxides of, G. Natta and A. Reina, 503; Oxides and Hydroxides of, ii., G. Natta and F. Schmid, 719
Cod: in the North Sea, The Distribution of Pelagic Stages of the, in 1924 in Relation to the System of Currents, M. Graham and J. N. Carruthers, with a Section by H. H. Goodchild, 356; -liver Oil, New Observations on the Anti-rickets Factor of, E. Lesné and S. Simon, 107; The Pelagic Young of the, 356
Colleges, The Supply of Literature for Scientific and Technical Departments of, Principal J. F. Hudson, 573
"Colloid: Chemistry," J. Alexander; P. C. L. Thorne, 878; Condenser, A, A. Nodon, 35
Colloidal Solutions, Surface Tension of, Application of the Drop Weight Method to the Determination of the, Prof. W. D. Harkins, 732
Colombia: A Botanical Exploring Expedition to, 744; Pre-hispanic Jewelry in, Dr. P. Rivet, 352
Colorimeter, Eastman Universal, The, 30
Colour: and Chemical Constitution, Part xxii., J. Moir, 467; The Theory of, and its Application to Painting, Prof. A. P. Laurie, 743
Combustion: in the Power Plant: a Coal Burner's Manual, T. A. Marsh. Second printing, 9; under Direct Electrical Discharge, G. I. Finch and L. G. Cowen, 100
Comet: Announcement, Mr. Wilk's, 425; Comas Sola, 745, 782, 854; Grigg-Skjellerup, The, G. Merton, 891; Suspected, 388
Comets, 459, 603, 709, 817
Commission Internationale de l'Éclairage en succession à la Commission Internationale de Photométrie. Sixième session, Genève, Juillet 1924, 333
Commonwealth Fund of New York City, award of fellowships to British graduates, 897
Complex Molecules, On the Rate of Maximum Activation by Collision for the, with Applications to Velocities of Gas Particles, R. H. Fowler and Dr. E. K. Rideal, 861
Complexes in Solution, Applications of the Spectrographic Method to the Study of, P. Job, 214
Compressional Waves in Two Superposed Layers, Dr. H. Jeffreys, 790
Concentration Shoot, The Sound of the, 708, 744
Conchological Society of Great Britain and Ireland, Fiftieth Annual Meeting of the, 601
Conformal Invariants, J. M. Thomas, 215
Coniferales, Branch Falls in the, C. Barnard, 215
Conine, A New Synthesis of, J. Koller, 682
Contact Catalysis: Fourth Report of the Committee on, Dr. H. S. Taylor; Dr. E. K. Rideal, 285
Contacts, Rectifying, H. Pélabon, 610
Continental Metallurgical and Chemical Engineering, No. 2, 536
Continents, The Structure of the, Dr. H. Jeffreys, 443; Prof. A. Holmes, 586; Dr. J. W. Evans, 697
Convoluta, Effects of Silver on, The Activation by Light of the, Mme. Anna Drzewina and G. Bohn, 756
Copepods in the Bay of Biscay, G. P. Farran, 318
Copper: at Low Temperatures, G. J. Alexander, 590; Catalysts produced by Thermal Decomposition, on the Stability of, Dr. F. H. Constable, 790; Catalytically Active, The Structure of, Dr. F. H. Constable, 730; Electrode, Single Potential of the, R. C. McGaffin and E. Newbery, 179; Hydride and its Crystal Structure, H. Muller and A. J. Bradley, 427; Industry, The Primitive, of America. Part 2, G. B. Phillips, 467; -magnesium Alloys, Preliminary Experiments on the, W. T. Cook and W. R. D. Jones, 466; Nickel and their Alloys, The Cementation of, by Tin, L. Guillet, 106; The Earliest Human Knowledge of, Dr. P. E. Spielmann, 411
Corallion Rocks of Oxfordshire, Berkshire, and North Wiltshire, The, W. J. Arkell, 934
Corals and Sediments, M. N. Bramlette, and others, 604
Cornish Geology, Handbook of, E. H. Davison, October 16, Suppt., 24
Corpuscular Light, Interference and, L. de Broglie, 441

CORRESPONDENCE.

Absorption Spectrum: A New Type of, Double Rotational Quantification in Formaldehyde, Prof. V. Henri and S. A. Schou, 225
Administration, Anthropology and, Dr. B. Malinowski, 768
'Allomorphs,' Prof. Labbé's Production of, by the Action of Increased Hydrogen Ion Concentration, R. Gurney, 336; A. G. Lowndes, 551
Alytes, Kammerer's, Prof. E. W. MacBride, 264, 661; Dr. G. K. Noble, 518
Animal Metabolism, Effect of Polarised Radiations on, Prof. S. S. Bhatnagar, B. B. Lal, and K. N. Mathur, 11
Animal Movement, The Rôle of the Cerebellum in the Co-ordination of, Prof. F. R. Miller and Dr. N. B. Laughton, 516
Anion, Hydrogen as, Prof. H. E. Armstrong, 13
Anthropology and Administration, Dr. B. Malinowski, 768
Atomic Number 61: Illinium, The New Element of, Prof. B. Brauner, 84
Atoms, The Synthesis and Disintegration of, as revealed by the Photography of Wilson Cloud Tracks, Prof. W. D. Harkins and H. A. Shadduck, 875
Auroral Spectrum, Luminescence from Solid Nitrogen, and the, Prof. L. Vegard, 801
β-particles ejected by X-rays, The Three-dimensional Reproduction of Tracks of, O. Darbyshire, 371
Biological Processes, Influence of Temperature on, Dr. J. Bělehrádek, 117
Biological Research in the Tropics, Prof. J. S. Dunkerly, 662
Birth-control, Broadcasting, Prof. J. S. Huxley, 771
"Bleeding" of Trees, The, through Injury, J. Parkin, 878
Blood Reactions and Sex, Dr. F. A. E. Crew, 85
Borax, The Volatility and Dissociation of, Prof. H. V. A. Briscoe and P. L. Robinson, 374
British Patent Office, The, E. E. Towler, 517
Butterflies, Migrations of, C. B. Williams, 118
Butterfly Migration, F. Cramer, 191
Camphor, Common, Imperfect Crystallisation of, W. G. Burgess, 116
Capillary Action, External, Sir W. Galloway, 300
Carbon: and Hydrogen, Atomic Volumes of, W. F. Short, 445; Compounds, The Influence of General Electron Displacement on the Reactivity of Conjugated Systems in the Molecules of, Prof. R. Robinson, 627; Dioxide Gas, Refractive Index of, Action of Magnetic Fields on the, Prof. P. N. Ghosh and P. C. Mahanti, 734; Dioxide, The Molecular Spectrum of, J. W. Ellis, 82;

Monoxide Molecule, Energy Levels of the, O. S. Duffendack and G. W. Fox, 12; Dr. R. B. Johnson, 50; Monoxide, The Reduction of, O. C. Elvins and Prof A. W. Nash, 154; The "H and K" Bands of, A. S. Ganesan, 842
Carbonic Oxide, The Reduction of, Prof H. E. Armstrong, 265
Caryophyllene Alcohols, The, and their Occurrence in Nature, Dr. J. M. Robertson, 156
Cephalopoda, Littoral, Light-organs in, G. C. Robson, 554
Ceylon, The Stone Age of, E. J. Wayland, 193
"Chemistry, Colloid", J. Alexander; P. C. L Thorne, 878
Chlorine Gas Filters in Relation to Reaction Velocity, W. Taylor, 697
Chou Kou Tien Discovery, the, Tertiary Man in Asia: Dr. D. Black, 733
Chromosomes in Trivalents and Quadrivalents, The Attractions of the Ends of, Dr. J. Belling, 227
Cirrus at a Lower Level than Alto-cumulus, A. Giao, 49
Clay, The Anomalous Flocculation of, Dr. N. M. Comber, 412; H. B. Oakley, 661
Clubiona interjecta, The Ancestral Third Claw of a Spider: T. H. Savory, 157
Coal, Ordinary, The Crystalline Nature of the Chief Constituent of, C. S. Fox; Dr. Marie C. Stopes, 913
"Colloid Chemistry," J. Alexander; P. C. L. Thorne, 878
Continents, The Structure of the, Dr. H. Jeffreys, 443, Prof. A. Holmes, 586; Dr. J. W. Evans, 697
Copper: at Low Temperatures, G J. Alexander, 590; Copper, Catalytically Active, The Structure of, Dr. F. H. Constable, 730; The Earliest Human Knowledge of, Dr. P. E. Spielmann, 411
Corpuscular Light, Interference and, L. de Broglie, 441
Crookes, Sir William, and Spiritualism, Lord Rayleigh, 843
Crystalline Carbonates, Nitrates, and Sulphates, The Birefringence of, Prof. C. V. Raman, 264
Dwi-Manganese in Native Platinum, O. Zvjaginstsev; M. Korsunski and Prof. N. Seljakow, 262
Dyes, Adsorption of, to Silver Halides, Dr. S. E. Shepherd, 913
Earthquake of August 15, Depth of Origin of the, R. D. Oldham, 302
Egypt, Early: and the Caucasus, Sir Flinders Petrie, 514; Miss G. Caton-Thompson and Miss E. W. Gardner, 624; and the Fayum, Sir Flinders Petrie, 696
Egyptian: History, Sir Flinders Petrie, 157; Shadouf, The, and the Rate of Human Work, H. S. Rowell; P. J. H. Unna, 481
Electric Television, A. A. Campbell Swinton, 590
Electrical Charges from Like Solids, The, Prof. P. E. Shaw, 659
Electricity, The Atomicity of, as a Quantum Theory Law, Dr. O. Klein, 516
Electrolytes: Antagonistic Action of, and Permeability of Membranes, K. C. Sen, 481, The Action of Silica on, Prof. J. N. Mukharjee, 517
Electron: Displacement *versus* Alternate Polarity in Aliphatic Compounds, Prof. G. Berger, 734; Spinning, Kaufmann's Experiment and the, Dr. L. C. Jackson, 263, L. H. Thomas, 374
Electrons: in Helium, Scattering of, E. G. Dymond, 336, in Ionised Gases, Scattering of, Dr. F. M. Penning, 301, Spinning, I I Rabi, 228
Equations, The Imaginary Roots of, Dr. H C. Pocklington, 627, 735
Ether Drift Experiments, Prof Miller's, Prof. H. Thirring, 81
Euphrates, River Terraces of the, Prof W. J. Sollas, 692
Evening Primroses and Mice, The Genetics of, Prof. T. D. A. Cockerell, 914
Fatty Acids, Higher Order X-ray Reflections from, J. A. Prins and Dr. D. Coster, 83
Fayum Lakes, The, G. W. Grabham, 911
Flame Speeds, The Supposed Law of, Prof. W A. Bone, 837
Flea Bites, The Reaction to, Prof. A E Boycott, 591; E. I. Robson, 843; Anaphylaxis and Louse Infestation, Prof. A. D. Peacock, 696
Fluorescence, Activated, and Doppler Effect, F. Rasetti, 47
Fluorine, Arc Spectrum of, The Double Normal State of the, T. L. de Bruin, 804
Fog-Signals from a Distance, Operation of, J. J. Dowling, The Writer of the Article, 265
Formaldehyde, Double Rotational Quantification in, A New Type of Absorption Spectrum: Prof. V Henri and S. A Schou, 225
Formic Acid Vapour, The Absorption Spectrum of, in relation to Molecular Associations, L. Harris, 482
Frog, Abnormal Venous Circulation in a, F W Flattely, 50
Furnaces, High Frequency or Ironless Induction, N. R. Davis and C. R. Burch, 47; F. Adcock, 48
Gaseous-Adsorption, Early History of, Sir Joseph Larmor, 586
Glaciated Ochreous Flint from Cromer, A, J. Reid Moir, 445
Golgi Origin of Fatty Yolk in the Light of Parat's Work, The, Prof Vishwa Nath, 767
Grafting, Pernicious, Dr M Grabham, 85, W. M. Macdonald, 303; R C. Knight and R. G. Hatton, 372; A and Gabrielle L. C. Howard, 373
Grasses, Chromosome Complements in, G. Evans, 841
Groma: The, an Ancient Surveying Instrument, R. W. Sloley, 303
Helium: and Neon in Vacuum Tubes, The Occurrence of, Prof E. C. C. Baly and R. W Riding, 625; Dr R. W. Lawson, 838; Solidification of, Prof. W. H Keesom, 81
Herpetomonas papatasii and *Leishmania tropica*, S. Adler and O. Theodor, 85
High Frequency: and Ironless Induction Furnaces, N. R. Davis and C. R. Burch, 47, F. Adcock, 48; Radiations, Properties of, Prof. J. A. Gray, 801
Hydrogen: as Anion, Prof. H. E. Armstrong, 13; Molecule, Absorption Spectrum of the, Prof J. J. Hopfield and G H. Dieke, 592; Series in the Extreme Ultra-Violet, The Reversal of the, Prof T Lyman, 156; Spectrum, The Secondary, Prof O. W Richardson, 116; Stark Components in, Observed Relative Intensities of, Dr. J. S. Foster and Miss M. Laura Chalk, 592
Illinium, The New Element of Atomic Number 61: Prof. B. Brauner, 84
Illumination, The Distribution of Red Algæ in relation to, Drs. W. R. G Atkins and H. H. Poole, 155
India, Western, Post-Cretaceous Igneous Activity in, Prof K. K. Mathur and V. S. Dubey, 769
Industrial Research Associations, The State and, Dr. W L. Balls, 770
Insect Drift, The Physical Basis of, C. J. P. Cave, 50
Interference and Corpuscular Light, L. de Broglie, 441
Invar, The Anomalous Dilatation of, Prof. F Zernike, 662; Prof. C. Benedicks and P. Sederholm, 842
Invention as a Remedy for Unemployment, W. A. Benton, 731
Iodine Molecule, The Size of the, B. Topley, 802
Jeans, Dr., and the 'Disease' of Life, J. J. Robinson; The Writer of the Notes, 877
Jungfrau, Variation of Penetrating Radiation on the, W Kolhorster and G von Salis, 518
Kammerer, Prof. Paul, Prof. H. Przibram, 555
Kammerer's Alytes, Prof. E. W. MacBride, 264, 661; Dr G. K Noble, 518
Kaufmann's Experiment and the Spinning Electron, Dr. L. C. Jackson, 263; L H. Thomas, 374
Kundt's Tubes, Use of Pith Dust in, Prof R. V. Cook, 157
Labiatæ or Mint Family, The Antiquity of the, Prof. T. D. A. Cockerell, 696
Laue-Photograph taken with a Long Slit, U Yoshida and K. Tanaka, 912
Lead Hydrogen Arsenate as a Mineral, Dr. L J. Spencer, 411
Leguminosæ, 'Hard Seeds' in, A. Nelson, 804
Leishmaniasis, Cutaneous, The Transmission of, to Man from Artificially Infected *Phlebotomus papatasii*, S. Adler and O. Theodor, 692
Life, the 'Disease' of, Dr Jeans and, J. J. Robinson, The Writer of the Notes, 877
Lightning, Dr. N. E. Dorsey, 190, 482; Dr. G. C. Simpson, 191, 482
Lithium, The Spark Spectrum of, S Werner, 154
Liveing's Fire-Damp Indicator, Prof. C. V. Boys, 626; The Writer of the Note, 627, Sir W. Galloway, 735
Liver Extracts in the Treatment of Malignant Disease, J. R. Howitt, 263, A. Piney, 374
Locusts, Migratory, New Facts regarding the Phase of, H B. Johnston, 10

Lumbricus, The Oogenesis of, L. A. Harvey, 803, Prof. J. B. Gatenby, 840
Luminescence from Solid Nitrogen, and the Auroral Spectrum, Prof. L. Vegard, 801
Magnetic Storms: and Wireless Communication, Sir Joseph Larmor, 662, T. L. Eckersley, 803; The Recurrence of, Dr. C. Chree, 335; Dr. H. Deslandres, 621; Dr. C. Chree; A. A. Buss, 769
Malignant Disease, Liver Extracts in the Treatment of, J. R. Howitt, 263; A. Piney, 374
Mammalian Spermatozoa, Preservation of, A. Walton, 265
Mars, The Planet, E. M. Antoniadi, 841
Mas d'Azil, Scientific Neglect of the, H. G. Wells, 228; Abbé Breuil, 265
Mathematical Proof *versus* Observation, Prof. W. H. Hobbs, 915
Medical: Entomology and the Tropical Field Worker, M. E. MacGregor, 338; Science, Apocryphal, Prof. A. Castellani, Dr. G. C. Low, Dr. D. Nabarro, and Sir Ronald Ross, 518
Mercuric Halides: Critical Potentials of the Vapours of, Prof. V. I. Pavlov and A. I. Leipunsky, 843; Optical Excitation of the Vapours of, Dr. A. Terenin, 843
Mercury: Atoms in the 2*P* State, Collisions of the Second Kind with Excited, J. G. Winans, 46, Microstructure of, Dr. W. Rosenhain and A. J. Murphy, 261; The Continuous Spectrum of, Lord Rayleigh, 767; Vapour, Superheated, The Fluorescence of, Dr. H. Niewodniczański, 877
Metallic Crystals, Single, Plastic Deformation of, Dr. F. S. Goucher, 157; W. E. W. Millington and Prof. F. C. Thompson, 409
Miller's, Prof., Ether Drift Experiments, Prof. H. Thirring, 81
Molecules: Electrostatic Moments of, R. J. Clark, 555; The Electrical Polarity of, Prof. C. V. Raman and K. S. Krishnan, 302; The Movements of, Prof. A. Liversidge, 303
Muscular Action, A. Mallock, 46
Natural History of the New Hebrides, J. R. Baker, 119
Naucrates ductor, The Eggs of the Pilot-fish, K. H. Barnard, 228
Nickel, Single Crystals of, Magnetic Properties of, W. Sucksmith and Dr. H. H. Potter, 730
Nitrogen: Absorption Bands in, Dr. H. Sponer, 696; Active, Dr E. B. Ludlam and L. H. Easson, 590; E. J. B. Willey, 735; On the Phosphorescence of, Prof. J. C. McLennan, H. J. C. Ireton, and K. Thompson, 408
Nursehound (*Scyliorhinus stellaris*), A Breeding Ground of the, in the Fal Estuary, Dr. J. H. Orton, 732
O II, The Ionisation Potential of, I. S. Bowen and Prof. R. A. Millikan; Prof. A. Fowler, 410
Observation, Mathematical Proof *versus*, Prof. W. H. Hobbs, 915
Optics and Poetry, Rev. H. C. Browne, 697
Organo-Metallic Compounds, W. H. George, 85
Oxygen Spectral Line $\lambda = 5577{\cdot}35$ Å U., On the, Prof. J. C. McLennan, J. H. McLeod and W. C. McQuarrie, 441
Patagonian *Lusus Naturæ*, Another, G. A. Gardner, 262
Patent: Law and Unemployment, E. Wyndham Hulme, 694, 840; The Writer of the Article, 695, 840; Office, The British, E. E. Towler, 517
Pendulous Jets, The Damping of, Prof. P. Kirkpatrick, 261
Photographic Theory, Prof. R. A. Sampson, 374
Photometry, Modern, A. P. Trotter, L. C. M., 770
Photons, The Conservation of, Prof. G. N. Lewis, 875
Pilot-fish (*Naucrates ductor*), The Eggs of the, K. H. Barnard, 228
Pith Dust in Kundt's Tubes, Use of, Prof. R. V. Cook, 157
Planetismal Hypothesis, The, Prof. E. H. L. Schwarz, 339
Platinum, Native, Dwi-Manganese in, O. Zvjaginstsev; M. Korsunski and Prof N. Seljakow, 262
Poetry, Optics and, Rev H. C. Browne, 697
Polishing of Surfaces, The, J. M. Macaulay, 339
Post-Cretaceous Igneous Activity in Western India, Prof. K. K. Mathur and V. S. Dubey, 769
Potatoes, Internal Rust Spot of, W. A. Millard, 804
Prehistory in France, The Canadian School of, Dr. H. M. Ami, 626
Press, Science and the, Dr. W. M. Cumming, 842
Protoplasmic Viscosity as determined by a Temperature Coefficient of Biological Reactions, Dr. J. Belehradék, 478
Psychical: Phenomena and their Interpretation, Prof. C. Richet, 876; Research, Science and, A. A. Campbell Swinton, 299, 442, 553, 659, 692; Dr. R. J. Tillyard, 300, 370, 553, 587, 735, Dr. J. P. Lotsy, 370; Sir Arthur Conan Doyle, 370, 553, 659, 694; Sir Bryan Donkin, 480, 658; E. J. Dingwall, 480; H. Price, 553, W. W. L., 588, 693, Dr. J. Weir French, 589; Sir Oliver Lodge, 622
'Pwdre Ser' (The Rot of the Stars), Dr H. A. Baylis, 552
Pyramid, Great, Surveys of the, F. S. Richards, Sir Flinders Petrie, 226
Quantum: Mechanics: and the Magnetic Moment of Atoms, Prof. E. Fermi, 876; New, Magnetic Susceptibilities and Dielectric Constants in the, Dr. J. H. Van Vleck, 226; Theory and Intensity Distribution in Continuous Spectra, Dr. J. R. Oppenheimer, 771
Radiation: On the Law of, Prof. G. Gianfranceschi, 302; Penetrating, on the Jungfrau, Variation of, W. Kolhorster and G. von Salis, 518; Supplementary Note on, Sir Oliver Lodge, 81
Radioactive Minerals, Ages of, Calculation of the, Prof. A. Holmes and Dr. R. W. Lawson, 478
Rainfall Interception by Plants, J. Phillips, 837; Lt.-Col. E. Gold, 915
Reaction Velocity, Chlorine Gas Filters in relation to, W. Taylor, 697
Red Algæ in relation to Illumination, The Distribution of, Drs. W. R. G. Atkins and H. H. Poole, 155
'Red Rain' at Bordighera, Italy, Prof. G. H. Bryan, 697
Relativity, Rotation and, A. Jaques and J. S. Morgan, 194
Research Work, The Classification of, Dr. W. L. Balls, 298
River Terraces of the Euphrates, Prof. W. J. Sollas, 692
Romani, Welsh, Dr. J. Sampson; Prof. R. L. Turner, 657
Rotation and Relativity, A. Jaques and J. S. Morgan, 194
Schroedinger's Quantum Theory and the Stark Effect, Dr. P. E. Epstein, 444
Science and Psychical Research, A. A. Campbell Swinton, 299; Dr. R. J. Tillyard, 300; Dr. J. P. Lotsy, 370; Dr. R. J. Tillyard, 370, 553, 587, Sir Arthur Conan Doyle, 370, 553; A. A. Campbell Swinton, 442, 553; Sir Bryan Donkin, 480; E. J. Dingwall, 480, H. Price, 553; W. W. L., 588, 693, Dr. J. Weir French, 589; Sir Oliver Lodge, 622; Sir Bryan Donkin, 658; A. A. Campbell Swinton, 659, 692; Sir Arthur Conan Doyle, 659, J. Reid Moir, 694; Dr R. J. Tillyard, 735
Science and the Press, Dr. W. M. Cumming, 842
Scientific Journals, The Disposal of, B. M. Headicar, 10
Scolopendra, Origin of Yolk in the Eggs of, Prof. Vishwa Nath and Tasdique Husain, 660
Scyliorhinus stellaris, A Breeding Ground of the Nursehound, in the Fal Estuary, Dr. J. H. Orton, 732
Seasonal Sunshine in Great Britain, L. C. W. Bonacina, 194
Selenium Cells, The Sensitivity of, Prof. A. O. Rankine, 13
Series Spectra of the First Long Period, Dr. R. J. Lang, 119
Sex, Blood Reactions and, Dr. F. A. E. Crew, 85
Shadouf, The Egyptian, and the Rate of Human Work, H. S. Rowell; P. J. H. Unna, 481
Silica, The Action of, on Electrolytes, Prof. J. N. Mukherjee, 517; Dr. A. F. Joseph, 878
Silicic Acid Gel, Behaviour of, during the Drying-up Process, K. Krishnamurti, 843
Silicon Tetrachloride, The Absolute Density and Coefficient of Expansion of, P. L. Robinson and H. C. Smith, 303
Silver Halides, Adsorption of Dyes to, Dr. S. E. Shepherd, 913
Simia, *S. satyrus*, and *Pithecus*, The Zoological Names, and their Possible Suppression, Dr. C. W. Stiles, 49; O. Thomas and M. A. C. Hinton, 411
Sitona hispidula, The Inheritance of Brachypterous and Macropterous Wings in, Dorothy J. Jackson, 192
Skylight, Intensity and Polarisation of, at Sunrise and Sunset, Dr. K. R. Ramanathan, 337
Solar Prominences, Persistent, A. A. Buss, 412
Spatial: Relations in a Dream, Dr. J. H. Kenneth, 194; and Time Relations in Dreams, M. E. J. Gheury de Bray, 372; A. E. Bostwick, 627

Species: Variability of, Dr. R. A. Fisher and E. B. Ford, 515; Origin of, The Problem of the, as it appeared to Darwin in 1859 and as it appears to us To-day, Prof. H. F Osborn, 591
Spectra of Metals of the Second Group, Explanation of the, Prof. Meghnad Saha, 695
Spiritualism, Sir William Crookes and, Lord Rayleigh, 843
Spraying Crops from Aeroplanes, G. F. Wilson, 412
Square Roots, Accurate, Prof. F. Schlesinger, 338
Stark Effect, Schroedinger's Quantum Theory and the, Dr. P. E. Epstein, 444
Stars: Companion, Names for, Prof. F. Schlesinger, 49; The Constitution of the, Prof. K. Grant, 373
State, The, and Industrial Research Associations, Dr. W. L. Balls, 770
Stimuli in Plants, Transmission of, Prof. N. G. Ball, 589
Sucker-fish, The Eggs of the, H. C. Delsman, 805
Sulphur, Lengthened Chain Compounds of, Dr. G. N. Bennett, 555
Superposed Fluids, The Oscillations of, Prof. H. Lamb, 915
Surface Tension: of Colloidal Solutions, Application of the Drop Weight Method to the Determination of the, Prof. W. D. Harkins, 732; The Drop-weight Method of Measuring, T. Iredale, 48
Tar, Low-Temperature, Complex Aromatic Hydrocarbons in, Prof. G. T. Morgan and D. D. Pratt, 805
Technical and Intellectual Values, A. E. Evans, 119
Television or Teleoptics? Sir Herbert Maxwell, 194
Tertiary Man in Asia: the Chou Kou Tien Discovery, Dr. D. Black, 733
Thermionic Emission, Equation for, P. Freedman, 193
Transmutation Experiments, M. W. Garrett, 84
Undulatory Mechanics, The Symmetrical Top in the, R. de L. Kronig and I. I. Rabi, 805
Unemployment, Patent Law and, E. Wyndham Hulme, 694, 840, The Writer of the Article, 695, 840
Vegetable Marrow, Sterility in the, Miss Eleonora Armitage, 592; J. Parkin, 697
Wave-Theory of Matter and Electro-Magnetism, A Possible Connexion between the, H. Bateman, 839
Welsh Romani, Dr. J. Sampson; Prof. R. L. Turner, 657, 805
Wild Hybrid Swarms, The Naming of, Dr. L. Cockayne and H. H. Allan, 623
Wireless: Communication: Magnetic Storms and, Sir Joseph Larmor, 662, T. L. Eckersley, 803; Transmission, The Kerr Effect in, Prof. E. V. Appleton, 514; Waves: Curved Path of, A. Mallock, 443; Polarisation of, J. Hollingworth, 409
Wool, Spirals and Waves in, Prof. J. E. Duerden, 153
X-ray: Reflections, Higher Order, from Fatty Acids, J. A. Prins and Dr. D. Coster, 83; Region and the Extreme Ultra-Violet, Spectrographic Junction between the, Dr. A Dauvillier, 551; R. Thoræus, 771
X-rays:—Internal Absorption and 'Spark' Lines, Dr. H. Robinson, 224; Distribution of Intensity in the Spectrum of, Dr. D. Skobeltzyn, 553
Yolk in the Eggs of Scolopendra, Origin of, Prof. Vishwa Nath and Tasdique Husain, 660
Zinc, The Spectrum of, D. M. Smith, 592
Zoological Nomenclature: Hubner's (1806) 'Tentamen,' Dr. C. W. Stiles, 591; International Code of, Dr. F. A. Bather, 412; Suspension of *Sarcoptes*, type *passerinus*, in favour of *Sarcoptes*, type *scabiei*, 339

Cosmical: Creation of Matter, Dr. A. Haas, 319; Physics, Recent Developments of, Dr. J. H. Jeans, December 4, Suppt., 29
Cottages, Ancient, The Preservation of, Sir Frank Baines, 60
Cotton: and Food, Dr. W. L. Balls, 616; and its Production, W. H. Johnson, 765; -growing: Countries, The, Present and Potential: Production, Trade, Consumption, 616; in the Sudan, Soil Problems in, 98; Industry, Possible Developments in the, Dr. W. L. Balls, 456; Recent Industrial Research in, Dr. F. P. Slater, 786
Crelles Journal fur die reine und angewandte Mathematik, Centenary of, 889
Cretaceous: Mammal Skulls from Mongolia, Dr. W. K. Greogry and G. G. Simpson, 698; Plant-bearing Rocks of Western Greenland, The, Prof. A. C. Seward, 808
Crinoids, Fossil, Unusual Forms of, F. Springer, 27
Crookes, Sir William, and Spiritualism, Lord Rayleigh, 843
Crop and Stock Improvement, A. B. Bruce and Dr. H. Hunter, 910
Crustacea: Experiments and Observations on, Part vii., J. Tait, 177; of the Plankton in Lough Derg and the River Shannon, The Seasonal Distribution of the, R. Southern and A. C. Gardiner, 391
Cryptotoxins, The General Properties of the, in particular of Tetanus Cryptotoxin, H. Vincent, 71
Crystalline: Carbonates, Nitrates, and Sulphates, The Birefringence of, Prof. C. V. Raman, 264; Compounds, The Absorption of X-rays in, R. J. Havighurst, 574
Crystallisation: Heats of, W. E. Garner, F. C. Madden, and J. E. Rushbrooke, 712; of Common Things, The Imperfect, Sir William Bragg, 120
Crystallised Violet, Action of, on the Cardio-vascular Apparatus of the Dog, A. Alivisatos and F. Mercier, 214
Crystals: Copper, Large, Experiments on the Production of, Prof. H. C. H. Carpenter and S. Tamura, 717; Gold, Silver, and Copper, Large, Tensile Tests of, C. F. Elam, 717; Iron, The Distortion of, Prof. G. I. Taylor and C. F. Elam, 717; Twinned Metallic, The Formation of, Prof. H. C. H. Carpenter and S. Tamura, 717; Single Metallic, Plastic Deformation of, F. S. Goucher, 157; W. E. W. Millington and Prof. F. C. Thompson, 409; Wave-length and the Photo-electric Behaviour of, B. Gudden and R. Pohl, 283
Cultivated Area and Population, The Relation between, Sir Daniel Hall, 304
Cupric Bromide, Action of Hydrobromic Acid and of the Alkaline Bromides in Acetic Acid Solution on, G. Denigès, 394
Current Meter: A Novel, J. N. Carruthers, 318; for Deep Water, A, Prof. V. W. Ekman, 354
Cyanogen: Bromide, Electrical Conductivity of, G. Glockler, 893; The more Refrangible Band System of, as developed in Active Nitrogen, Dr. W. Jevons, 33
Cyclohexene, Some New Reactions of the Oxide of, P. Bedos, 681
Cyclone, The Tropical, E. V. Newnham, 524
Cyclones over Ceylon, A. J. Bamford, 390
Czech Academy of Sciences and Arts, Prague, Almanack for 1924, 464

Daily Express, Science Articles in the, 706
Dairy Cattle: Selection, Feeding and Management, Prof. W. W. Yapp and Prof. W. B. Nevens, 765
Dalton Hall, Manchester, Jubilee Dinner of, 104
Darmstaedter, Prof. Dr. phil. Dr. jur. h.c. Ludwig, Prof. H. E. Armstrong, 690
Datura, Pollen Abortion in Chromosomal Types of, A. F. Blakeslee and J. L. Cartledge, 143

DEATHS.

Adami (Dr. J. G.), 347, 453
Akeley (C.), 849
Bell (Miss Gertrude Lowthian), 92, 165
Bles (Dr. E. J.), 90
Bremer (Dr. W.), 921
Bucknill (Sir John), 636
Busk (Sir Edward), 704
Caird (Prof. F. M.), 740
Carman (Dr. R. D.), 347
Charleton (A. G.), 92
Clarke (Dr. R. H.), 201
Coffin (C. A.), 347
Cole (Prof. F. N.), 20
Cresson (E. T.), 165
Currie (L. D.), 921
Dreyer (Dr. J. L. E.), 454
Eberth (Prof. C. J.), 921
Eliot (Dr. C. W.), 313, 346
Eucken (Prof. R.), 490
Exner (Dr. F.), 921
Fawcett (W.), 276, 347

Finn (Dr. D. E.), 313
Fletcher (J. J.), 20
Franks (W. Temple), 92
Frouin (A.), 201
Gamble (Prof. F. W.), 455, 490
Gilchrist (Prof. J. D. F.), 636, 776
Glen (F. Harrison), 92, 165
Gnehm (Prof. R.), 276
Goold (J.), 849
Gutbier (Prof. A.), 636
Hall-Ewdards (Dr. J. F.), 276, 313
Hedley (C.), 811
Hussey (Prof. W. J.), 672, 740
Kammerer (Dr. P.), 490, 635
Keartland (G. A.), 165
Kemp (Prof. J. F.), 921
Lamplugh (G. W.), 562, 634
Lang (Sir Peter Scott), 92, 164
Lee (Dr. W. T.), 347
Lennox (R. N.), 704
Lewis (G.), 636
Lintner (Prof. C. J.), 20
Lyman (Dr. G. R.), 92
Marshall (Major W. E.), 562
Molinari (Prof. E.), 849
Morice (Rev. F. D.), 562
Mummery (J. H.), 454
Naville (Prof. E.), 636, 703
Newbold (Prof. W. R.), 740
Nipher (Prof. F. E.), 740
Page (H. W.), 562
Pfaff (Dr. F.), 740
Phillips (Prof. R. W.), 849
Ridgeway (Sir William), 275
Roebling (W. A.), 636
Rowe (Dr. A. W.), 455, 561
Shepardson (Prof. G. D.), 165
Skinner (Dr. H.), 20
Smith (O.), 636
Smith (Prof. S. Irving), 20
Smock (Prof. J. C.), 165
von Soxhlet (Prof. F.), 20
Spegazzini (Prof. C.), 704
Stebbing (Rev. T. R. R.), 92, 201
Steklov (Prof. P. V. A.), 91
Tilden (Sir William), 890
Turner (C.), 636
Viger (A.), 201
Waldo (Prof. C. A.), 740
Warner (Dr. F.), 704
Whelpley (Dr. H. M.), 165
Withycombe (Dr. C. L.), 921
Woodruff (F. M.), 347

Deccan Village Life in the Eighteenth Century, S. M. Edwardes, 243
Decrementless Conduction, The further Studies on, Prof. G. Kato, 476
De-Differentiation, Studies in, Prof. J. S. Huxley, 206
Delphinus Delphis, Oils extracted from the Head of, H. Marcelet, 107
Denbighshire Moors, Eastern Part of the, The Geology of the, Prof. P. G. H. Boswell, 69
Depressions, The Travel of, Lieut.-Col. E. Gold, 63
Descartes' "Géométrie," 400
Detonation: Dopes and, Prof. H. L. Callendar, R. O. King, and C. J. Sims, 753; Temperatures in Closed Vessel Explosions, R. W. Fenning, 245
Dewar Vessels, the Efficiency of, The Effects of Variations in the Radiation Factor on, B. Lambert and K. T. Hartley, 34
Dextro-rotatory Tartaric Acid, Rotatory and Refractive Dispersion of Aqueous Solutions of, Maria Lingia Pagliarulo, 682
Diabetes, Nickel, Cobalt and, G. Bertrand and M. Mâchebœuf, 394
Dialogues in Limbo, G. Santayana, 188
Diamagnetic Gases, E. Zeher; G. W. Hammar, 712
Diamonds near Port Nolloth, An Occurrence of, W. A. Humphrey, 179
Didinga Witchcraft, J. H. Driberg, 710
Diethylamine, Triethylamine and, 461
Diffraction Gratings, A New Method for Measuring Microscopic and Ultramicroscopic Distances by Means of, G. de Mottoni, 432
Digestion and Gastric Disease, Modern Views on, Prof. H. MacLean, 439
3-5-Dimethylpyrazole-4-Diazonium Chloride, The Velocity of Formation of, Prof. J. Reilly and Miss H. E. Bastible, 142
Diphtheria Bacillus, The, and Related Organisms, 832
Direction Finding by Radio, Dr. Smith-Rose, 100
Discovery Expedition, The, Dr. S. Kemp, 628; Work of the Marine Station at Grytviken, N. A. Mackintosh, 629; A New Method of Plankton Research, A. C. Hardy, 630
Disease, The Fight against, July, 351
Diuris from Barrington Tops, N.S.W., New Species of, Rev. H. M. R. Rupp, 719
Domestic Refrigeration, 234
Dominion Astrophysical Observatory, The, Victoria, B.C., 925
Dopes and Detonation, Prof. H. L. Callendar, R. O. King, and C. J. Sims, 753
Doppler's Principle and the Ballistic Hypothesis of Light, O. M. Corbino and T. Levita-Civita, 432
Double: Bonds, Conjugated, The Catalytic Hydrogenation of, G. Vavon and Jakes, 394; Salts in Solution, Determination of some, by the Boiling Point Method, E. Rouyer, 250
Doublets of Stripped Atoms, of the Potassium Type, R. C. Gibbs and H. E. White, 396
Drawing Instruments, W. H. Harling, 208
Dreams, Spatial and Time Relations in, Dr. J. H. Kenneth, 194; M. E. J. Gheury de Bray, 372; A. E. Bostock, 627
Drosophila: for Laboratory purposes, Cultivation of, Prof. R. Pearl, 282; *melanogaster*, Crossing-over in the First Chromosome of, An Effect of Temperature and Age on, C. Stern, 575
Drugs: and Perfumes, The Chemistry of, 113; The Chemistry of, N. Evers, 113
Drying Oils: and Antioxygens, The Rapid Oxidation of, F. Taradoire, 611; The Chemistry of, Dr. R. S. Morrell and H. R. Wood, 79
Duddell medal of the Physical Society, award of the, to F. Twyman, 922
Durham University: Dr. A. Holmes made professor of geology, 68; Philosophical Society, election of officers, 781
Dust in Mines, P. S. Hay, 244
Dutch: East Indies, Insect Fauna of the, Dr. J. H. S. Stekhoven, jr., 673; New Guinea, The Dutch-American Expedition to, 850; Pendulum Observations in the Atlantic and the Pacific, Dr. J. J. A. Muller, 930
Dwi-Manganese in Native Platinum, O. Zvjaginstsev, 262; M. Korsunski and Prof. N. Seljakow, 263
Dynamics of a Particle and of Rigid Bodies, Solutions of the Examples in a Treatise on, Prof. S. S. Loney, 656
Dynamometer, Use of the, in Soil Cultivation Studies, Dr. Keen, 96

Eagle, The Golden, Seton Gordon, 377
Earth: the Composition of the, The Compressibilities of Dunite and of Basalt Glass and their Bearing on, L. H. Adams and R. E. Gibson, 143; The Age of the, Sir Frederick Chapman, 461; the Interior of the, Constitution of, Dr. H. Jeffreys, 131
Earthquake: An, in England and Wales, 277; British, of August 15, 314; in Armenia, 639; in Jersey and other places, 204; in the Azores, 387; in the Eastern Mediterranean, 24; of August 15, Depth of Origin of the, R. D. Oldham, 302; On the West Coast of Sumatra, 93
Earthquakes: in France, E. Rothé, 784; Observed in Central France in 1925, J. Lacoste, 35; Origin of, The Depth of, R. D. Oldham, 27; Recent, 58; The Periodicity of, 5
Earth-shakes in the Rand, 889

Earth's: Atmosphere: The Uppermost Regions of the, being the Halley Lecture delivered on May 5, 1926, Dr. G M. B. Dobson, 221; Rate of Rotation, Changes in the, Prof. E. W. Brown, 170; Rotation, The Uniformity of the, M. Bigourdan, 425
Earthworms, Luminescence in, G. E. Gates, 171
East: African Research, 433; London College, a New Research Laboratory for Physical and Inorganic Chemistry opened, 923; Calendar of the, 501
Eastman Universal Colorimeter, The, 30
Echo-Sounding Apparatus, Development in the use of, 846
Eclipse, The Total: Solar, of January 14, 1926, C. R. Davidson and others, 751; of June 29, 1927, 854
Eclipses, Ancient, C Schoch's Researches on, 566
Eclipsing Variables, The Reflection Effect in, Prof. A. S. Eddington, 170
Ecuador, the Upper Eocene Deposits of the Coast of, Foraminifera from, T. W. Vaughan, 575
Edinburgh: Royal Botanic Garden, a memorial tablet to Sir Isaac Bayley Balfour unveiled, 501; Royal Infirmary, the New X-ray Department of the, 639; University: conferment of doctorates, award of the Cameron prize to Dr. H. H. Dale, 176; Address to new graduates by Prof. J. H. Ashworth, 240, Animal Breeding, gift by Lord Woolavington for a chair of, 601; inaugural address of Prof. E. Shearer, 609, Dr. D. Bain appointed lecturer in technical chemistry; J. E. Gordon appointed lecturer in the Department of Agriculture, 680; Prof. Baldwin Brown appointed Munro lecturer; J. A. V. Butler appointed a lecturer in the Department of Chemistry, 788
Education: Labour Policy in, 871, Science and Mr. H. G. Wells, Prof. H. E. Armstrong, 723
Educational: Settlement Association, Report for 1925–26, 824; Training for Oversea Life, 253
Egypt: Ancient, Royal Costume and Race in, Miss M. A. Murray, 206; Early: and the Caucasus, Sir Flinders Petrie; Miss Gardiner and Miss Caton-Thompson, 463, Sir Flinders Petrie, 514, Miss G. Caton-Thompson and Miss E. W. Gardner, 624; and the Fayum, Sir Flinders Petrie, 696; Physical Department of the Ministry of Public Works, Annual Report, 1923–24, Dr. H. E. Hurst, 279
Egyptian: Antiquities from Southern Russia, M. Matthieu, 855; Cosmetic, an Ancient, A. C. Chapman and H. J Plenderleith, 857; History, Sir Flinders Petrie, 157; Shadouf: The Rate of Work done with an, Drs. J. S. Haldane and Y. Henderson, 308; The, and the Rate of Human Work, H. S. Rowell, P. J. H. Unna, 481
Eka-Cæsium, O. Hahn and O. Erbacher, 534
Elastic Co-actions, Experimental Investigations on, Colonnetti, 323
Elasticity and Plasticity, Prof. E. G. Coker, 743
Electric: Carrier in Copper, The Inertia of the, R. C. Tolman and M. Mott-Smith, 785; Discharge through Helium, Dr. T. Takamine, 857; Field, The Mechanics of the, Sir J. J. Thomson, 342; Light, Standardisation in the Design of Systems for Distributing, J. Beard and T. Haldane, 708; Power Station at Töging, 601; Television, A. A. Campbell Swinton, 590; Waves and their Propagation, Sir Ernest Rutherford, 809
Electrical: Charges from Like Solids, The, Prof. P. E. Shaw, 659; Energy, Exchange of, between Countries, 527; Engineers, Institution of, election of officers, 169; Senatore G. Marconi elected an honorary member of the, 708; Field of the Atmosphere up to a Height of 20,000 Metres, Records of the, P. Idrac, 214, Industry in Great Britain, the present day position of, Dr. W. H. Eccles, 637; Technology: a Textbook for the following Examinations, National Certificate, City and Guilds, A.M.I.E.E., B.Sc. Engineering, H. Cotton. Part 1, 691; Underground Network in Paris, The 60,000-volt, Col. E. Mercier, 923
Electricity: Bill, The, 759; Supply: in Ireland, The Future of, Kettle, 742, Position and Prospects of, Sir John Snell, August 7, Suppt., 17; The Atomicity of, as a Quantum Theory Law, Dr. O. Klein, 516
Electrolytes: Antagonistic Action of, and Permeability of Membranes, K. C. Sen, 481; The Action of Silica on, Prof. J. N. Mukherjee, 517; Dr. A. F. Joseph, 878
Electro: -endosmosis and Electrolytic Water Transport, H. C. Hepburn, 934; -medical Apparatus, List of, Newton and Wright, Ltd., 925; -motive Force in a Photo-active Cell containing a Fluorescent Electrolyte, The Location of the, C. C. Murdock, 575
Electromagnetic Waves, Detection of, by Metallic Contacts, H. Pelabon, 214
Electrometers and Photo-electric Cells, List of, Cambridge Instrument Co., Ltd., 643
Electron: Emission Energy with Oxide Cathodes, H. Rothe, 64; Spinning: Kaufmann's Experiment and the, L. H. Thomas, 374; The Electromagnetic Mass and Momentum of a, G. Breit, 396; The Jolly, Sir R. A. S. Paget, 885
Electronic Structure and Band-spectrum Structure in Diatomic Molecules, Systematic Relations between, iii., Dr. R. S. Mulliken, 143
Electrons: in Ionised Gases, Scattering of, Dr. F. M. Penning, 301; in Mercury Vapour, The Mean Free Path of, L. R. Maxwell, 575; Photo-electric Emission and Thermionic Emission of, The Temperature relations of, E. H. Hall, 574; Spinning, I. I. Rabi, 228
Electrostatic Machines, The Current-voltage Characteristics of, when supplying Current to Non-inductive loads and to a Coolidge X-ray Tube, E. J. Evans, 70
Element 61, J. A. Harris and B. S. Hopkins, 319
Elephant, The Anatomy of the, Dr. N. B. Eales, 282
Embryonic Tissues Growing *in vivo* and *in vitro*, The Differentiation of, ii., T. S. P. Strangeways and Honor B. Fell, 35
Emergence of New Qualities, Philosophy of, Prof. G. C. Field, 582
Emotion and Insanity, Dr. S. Thalbitzer. Translated by M. G. Beard, 405
Empire: Air Transport, speeches on, 668; *Cotton Growing Review*, The, July, 529
Emu, Kidney Fat of the, The Fixed Oil of the, F. R. Morrison, 467
Endamœba histolytica, Nuclear Division in the Trophozoites of, C. Uribe, 143
Endemic Flora, An, F. Lewis, 604
Energy, The Loss of, in Metal Plates of Finite Thickness, due to Eddy Currents produced by Alternating Magnetic Fields, Prof. E. W. Marchant and J. L. Miller, 34
Engineer Officers of the Royal Navy, The Status of, 126
Engineering and the Chemical Industry, Sir Max Muspratt, 166
Engineers, The Training of, Sir Theodore Morison, 742
English Provincial Universities: Demand and Supply, 556
Entamœba histolytica, Nuclear Division in, Prof. C. A. Kofoid and Dr. O. Swezy, 926
Entomology, Economic, The Progress of, with special reference to Australia and New Zealand, Dr. R. J. Tillyard, 888
Enzyme: Activity, The supposed Regeneration of, Prof. I. Novi, 712; Investigation, Technique in, R. Willstatter, 785
'Eotvos' Torsion Balance, The, 406
Equations, The Imaginary Roots of, Dr. H. C. Pocklington, 627, 735
Erdbeben. Die Frage der Periodizitat der: eine Darstellung des gegenwartigen Standes der einschlagigen Untersuchungen, Prof E. Tams, 5
Erde und Weltall, Prof S. Arrhenius, Aus dem Schwedischen ubersetzt von Dr. Finkelstein, 656
Erythrite, A New, C. Prévost, 358
Eskimo: Culture in Alaska, An Early, D. Jenness, 710; Engravings on Walrus Ivory, L. Giraux, 604
Essex an Outline Scientific Survey; including Geology, Botany, and Zoology, by Members of the Essex Field Club and others. Edited by G. E. Hutchings, 188
Ether Drift Experiments, Prof. Miller's, Prof. H. Thirring, 81
Ethnographical Specimens in Great Britain, Plea for the Preservation of, Lord Onslow, 94
Ethylene Derivatives, The Stereochemistry of the, J. A. Le Bel, 899
Eucalypts: belonging chiefly to the Ash Group, The Wood Structure of certain, M. B. Welch, 611; Cultivated, The Essential Oils from some, A. R. Penfold, 287

Eugenic Reform, The Need for, Major L. Darwin, 39
Eugenics: and Human Heredity in South Africa, Studies in, 101; Some Factors in, together with Notes in some South African Cases, Prof. H. B. Fantham, 101
Euphrates, River Terraces of the, Prof. W. J. Sollas, 692
European: Civilisation, African Natives and, 289; The Dawn of, V. Gordon Childe, 401; Culture, The Origin of, 401
Evans Collection at Oxford, The Lewis, Recent Additions, 160
Evening Primroses and Mice, The Genetics of, Prof. T. D. A. Cockerell, 914
Evolution: Prof. J. Graham Kerr, 329; and Religion in Education: Polemics of the Fundamentalist Controversy of 1922 to 1926, Prof. H. F. Osborn, 652; Modern Aspects of, Prof. H. F. Osborn, 617; Selected Articles on, Compiled by Edith M. Phelps, 543; The Gist of, Prof. H. H. Newman, 543
Evolutionary Physiology, 361
Exakten Naturwissenschaften, Ergebnisse der, Herausgegeben von der Schriftleitung der *Naturwissenschaften*. Funfter Band, 729
Exhibition of 1851, appointments to studentships and scholarships, 104
Expansion at Low Temperatures, Coefficients of, R. M. Buffington and W. M. Latimer, 748
Experimentalphysik, Handbuch der, Herausgegeben von W. Wien and F. Harms. Band 1, 909
Exploration, Adventures of. Book 5: Australia and New Zealand, Sir John Scott Keltie and S. C. Gilmour, 910
Explosifs, poudres, gaz de combat: leçons professées à la Faculté des Sciences de Lille, Prof. P. Pascal, 150
Explosions: Audibility of, and the Constitution of the Upper Atmosphere, F. W. J. Whipple, 309; in Gaseous Media, Dr. Garner, and others, 29
Explosive: Flames, Projection of, M. J. Burgess, 569; Wave, Influence of the Pressure on the Formation of the, P. Dumanois and P. Laffitte, 394
Explosives: in Mines Research Committee, Prof. J. F. Thorpe appointed chairman of the, and F. E. Smith a member of the committee, 241; Velocity of Detonation for, E. Jones, 134

Factories and Workshops Report for 1925, The, 780
Falkenbergia Doubletii, Existence of Free Iodine in, E. Chemin and R. Legendre, 899
Falmouth, Climatology of, J. B. Phillips, 390
Family 'Trinity,' The, Prof. Radcliffe-Brown, 496
Faraday, Michael, a portrait of, to be presented to the Institution of Electrical Engineers, 781
Fatty Acids, Higher Order X-ray Reflections from, J. A. Prins and Dr. D. Coster, 83
Fauna of British India, including Ceylon and Burma, The, edited by Sir Arthur E. Shipley. Birds. Vol. 3. Second edition, E. C. Stuart Baker, 45; edited by Sir Arthur E. Shipley, assisted by Dr. H. Scott, Coleoptera: Chrysomelidæ (Chrysomelinæ and Halticinæ), S. Maulik, October 16, Suppt., 23
Faurea McNaughtonii Phill. ("Terblanz"), its Ecology and Distribution, J. Phillips, 934
Fayum Lakes, The, G. W. Grabham, 911
Feeding in Infancy and Childhood, Modern Methods of, D. Paterson and J. F. Smith, 439
Female Oestral Hormone in the Female Organs of the Vegetable Kingdom, Detection and Determination of, S. Loewe and E. Spohr, 899
Fermentation, Influence of certain Colloids upon, Part 3, R. Greig-Smith, 251
Fern Prothalli, Abnormal, Miss E. Schindler, 710
Ferric Hydroxide Sol and the Lyotrope Series, W. W. Taylor, 71
Ferro-nickels, Reversible, The Course of the Isothermo Representing the Resistance and Thermo-electric Power of the, in the Interval −200° C. to 1000° C., Chevenard, 107
Fever, Recurrent, transmitted both by Ornithodnus and by Lice, C. Nicolle and C. Anderson, 142
Field: Crops, Yield, and Position of, J. S. Cole and A. L. Hallsted, 282; Museum of Natural History, Report for 1925, 530
Fierasfer, The Inquiline Fish, at Key West, Florida, G. H. Parker, 396
Films, Thin, Properties of, Sir William B. Hardy, 700
Finlay's Comet, S. Hasunuma, 97, 242
Finsbury Technical College, The Passing of, 122
Fire, Outbreaks of, A Practical Treatise on, S. G. Gamble, 728
Fireball: Another Detonating, W. F. Denning, 566; on August 13, W. F. Denning, 388
Fireballs, Abundance of, W. F. Denning, 495
Fire-damp Detector, Electric Lamp, C. S. W. Grice and A. G. Guilliford, 497
First Order Triangulation, Rev. C. V. Hodgson, 458
Fish: Oxygen Requirements of, J. A. Gardner, 98; Passes, W. L. Calderwood, 710; Stocking in America, C. W. Creaser, 62
Fisheries: around Greenland and Iceland, 318, Investigations in Denmark, Dr. Petersen and Dr. Blegvad, 282
Fishes, A Remarkable Suborder of, 774
Fishing: from the Earliest Times, W. Radcliffe. Second edition, 907; The History of, 907
Fison Memorial Lecture, 1926, Very Rev. W. R. Inge, 109
Flame Speeds, The Supposed Law of, Prof. W. A. Bone, 837
Flea Bites, The Reaction to: Prof. A. E. Boycott, 591; E. I. Robson, 843; Anaphylaxis and Louse Infestation, Prof. A. D. Peacock, 696
Fleece Characters, Inheritance of, F. Roberts, 783
Fleurs de la Côte d'Azur (De Toulon à Menton), Les, L. Marret, 9
Floral Organs, The Fall of, I. Namikawa, 784
Florida, The Hurricane in, 458
Flow Past a Rotating Cylinder, Relf and Lavender, 819
Fluids: Plane Flow of, Study of the, A. Toussaint and E. Carafoli, 35; Superposed, The Oscillations of, Prof. H. Lamb, 915
Fluorescence, Activated, and Doppler Effect, F. Rasetti, 47
Fluorescent Bodies, The Radio-chemistry of, Mlle. Choucroun, 395
Fluorine: Arc Spectrum of, The Double Normal State of the, T. L. de Bruin, 804; (F1), The Spectrum of, Prof. H. Dingle, 862
'Flying Shadows': The Cause of, E. Perucca, 35; The Theory of, G. Horn-D' Arturo, 142
Focus, the Best Position of, The Criterion for, T. Smith, 35
Fog-Signals: Operation of, from a Distance, J. J. Dowling; The Writer of the Note, 265; Unattended, at or near the Sea, 58
Folk Dances as a Survival of Primitive Ritual, Miss Violet Alford, 824
Food: its Composition and Preparation: a Textbook for Classes in Household Science, Mary T. Dowd and Jean D. Jameson. Second edition, 909; Supply and Population, Sir Daniel Hall, August 7, Suppt., 20
Foods: The Chemical Analysis of, a Practical Treatise on the Examination of Foodstuffs and the Detection of Adulterants, Dr. H. E. Cox, 115
Forest: in Relation to Humus, Dr. W. H. Pearsall, 642; Phase in Britain, The Last, O. G. S. Crawford, 206
Forestry: Commissioners, Sixth Annual Report of the, 385; Congress, The World's, 30, in the British Empire, The Practice of, Prof. E. P. Stebbing, 145; The Rôle of the University in the Practice of, Prof. A. W. Borthwick, 202; within the British Empire, The Imperial Conference and, 777
Formaldehyde: Double Rotational Quantification in, A New Type of Absorption Spectrum: Prof. V. Henri and S. A. Schou, 225; The Examination of Fish for, A. R. Tankard and D. J. T. Bagnall, 610; Vapour of, The Ultra-violet Absorption Spectrum of the, Prof. V. Henri and S. A. Schou, 214
Formic Acid Vapour, The Absorption Spectrum of, in Relation to Molecular Associations, L. Harris, 482
Forrest, James, Lecture, Senator Marconi, 669
Forthcoming Books of Science, 570
Fossil: Apes and Man, Dr. D. Black, 746; Insects, Hunting, Prof. T. D. A. Cockerell, 781; Leaf-beds in Victoria, F. Chapman, 711; Men of the Denise, The, L. Mayet, 395
Fourier Integral of Finite Type, The Summation of a, S. Pollard, 790

Fowl, Domestic, Fertility in the, Dr. F. A. E. Crew, 282
Fowls: Sex Chromosomes in, Factors of the, Serebrovsky and Wassina, 819; Sex-linked Inheritance in, Prof. Punnett, 819
Fox Indians, Reservation of the, Tama, Iowa, Expedition to the, Dr. T. Michelson, 95, 132
France, The New Map of, Col. G. Perrier, 461
Franks, Physical Characters of the, H. V. Vallois, 281
Fraunhofer, Joseph, and the Development of Optical Instruments, M. von Rohr, 141
Fritz, John, gold medal, award of the, to E. A. Sperry, 744
Frog, Abnormal Venous Circulation in a, F. W. Flattely, 50
Frogs, etc., frozen into Solid Ice, The Vitality of, J. T. Cusworth; E. G. Boulenger, 457
Fuel: Research, 645; Research Board, Pamphlet No. 6, 130; Technology, Institution of, election of officers, 204; Utilisation, 905
Fuels: and their Combustion, Prof. R. T. Haslam and Prof. R. P. Russell, 905; The Economic Use of, appointment of a Committee on, 314
Fumigation with Hydrocyanic Acid, B. J. Smit and T. J. Naude, 534
Function and Design, Prof. J. B. Leathes, August 7, Suppt., 18, 519
Fungal Symbiosis, Prof. F. Morini, 710
Fungi, 532
Future, The Making of the: The Coal Crisis and the Future: a Study of Social Disorders and their Treatment, Prof. P. Abercrombie, and others, 9

γ-pipeconylidene-methylethylketone, Some Derivatives of, Prof. H. Ryan, J. Keane, and B. A. O'Donoghue, 177
γ-Rays, Distribution of Intensity in the Spectrum of, Dr. D. Skobeltzyn, 553
Gang Age, The, a Study of the Preadolescent Boy and his Recreational Needs, Dr. P. H. Furfey, 257
Gas: A New Representation of a, S. Drzewiecki, 862; Cylinders, Heat Treatment of, 712
Gaseous: Adsorption, Early History of, Sir Joseph Larmor, 586; Media, Explosions in, Dr. Garner and others, 29
Gases: Ignition of, N. S. Walls and Prof. R. V. Wheeler, 461; Temperatures, Pressures, and Densities of, Relations between the, 169; The Burning of, in Nitrous Oxide, Prof. H. B. Dixon and W. F. Higgins, 862
Gear, a Novel, 927
Gels, Velocities of Diffusion in, M. Watanabé, 748
Geminid Meteoric Shower, The, W. F. Denning, 854
Gene, The Theory of the, Prof. T. H. Morgan; Prof. R. C. Punnett, 435
Genetica, Bibliographia. Onder redactie van Dr. J. P. Lotsy en Dr. H. N. Kooiman. Deel 1. 766
Genetics, Animal Breeding and, 464
Geographical Exploration, Dr. D. G. Hogarth, 23
Geography: in School, J. Fairgrieve, 45; and Town Planning, 505
Geological: Congress at Madrid, The International, 284; Society, election of a foreign member and of foreign associates, 96; Survey: in Great Britain, The Progress of, 211; Scotland, Memoirs of the, The Economic Geology of the Central Coalfield of Scotland. Area 5: Glasgow East, Coatbridge, and Airdrie; with Chryston, Glenboig, Greengairs, Slamannan, Caldercruix, and Salsburgh, Dr. C. T. Clough and others. Second edition, 656; Time, Dr. A. Holmes, 27
Geologisch dargestellt, Die Kriegsschauplatze 1914–18. In 13 Heften. Herausgegeben von Prof. J. Wilser. Heft 2 (zu Heft 1 gehorig): Lothringen. Von Prof. E. Kraus. Mit einem Beitrag (Abschnitt Jura) von Dr. W. Klupfel. Heft 3: Zwischen Maas und Mosel. Von Prof. R. Lais. Heft 13: Sudostmazedonien und Kleinasien. Von Prof. O. H. Erdmannsdoerffer, Prof. C. Lebling, Prof. K. Leuchs, Dr. K. Oswald, Dr. A. Wurm, 152
Geology: Historical, An Introduction to, with special reference to North America, Prof. W. J. Miller. Second edition, 189
Geometrical Analysis, A Course of, Dr. H. Bagchi, 766
Geometry: Analytic, Prof. Maria M. Roberts and Prof. Julia T. Colpitts. Second edition, October 16, Suppt., 28; Fourfold, being the Elementary Geometry of the Four-Dimensional World, D. B. Mair, 368; of René Descartes, The, translated from the French and Latin by D. E. Smith and M. L. Latham. With a facsimile of the first edition, 1637, 400; Practical, based on the various Geometry Books by Godfrey and Siddons, A. W. Siddons and R. T. Hughes, October 16, Suppt., 28; Theoretical, based on the various Geometry Books by Godfrey and Siddons, A. W. Siddons and R. T. Hughes, October 16, Suppt., 28
Geophysical Papers, The Publication of, 780
Geophysik, angewandten, Methoden der, Dr. R. Ambronn, 620
Geotropic Curvature, The Mechanism of, F. Tondera, 673
German: Dye Trust, The, 348; Scientific and Medical Association, Handbook of the Düsseldorf Assembly of the, 456; University Students, Statistics of, 1914 and 1925, 249
Germany, Universities of, Guide-book to the, 357
Ghost Dance Religion among the Pomo of California, The, E. M. Loeb, 818
Giacobini's Comet and the Meteoric Display of October 9, W. F. Denning, 709
Gibbs, Willard, gold medal for 1926, Prof. J. J. Abel. awarded the, 890
Gibraltar Skull, The Recently Discovered, Miss D. A. E. Garrod, 320
Glacial Anticyclones, The: the Poles of the Atmospheric Circulation, Prof. W. H. Hobbs, 111
Glaciated Ochreous Flint from Cromer, A, J. Reid Moir, 445
Glasgow: Royal Technical College, Calendar of, 465; University, conferment of doctorates, 31
Glass: Annealing, Dr. J. W. French, 681; Effects of Thermal Treatment on, as shown by Precise Viscometry, V. H. Stott, D. Turner, and H. A. Sloman, 34; in Early Ages, Sir Flinders Petrie, 178; -making in Ancient Egypt, J. H. Gardiner, 389; Opal, J. W. Ryde, 178
Glasses: at High Temperatures, The Electrical Conductivity of, F. F. S. Bryson, 178; Commercial, The Expansion of, M. Samsoen, 106; Soda-lime, The Influence of Moisture on the Rate of Melting and on the Properties of, Edith M. Firth, F. W. Hodkin, M. Parkin, and Prof. W. E. S. Turner, 178; The Physical Properties of, Prof. W. E. S. Turner, 569
Glozel: Archæological Discoveries at, Prof. S. Reinach; Prof. G. Elliot Smith, 600; The Neolithic Layer of, C. Depéret, 755
Glucosamine, The Rotatory Power of Organic Bodies as a Function of the *p*H: E. Vellinger, 214
Glucoside, A New, Hydrolysable by Rhamno-diastase, extracted from the Fresh Flowers of *Ulex europæus*, M. Bridel and C. Béguin, 250
Gmelin's Handbuch der anorganischen Chemie, 853
Gobi Desert: American Museum Expeditions in the, 1922–25, Methods and Results of the, Prof. H. F. Osborn, 198; Discoveries in the, by the American Museum Expeditions, Prof. H. F. Osborn, 418
God and Evolution, Rev. Dr. W. R. Matthews, 543
Gold: Arc Spectrum of, On the Structure of the, Prof. J. C. McLennan and A. B. McLay, 33; Das kolloide in Biologie und Medizin: die Goldsolreaktion in Liquor Cerebrospinalis, Dr. E. Joel, 77; Prof. R. Zsigmondy und P. A. Thiessen, 77; in Sea-water, Prof. F. Haber, 23
Golden Eagle, The, Seton Gordon, 377
Goldfish Culture for Amateurs: How to breed and rear Goldfish in Aquaria and Ponds, A. E. Hodge and A. Derham, October 16, Suppt., 23
Golgi Origin of Fatty Yolk, The, in the Light of Parat's Work, Prof. V. Nath, 767
Gordonia, S. W., The River System of, S. H. Haughton, 251
Government Chemist, Report of the, 491
Grabau medal, founded by C. Y. Wang, awarded to Prof. A. W. Grabau, 130
Grafting, Pernicious, Dr. M. Grabham, 85; W. M. Macdonald, 303; R. C. Knight and R. G. Hatton, 372; Albert and Gabrielle L. C. Howard, 373
Grapes, The Growth of, P. R. v. d. R. Copeman, 935
Grasses, Chromosome Complements in, G. Evans, 841
Gravity Determinations at Sea, Dr. F. A. V. Meinesz, 497
Great Britain: Bird Protection in, Dr. J. Ritchie, 73; Seasonal Sunshine in, L. C. W. Bonacina, 194

Great Rift Valley, The, Dr. F. Dixey, 389
Greece, Ancient, at Work: an Economic History of Greece from the Homeric Period to the Roman Conquest, Prof. G. Glotz. Translated by M. R. Dobie, 79
Greenland: Expedition of the University of Michigan to, Report of the, 707; The Cretaceous Plants of, 808
Groma, The: an Ancient Surveying Instrument, R. W. Sloley, 303
Ground Photo-surveying in India, 641
Grubb, Sir Howard, Parsons and Company, The Optical Works of, 340
Gunter, Rev. Edmund, three hundredth anniversary of the death of, 813
Gustatory Sensory Reflex, The, F. Allen and others, 246
Gypsies of Wales: The Dialect of the, being the Older Form of British Romani preserved in the Speech of the Clan of Abram Wood, Dr. J. Sampson, 291
Gypsy Marriage in England, T. W. Thompson, 673

Haddock and Biology, H. Thompson, 783
Hæmochromogen, The Chemical Nature of, and its Carbon Monoxide Compound, R. Hill, 790
Hæmoglobin, Prof. J. Barcroft, 285
Halides of Tin and Titanium with Organic Bases, Additive Compounds of, II., G. Scagliarini and M. Monti, 682
Halley Lecture, The, Dr. G. M. B. Dobson, 221
Hannover, Technische Hochschule, Prof. G. von Hevesy invited to the professorship of physical chemistry at the, 715
Harmonic Constants, Prediction of Tide and Current, and their Description by Means of these Constants, Investigation of, Rear-Admiral Phaff, October 16, Suppt., 25
Harrison, B., a memorial tablet to, 94
Harrison Memorial prize, The, awarded to Dr. C. R. Harington, 924
Haslemere Educational Museum, The, 357
Hauptlinien der Linienspektra, Tabelle der, aller Elemente nach Wellenlange geordnet, Prof. H. Kayser, 509
Haut Chagres, Panama, The Stratigraphic Horizon of the Beds containing *Lepidocyclina chaperi* on, T. W. Vaughan, 575
Hawaiian Volcano Plants, I. H. Burkill, 69
Hawksley, Thomas, lecture, The, Prof. E. G. Coker, 743
Health of the Army, 1924, Report on the, 95
Helium: and Neon in Vacuum Tubes, The Occurrence of, Prof. E. C. C. Baly and R. W. Riding, 625; Dr. R. W. Lawson, 838; Hydrogen into: reported Transformation of, Profs. Paneth and Peters, 455, 526; in Natural Gases of Japan, Y. Kano and B. Yamaguti, 64; Scattering of Electrons in, E. G. Dymond, 336; Stars, Radial Velocities of 368, E. B. Frost, S. B. Barrett, and O. Struve, 143; The Curve of Fusion of, Prof. W. H. Keesom, 359; The Solidification of, Prof. W. H. Keesom, 58, 81, 600
Helmholtz's Treatise on Physiological Optics, translated from the third German edition. Edited by Prof. J. P. C. Southall. Vol. 3: The Perceptions of Vision, 74
Helwan, The Climate of, L. J. Sutton, 133
Hepatic Glycogen in Fasting Animals treated with Insulin, Behaviour of the, S. Visco, 719
Heredity in Man: Its Importance both Biologically and Educationally, Prof. H. B. Fantham, 101
Heron-Allen and Earland Collection of Foraminifera, The, presented to the British Museum (Natural History) by E. Heron-Allen, 924
Herpetomonas papatasii and *Leishmania tropica*, Identity of, S. Adler and O. Theodor, 85
Herring: and Plankton, R. E. Savage, 353; Mackerel and Plankton, A. C. Hardy, 281
Herrings along the Baltic Coast of Sweden, C. Hessle, 321
Hessian Fly, a Parasite of the, Studies on, C. C. Hill, 207
High: Altitudes, Acclimatisation to, Dr. J. S. Haldane, 702; Compressions, The Possibility of Realising, without Antidetonants, P. Dumanois, 106; Frequency: or Ironless Induction Furnaces, N. R. Davis and C. R. Burch; F. Adcock, 48; Radiations, Properties of, Prof. J. A. Gray, 801; Voltage Laboratories, A. P. M. Fleming, 167
*p*H intérieur cellulaire, Le, Dr. P. Reiss, 836
History: and Evolution, F. S. Marvin, 187; Theory of, Prof. F. J. Taggart, 187; The Outline of, a Plain History of Life and Mankind, H. G. Wells. New edition, fully revised. Parts 1-24, 872; The Twilight of, Dr. D. G. Hogarth, 529
Hofmeister: Wilhelm, the Work and Life of a Nineteenth-Century Botanist, Prof. K. von Goebel, with Biographical Supplement by Frau Prof. Ganzenmuller, translated by H. M. Bower, and edited botanically by Prof. F. O. Bower, 473
Hokkaido Eruption, The, 60
Hormones, The Commercial Production of, 174
Horse, The Evolution of the, Prof. F. B. Loomis, 873
Host-parasite Specificity, Prof. R. W. Hegner, 784
Huddersfield Technical College, H. Lowery appointed head of the physics department, 788; W. M. Wilcox, appointed head of the electrical engineering department, 789
Hull: Catalogue of Exhibits of Shipping and Fisheries at, T. Sheppard, 316; University College, appointment of Prof. A. E. Morgan as principal, 68
Human: Body, The, Dr Marie Carmichael Stopes, 115; Embryo, Early Development of, Profs. G. W. Bartelmez and H. M. Evans, 317; Life, Biology and, Prof. J. S. Huxley, 844; Race, The Pedigree of the, Prof. H. H. Wilder, 260
Hungarian Bronze Age, The, Dr. L. Zoltai, 281
Hunter and Driffield memorial lecture, The, Prof. C. Fabry, 128
Hydra, Localisation of Formative Agencies in, H. W. Rand, J. F. Bovard, and D. E. Minnich, 682
Hydration of Ions, On the Free Energy of, T. J. Webb, 575
Hydrion Concentration and Photographic Emulsions, S. O. Rawling and J. W. Glassett, 893, 927
Hydroaromatic Alcohols, The Etherification of the, J. B. Senderens and J. Aboulenc, 898
Hydrocarbons, The Heats of Combustion of some, D. P. Konovalov, 250
Hydrogen: A Photo-ionisation Experiment with, F. L. Mohler, 575; as Anion, Prof. H. E. Armstrong, 13; Atom, Radiating, Effects of an Electric Field upon the, K. L. Hertel, 396; Carbon and, Atomic Volumes of, W. F. Short, 445; into Helium, Reported Transformation of, Profs. Paneth and Peters, 455, 526; Molecule, Absorption Spectrum of the, Prof. J. J. Hopfield and G. H. Dieke, 592; Occluded, The Effect of, on the Tensile Strength of Iron, L. B. Pfeil, 34; Series in the Extreme Ultra-violet, The Reversal of the, Prof. T. Lyman, 56; Spectrum, The Secondary: Prof. O. W. Richardson, 116; Structure in the, v., Prof. O. W. Richardson, 861; Stark Components in, Observed Relative Intensities of, Dr. J. S. Foster and Miss M. Laura Chalk, 592; Sulphide in the Black Sea Waters, The Source of, Prof. B. L. Issatchenko, 26; The Action of, on Hot Solid Copper, C. S. Smith and C. R. Hayward, 466; The reported Conversion of, into Helium, Prof. H. S. Taylor, 852; The Secondary Spectrum of, and the Occurrence of H_3+, H. D. Smyth and C. J. Brasefield, 396
Hydroids of the *Valdivia* Expedition, Prof. E. Stechow, 926
Hydrology and Ground Water: a Practical Text-book for the Use of Civil Engineers, Surveyors, Students, and all those who deal with the Control of Water, J. M. Lacey, 440
Hygiene: and Tropical Medicine, The London School of, 383; A Manual of, Sir William H. Hamer and Dr. C. W. Hutt, 799
Hygrometer employing Glycerine, A, Dr. E. Griffiths and J. H. Awbery, 825
Hypnotics, A New Class of, A. Lumière and F. Perrin, 718
Hypophysis Cerebri in Man, Development of the, with a Note upon its Structure in the Human Adult, D. Waterston, 826

Ice Ages, Recent and Ancient, Prof. A. P. Coleman; C. E. P. Brooks, 293; -bergs, The Detection of, 750; -domes and the Atmosphere, Dr. G. C. Simpson, 111
Ignition, Protection against, by Perforated Plates, Wheeler and Grice, 100

Illegitimacy and Racial Invasions in Britain, Dr. J. Brownlee, 746
Illinium : Isolation of, P. Rolla and L. Fernandes, 820 ; The New Element of Atomic Number 61 : Prof. B. Brauner, 84
Illuminating Engineering, Progress of, 671
Illumination : in relation to Plant Distribution, Photo-electric measurements of, Part 1, Drs W .R. G. Atkins and H. H. Poole, 141 ; Research, 60 ; J. W. T. Walsh, and others, 102 ; The Distribution of Red Algæ in relation to, Drs. W. R. G. Atkins and H. H. Poole, 155
Immigrant Children at Ellis Island, A Psychological Study of, Dr. Bertha M. Boody, 406
Immunochemical Studies, edited by Prof. C. H. Browning, 910
Imperial : Cancer Research Fund, Report of the, 815 ; Chemical Industries, Ltd., Registration of, 852 , College of Tropical Agriculture, The, 741 ; Conference : Address at the, Mr. Amery, 637 ; Research and the, 793 ; Research Sub-Committee, Speeches at the, 668 ; Institute, opening of the reorganised public exhibition galleries of the, 529 ; Social Hygiene Congress, Wembley, October 1925, Proceedings of the, 762
Inanition and Malnutrition, The Effects of, upon Growth and Structure, Prof. C. M. Jackson, 152
Inbreeding, A. D. Buchanan Smith, 856
Incandescent Lamps, Rating, Dr. N. R. Campbell and C. G. Eden, 820
Index Kewensis Plantarum Phanerogamarum. Supplementum Sextum, October 16, Suppt., 22
India : Cold Weather Rains in, Sir Gilbert T. Walker, 172 ; Government of, Report of the Educational Commissioner for 1924–25, 933 ; Irrigation in, 568 ; Peasant and Pundit in, 472 ; Rainfall forecast for August and September, 493 ; scheme for a co-operative colony of middle-class home-crofters, 286 ; Southern : Archæan Rocks of, Dr. W. F. Smeeth, 533 ; Vital Statistics of, Major A. J. H. Russell, 352 , Survey of, General Report and Report on Map Publication and Office Work for 1924–25, 816 , Western, Post Cretaceous Igneous Activity in, Prof. K. K. Mathur and V. S. Dubey, 769
Indian : Clan in Wales, An, Prof. R. L. Turner, 291 ; Geology, A Bibliography of, Part IV. Palæontological Index, T. H. D. LaTouche, 334 ; Origins, H. B. Hannah, 642 ; Science Congress, Sir Jagadis C. Bose elected President of the, 60 , Witchcraft and Primitive forms of Belief, 255
Indus Valley, Mr. Mackay to work on the sites in the, 708
Industrial : Fatigue Research Board, acceptance by Lord D'Abernon of the, 890 ; Research : Associations, the State and, J. W. Williamson, 676 ; Dr. W. L. Balls, 770 ; The Administration of, Dr. E. R. Weidlein, 57
Industry, The Facts of, Lord Astor, and others, 166
Infant Welfare, Relative Value of Factors influencing, Miss Ethel M. Elderton, 98
Infinite Series, An Introduction to the Theory of, Dr. T. J. I'a. Bromwich. Second edition, revised with the assistance of Dr. T. M. MacRobert, 112
Inheritance as an Economic Factor, Sir Josiah Stamp, August 7, Suppt , 17
Insect : Drift, The Physical Basis of, C. J. P. Cave, 50 ; Pests of Farm and Garden Crops, Leaflets on, 204
Insecticides : Fungicides and Weed Killers, Dr. E Boucart. Translated from the French and adapted to British Standards and Practice. Second English edition, revised and enlarged by T. R. Burton October 16, Suppt., 24 ; New and Little-known, F. Tattersfield, C. T. Gimingham, and H. M. Morris, 642
Insects, Intestinal Secretion of, O. Shinodo, 460
Insulin, The Influence of Nickel and Cobalt on the Action produced by Insulin in the Rabbit, G. Bertrand and M Mâcheboeuf, 178
Intelligence : and Family History, Miss Grace Allen, 389 ; How we Judge, An Investigation into the Value of an Interview as the Means of Estimating General Intelligence, Dr E. H. Magson, 687 ; Judging, R. J. Bartlett, 687
Interfaces, Physical Phenomena and Molecular Orientation at, 607
Interference and Corpuscular Light, L. de Broglie, 441
Interferogram, The Analysis of an, R. Kinglake, 754
Intermediates, Prof. J. F. Thorpe, 689 , for Dyestuffs, A. Davidson, 689
Internal Combustion Engines, Importance of the combustion yield in, P. Dumanois, 718
International : Agreements affecting Port Sanitary Work, Sir George Buchanan, 537 ; Congress of Psychology, 606 ; Longitude-Determinations, Dr. J. Jackson, 891 , Ornithological Congress at Copenhagen, The, 247 ; Physiological Congress in Stockholm, The twelfth, 499 ; Research Council, Invitation to Germany, Austria, Hungary, and Bulgaria to join the, 21 ; Scholarships for the Advancement of the Sciences, Madame Curie, 888
Interpolation Theory, on the Cardinal Function of, W. L. Ferrar, 178
Intestinal Protozoa, Prof. R. W. Hegner, 855
Invar : Steel Balance Beams, J. J. Manley, 674 ; The Anomalous Dilatation of, Prof. F. Zernike, 662 ; Prof. C. Benedicks and P Sederholm, 842
Invention as a Remedy for Unemployment, 397 ; W. A. Benton, 731
Iodine . Molecule, The Size of the, B. Topley, 802 ; The Absorption of, by Precipitated Magnesia, A. Hamy, 358
Ionisation : in Reacting Gases, A. K. Brewer, 682 , Potential and the Periodic System, Rolla and Piccardi, 820
Ions in Air, The Mobility of, Part iii., Prof. A. M. Tyndall and L. R. Phillips, 33
Ireland : Early, The Historical Geography of, W. Fitzgerald, 334 ; National University of, Calendar, 357
Irish : Limnology, 391 ; Sea, Hydrography of the, R. J. Daniel, 353
Iron : Amalgam, The Electrolytic Potential of, J. Heyrovský and B. Souček, 358 ; and Steel, Stainless, J. H. G. Monypenny, 3 ; in Minerals and Rocks, Colours due to, G. R. MacCarthy, 208 ; Single Crystals of, Magnetic Properties of, E. B. Wedmore, 14.
Islamique, Le monde, M. Meyerhof, October 16, Suppt., 21
'Island Universes,' The Problem of, Dr. Hubble, 388
Isle of Wight, Alien Plants in the, J. F Rayner, 567
Isomers, Two, The Absorption in the Ultra-violet of, A. Kirrmann and H. Volkringer, 142
Isomorphous Double Tartrates, The Anomalous Optical Properties of Some New Series of, H. E. Buckley, 105
Isostasy, The Nature of, Dr. H. Jeffreys, 461
Isotherms of Hydrogen, of Nitrogen and of Hydrogen-nitrogen mixtures at 0° and 20° C. up to a pressure of 200 atmospheres, T. T. H. Verschoyle, 34
Italian Patented Inventions, The Printing *in extenso* of, 166

Jan Mayen : The Rocks of, Dr. G. W. Tyrrell, 674 ; Island, visit of Mr. Rasmussen to, 239
Japan : Permo-Carboniferous Fauna of, Y. Ozawa, 856 ; Tertiary Fossils from, Prof. M. Yokoyama, 389
Japanese · Botany, 604 ; Extinct Mammals, Prof. Matsumoto, 353 , Frogs and Toads, Nematodes from, K. Morishita, 892 ; Physical Anthropology of the, A. Matsumura, 426
Jeans, Dr., and the 'Disease' of Life, J. J. Robinson ; The writer of the notes, 877
Jefferies, Richard, a memorial to, at Swindon, 422
Jefferson and Cruft Laboratories of Harvard University, Contributions from the. Vol. 17, 279
Jenkinson, Francis, Fellow of Trinity College, Cambridge, and University Librarian · a Memoir, H F. Stewart, 476
Jerusalem, Department of Antiquities at, resignation of the directorship of the, by Prof. Garstang, 814
Junior Institution of Engineers, Sir Robert B. Dixon elected president of the, 24
Jupiter : Changes recently observed on the Planet, E. M. Antoniadi, 394 ; Four Large Satellites of, Interferometric Measurements on the, M. Maggini, 719
Jupiter's Satellites, Mutual Eclipses of, B. M. Peek, 170
Jurassic Chronology (iii.), S. S. Buckman, 825

Kalahari, The, or Thirstland Redemption, Prof. Schwarz, 423
Kalkfrage, Bodenreaktion und Pflanzenwachstum, Dr. O. Arrhenius, 584

Kammerer's Alytes. Prof. E. W. MacBride, 264, 661; Dr. G. K. Noble, 209, 518; Dr. H. Przibram, 210
Kaolin, The Action of Heat on the Superficial Properties of, R. Dubrisay, 862
Kapok, 532
Kashmir, The Vegetation of, S. K. Mukerji, 70
Kaufmann's Experiment and the Spinning Electron, L. H. Thomas, 374
Kedah, Antiquities from, I. H. N. Evans, 460
Kelvin: Lecture, The Seventeenth, Sir J. J. Thomson, 342; medal, presentation of the, to the Hon. Sir Charles Parsons, 678
Kent's Cavern, Torquay, Excavations in, 391
Kew, Royal Botanic Gardens, Postcards of the, 494
Kilauea Volcano, Subsidence of, 208
King's Birthday Honours List, 57
Kish, Mesopotamia, The 'A' Cemetery at, E. Mackay, 532
Kopff's Periodic Comet, 131
Korea, Tertiary Molluscan Fossils from, J. Makiyama, 426
Kosmischen Physik, Probleme der, Herausgegeben von Prof. C. Jensen und Prof. A. Schwassmann. Band 7: Der Massenaustausch in freier Luft und verwandte Erscheinungen, Prof. W. Schmidt, October 16, Suppt., 26
Kronecker's Relation, Generalisation of, among the Minors of a Symmetric Determinant, Helen Barton, 215
Krypton: and Xenon in Atmospheric Air, The Determination of, C. Moureu and A. Lepape, 359; and of Xenon in the Atmosphere, Proportions of, C. Moureu and A. Lepape, 318
K Series of the Light Elements, Spectrometry of the, Holweck, 250
Kundt's Tubes, Use of Pith Dust in, Prof. R. V. Cook, 157

Labiatæ or Mint Family, The Antiquity of the, Prof. T. D. A. Cockerell, 696
Labour Policy in Education, 871
Lactic Acid in Muscle, The Formation of, Prof. Meyerhof; Prof. A. Harden, 895
Lake: The, as a Microcosm, Prof. S. A. Forbes, 204; Water, The Organic Content of, E. A. Birge and C. Juday, 575, 818
Lakes, Great, The Decreasing Level of the 493
Lamellibranchs, The Digestive Diverticula in, Dr. C. M. Yonge, 855
Larix and Pseudotsuga, The Ovule of, J. Doyle, 70
Laue-Photograph taken with a Long Slit, U. Yoshida and K. Tanaka, 912
Lava, Block, and Ropy Lava, O. H. Emerson, 533
Lead: Accumulators, Products formed during the Working of, L. Mazza, 682; and other Metallic Impurities in Marine Crustaceans and Shellfish, On the Presence of, A. Chaston Chapman and H. Linden, 610, -antimony, Lead-tin, and Lead-antimony-tin Alloys, The Tempering of, L. Guillet, 106; Electrolytic, The Thermal Study of, A. Travers and Houot, 395; Hydrogen Arsenate as a Mineral, Dr. L. J. Spencer, 411
League of Nations': International Committee on Intellectual Co-operation: Session of the, 248; Eighth Plenary Session of the, 798; Recommendations concerning the Instruction of Children and Young People, 322
Leeds: Clean Air for, 212; University: appointment of A. E. Ingham as reader in Mathematical Analysis, and of L. R. Johnson as assistant lecturer in Agricultural Zoology, 176; E. L. E. Wheatcroft appointed professor of Electrical Engineering, 538; the title of Emeritus Professor conferred on Prof. A. G. Perkin, 646; Dr. Georgina M. Duthie and G. A. Collinson appointed Cancer Research Fellows, 788; J. S. Young appointed lecturer in Experimental Pathology and assistant director of Cancer Research; H. J. Channon appointed Biochemist in the Department of Experimental Pathology, 788; resignation of the chair of Surgery by Sir Berkeley Moynihan, 932
Leguminosæ, 'Hard Seeds' in, A. Nelson, 804
Leicester, Leicestershire, and Rutland University College, The, 680
Leishmania tropica, Herpetomonas papatasii and, Identity of, S. Adler and O. Theodor, 85
Leishmaniasis, The Transmission of Cutaneous, to Man from Artificially Infected *Phlebotomus papatasii*, S. Adler and O. Theodor, 692
Lepidoptera: Phalænæ of the Subfamily Noctuinæ (Noctuidæ) in the British Museum (Natural History), Descriptions of New Genera and Species of, Sir George F. Hampson, October 16, Suppt., 24; The Biology of, Dr. A. D. Imms, 43
Lepidopteran Fauna of Polar Europe, Asiatic and American Elements in the, Prof. N. I. Kuznecov, 98
Leptospermum lanigerum, Smith, The Essential Oils of. Part 1, A. R. Penfold, 324
Life: and Mind, Dr. B. Hollander, 778; Continuity of, The Physiology of the, Prof. D. Noel Paton, 902; Mind and Spirit: being the Second Course of the Gifford Lectures delivered in the University of St. Andrews in the Year 1923 under the General Title of "Emergent Evolution," Prof C. Lloyd Morgan, 582
Light: in Elementary Optical Images, The Distribution of, Dr. L. C. Martin, 35; On the Nature of, R. C. Tolman and S. Smith, 143; Quanta, The Path of, in an Interference Field, G. N. Lewis, 396, Quantum, Polarised, On a, J. M. Whittaker, 71; The Aberration of, and the Theory of Relativity, G. Wataghin, 935; Transmitted and Reflected by a Pile of Plates, On the, T. Smith, 141; Penetration of, into the Sea, Dr. W. R. G. Atkins, 244
Lighting: Hours, Beveredge, 564; Public, in Scottish Boroughs, Colquhoon, 564
Lightning: Dr. N. E. Dorsey, 190; Dr. G. C. Simpson, 191, 482; Progressive, Prof. C. V. Boys, 749; The Spectrum of, J. Dufay, 71
Liliaceæ, The Embryogeny of, R. Souèges, 359
Line Spectra, The Analysis of, Prof. A. Fowler, August 7, Suppt., 15, 593
Linen Industry Research Association, Dr W. H. Gibson appointed director of research for the, 130
Lipase, The Nature of the Co-enzyme of, L. P. Bosman, 502
Liquids and Gases: Photochemical Reactions in, a General Discussion held by the Faraday Society, October 1925, October 16, Suppt., 26
Lister: Institute of Preventive Medicine, Report of the, 248, medal of the Royal College of Surgeons of England, award of the, to Prof. A. F. von Eiselsberg, 96
Lithium: The Spark Spectrum of, S. Werner, 154; Vapour, The Resonance of, A. Bogros, 358
Liveing's Fire-Damp Indicator, Prof. C. V. Boys, 626; The writer of the note, 627; Sir W. Galloway, 735
Liver Extracts in the Treatment of Malignant Disease, J. R. Hewitt, 263; A. Piney, 374
Liverpool University: Bequest by S. Turner, 538; Dr. W. S. Patton appointed Dutton professor of entomology; and Prof. H. J. W. Hetherington, Vice-chancellor, 860
Lobostemon (Lehm.), the Genus, M. R. Levyns, 934
Lobster Fisheries, The Control of, 244
Lockyer, Norman: Lecture, Prof. J. S. Huxley, 844; Observatory, Report of the, 495
Locusts, Migratory, New Facts regarding the Phases of, H. B. Johnston, 10
London: Mathematical Society, election of officers, 781; School of Economics and Political Science, Programme of the, 501; School of Hygiene and Tropical Medicine, The foundation stone of the, laid by N. Chamberlain, 92; University: appointment of Commissioners; Sir William Beveridge elected Vice-chancellor; W. C. Clinton appointed professor of Electrical Engineering at University College; P. A. Buxton appointed reader in Medical Entomology at the London School of Hygiene and Tropical Medicine, 31; conferment upon T. E. Wallis of the title of reader of Pharmacology; resignation of Prof. A. J. Clark and Dr. G. V. Anrep; M. Greenwood appointed professor of Epidemiology and Vital Statistics at the London School of Hygiene and Tropical Medicine, 32; Prof. W. W. C. Topley appointed professor of Bacteriology and Immunology at the London School of Hygiene and Tropical Medicine, 32; Reconstitution of the, T. Ll. Humberstone, 37; award of a Post-graduate Travelling Studentship to Miss C. L. T. Lucas, 68; appointment of E. B.

Verney to the chair of Pharmacology at University College; and S. J. Davies to the readership in Mechanical Engineering at King's College; the title of Emeritus Professor conferred on Prof. J. A. Fleming, 176; award of the Rogers prize to Dr R. Coope; and the university studentship in Physiology to E. T. Conybeare, 213; conferment of doctorates, 248; proposed purchase of part of the Bloomsbury site, Dr. P. Stocks appointed reader in Medical Statistics at University College; Dr. C. H. Lobban appointed reader in Civil Engineering at King's College; Dr. H. T. Flint appointed reader in Physics at King's College, 646; conferment of doctorates, 715, 788, of, Bill, second reading of the, 789; gifts to, by J. G. Wilson, Lady Godlee, and P. Gow, 932; conferment of doctorates; Dr. P. Hartley awarded the William Julius Mickle Fellowship, 933
Long-Chain Compounds, X-ray Examination of, M. Trillat, 568
Longitude, Measurements of, A World-wide Scheme for, C. Lallemand, 862
Longstaff medal of the Chemical Society, The, awarded to Prof. R. Robinson, 924
Loughborough College, Calendar of, 286
Louisiana Mound Builders, Dr. J. W. Fewkes, 171
Lower Carboniferous (Avonian) Rocks of England and Wales, The, Prof. S. H. Reynolds, August 7, Suppt., 15
Low Temperature Carbonisation, Salermo, Ltd., 569
Lubaantun, British Honduras, Excavations at, 669
Ludwig-Sorel Phenomenon in Alloys, The, M. Ballay, 718
Lunacy, Royal Commission on, Report of the, 239
Lunar: and Planetary Temperatures, Menzel, Coblentz and Lampland, 205; Co-ordinates, A Means of Improving the, deduced from the Occultations of Stars, G. Bigourdan, 359
Lumbricus, The Oogenesis of, L. A. Harvey, 803; Prof. J B Gatenby, 840
Lumière, Pression de la, P. Lebedef. Traduit du russe par T. Kousmine, 45
Luminescence. from Solid Nitrogen, and the Auroral Spectrum, Prof. L. Vegard, 801; of Water and Organic Substances submitted to γ-radiation, L. Mallet, 394
Luminous: Fishes and Cephalopods of the Mediterranean, P. Jespersen and Å. V. Tåning, 133; Night Clouds, V. Malzev, 14; Vapour distilled from Metallic Arcs, The, Lord Rayleigh, 33
Lummer, Prof. O., The Life and Work of, Prof. E. Riecke, 530
Lustre on Flint Implements, The Artificial Production of, W. J. Lewis Abbott, 62

Maglemose Culture, The, Abbé Breuil, 426
Magnesium: Plumbide, The Crystal Structure of, J. B. Friauf, 390, Reactions starting with 1 : 3 Dibrompropylene, A. Kirrmann, 214; The Action of, on Methylene Iodide, G. Emschwiller, 755, Wrought, and Magnesium Alloys, S. L. Archbutt and J. W. Jenkin, 927
Magnetic: Alloys, P. E. Billinghurst, 283; Disturbances, Recurring, W. J. Peters and C. C. Ennis, 533; Observatories, The Geographical Distribution of, Dr. C. Chree, 273; Rotatory Dispersion and the Dispersion of Electric Double Refraction, R. de Mallemann, 250; Storm, The, and Aurora of October 14-15, and Associated Solar Activity, W. B. Housman, 679; A. A. Buss, 680; Storms: and Wireless Communication, Sir Joseph Larmor, 662; T. L. Eckersley, 803; The Law of Distribution in Time of, Dr. H Deslandres, 610, The Recurrence of, Dr. C. Chree, 335, 769, Dr. H. Deslandres, 621; A A. Buss, 769, Survey of France, A. Baldit, 497; Susceptibilities and Dielectric Constants in the New Quantum Mechanics, Dr. J. H. Van Vleck, 226
Magnétisme, Le, Prof. P. Weiss et G. Foex, 584
Makalla (South Arabia), Geography and Geology of, The, O H. Little, with two Appendices, by Prof. G. Stefanini and P. Pallary, 332
Malaria: and Abortion, The Relation between, P. A. Buxton, 744; and the Mosquito, 452; in England, Report of the First Results of Laboratory Work on, Lieut.-Col. S P. James and P G Shute, 452
Malignancy and Evolution: a Biological Inquiry into the Nature and Causes of Cancer, Morley Roberts, 404
Malignant Disease, Liver Extracts in the Treatment of, J. R. Howitt, 263, A. Piney, 374
Mammalian Spermatozoa, Preservation of, A. Walton, 265
Mammals, Tropisms of, W. J. Crozier and G. Pincus, 791
Man: in America, The Antiquity of, H. J. Cook, 855; The Ascent of, by means of Natural Selection, A. Machin, 506, The Geologic Antiquity and Creative Evolution of, Prof H. F Osborn, 59
Manchester: Municipal College of Technology, Journal and Prospectus of the, 501; University: presentation to Prof. S. J. Hickson, 104; H. E. Buckley appointed lecturer in Crystallography; Miss Margaret S Willis appointed assistant lecturer in Geography, Dr. C. E. Brunton appointed demonstrator in Human Physiology; Dr. O. R. Howell appointed lecturer in Applied Chemistry; R. Grindlay appointed demonstrator in Chemical Technology, 140, A. Riley appointed assistant lecturer in Textile Engineering; F. W. Bailey lecturer in Papermaking; Dr. I Waller awarded an honorary research fellowship in Physics; Dr J A. Bowie appointed director of the Department of Industrial Administration in the Manchester College of Technology, Dr. W Susman appointed lecturer in Morbid Anatomy and Histology; C. J Polson assistant lecturer in Chemical Pathology; A. M. Downie assistant lecturer in Bacteriology; Dr. F. A Mason lecturer in Tinctorial Chemistry and Dyestuffs, 753; conferment of honorary degrees, 788
Mangold Seedlings, Collembola injuring, W M Davies, 856
Mankind, The Races of, Prof G. Elliot Smith, 545
Maori, Sickness, Death, and Burial among the, E. Best, 567
Marconi Direction Finder, Major Franco and Capt. Ruiz de Alda, 315
"Margery" Case, The, E. J Dingwall, 618
Marine Biology at Plymouth, Dr. J. H Orton and others, 714
Mars: E. M. Antoniadi, 495; Prof. W. H. Pickering, 709, in 1926, Dr. W. H Steavenson, 666, The Atmosphere of, B. Fessenkoff, 25; The Planet, E. M. Antoniadi, 841
Masai, The Origin of the, and the Wild Tribes of Borneo, C. C. Luck, 567
Mas d'Azil, Scientific Neglect of the, H. G. Wells, 228; Abbé H. Breuil, 265
Mass and Energy, Conservation of, Rev. J. C. Herrick, 851
Mathematical Proof *versus* Observation, Prof. W. H. Hobbs, 915
Mathematics: Higher, for Students of Engineering and Science, F. G. W. Brown, 80; Practical, A Dakin, October 16, Suppt., 27
Mathematischen Erdkunde, Grundzuge der, Prof. G. Wegemann, 513
Matrices and Determinoids, Prof W. E. Cullis. Vol. 3, Part 1, 295
Matrix Quantum Dynamics, The Postulates of the, Dr. J. H. Van Vleck, 215
Maxwell, James Clerk, Sir Joseph Larmor, December 18, Suppt., 44
Mechanics and Applied Mathematics: Statics—Dynamics—Hydrostatics, W. D. Hills Part 2: Applied Mathematics, October 16, Suppt., 27
Medical: Entomology and the Tropical Field Worker, M. E. MacGregor, 338, Research: Committee of Privy Council for, additions to the, 241, Council, Dr. C. J. Martin and Sir Frederick G. Hopkins appointed members of the, 530; Science, Apocryphal, Prof. A Castellani, Dr. G. C. Low, Dr D Nabarro, and Sir Ronald Ross, 518
Mediterranean Sternoptychidæ, P. Jesperson and A. V. Tåning, 99
Melaleuca pubescens Schauer and *M. Preissiana* Schauer, Notes on, E Cheel, 719
Melanesian Mythology, S. H. Ray, 688
Melanism in Lepidoptera, Inheritance of, Dr. Heslop Harrison, 747
Mellon Institute of Industrial Research, The, 57

Mental: Disease, Joint Board of Research for, Birmingham, Dr. F. A. Pickworth appointed honorary director of the, 816; Report of the Laboratory of the, 890; Life: an Introduction to Psychology, Dr. B. Edgell, 549; Physical and, Inheritance, Aspects of, Prof. R. R. Gates, 663; Work: Effects of, Prof. V. Suk, 132; The Effect of the Group on, N. N. Sen Gupta and C. P. N Sinha, 426
Merchant Taylors' School, laying of foundation stone of a new science building by the Prince of Wales, 104
Mercuric: Chloride, Results obtained in the Quantitative Study of the Association of, F. Bourion and E. Rouyer, 179; Halides: Critical Potentials of the Vapours of, Prof. V I Pavlov and A. I. Leipunsky, 843; Optical Excitation of the Vapours of, Dr A. Terenin, 843
Mercury: and Saturn, Conjunction of, 854; and Helium, The Union of, J. J. Manley, 276; Atoms in the 2*P* State, Collisions of the Second Kind with, J. G. Winans, 46; Microstructure of, Dr. W Rosenhain and A. J. Murphy, 261; Solid, The Metallography of, and Amalgams, Dr. W. Rosenhain and A. J. Murphy, 717; The Continuous Spectrum of, Lord Rayleigh, 767; H. Volkringer, 862; Vapour: The Ionisation of, as a Function of the Intensity of Exciting Light, G. W. Giddings and G. F. Rouse, 396; The Fluorescence of Superheated, Dr. H. Niewodniczański, 877
Messel Memorial: Lecture, The, Lord Balfour, 128; medal, the, presented to Lord Balfour, 128
Metal Tubes and Sheets, The Manufacture of, by Electrolytic Means, Dr. W. Blum, 423
Metallic: Crystals, Single, Plastic Deformation of, W. E. W. Millington and Prof. F. C. Thompson, 409; Hydrides: Copper Hydrides, Rontgenographic Investigation of, A Quilico, 503, Silver and Tin, The Antagonistic Action of, on Living Beings, Mme. Anna Drzewina and G. Bohn, 681
Metals: Exploded, Spectra of, T. Hori, 28; Heavy, Spectra of, Nagaoka and Mishima, 784; Institute of, The Journal of the, edited by G. Shaw Scott. Vol. 35, No 1, October 16, Suppt., 28, The Immersion of, in Homogeneous Media Opaque to the X-rays, H. Pilon and A. Laborde, 755; The Latent Heat of Fusion of Some, J. H. Awbery and Dr. Ezer Griffiths, 70; The Production of Single Crystals of, and some of their Properties, Prof. H. C. H Carpenter, 266
Meteoric Phenomena of September 6, The, W. F. Denning, 425, 531
Meteorological: Committee: Annual Report of the, to the Air Council, 852; International, meetings of the, 671; Cruise in the Atlantic, proposed, 708; Directors, International Conference of, Meetings of Commissions of the, 670; Literature, Bibliography of, 279; Reports issued by Wireless Telegraphy in Great Britain, etc, 278
Meteorology and Geodynamics, Zentralanstalt for, at Vienna, *Festschrift* of the, 670
Meteors: and the Constitution of the Upper Air, Prof. F. A. Lindemann, 175; July, W. F. Denning, 170; Large, Unusual Display of, W. F. Denning, 603
Methylene-amino-acetonitrile, A Supposed Isomer of, M Delépine, 250
Michelson's Experiment, realised in a Free Balloon, A. Piccard and E. Stahel, 432
Micro-organisms in Industry, A. Chaston Chapman, 133
Microscope, A Wide-field Binocular, Bausch and Lomb Optical Co., Ltd, 675
Microscopical Illuminating Apparatus, Catalogue of, Ogilvy and Co., 816
Midas: or the United States and the Future, C. H. Bretherton, 76
Middle and Upper Lias on the Dorset Coast, The Junction-bed of the, J. F. Jackson, 69
Migraine and other Common Neuroses: a Psychological Study, Dr. F G. Crookshank, 223
Mikiola Fagi, The Dimorphism determined in the Gall of, by a Secondary Parasite, M Molliard, 755
Military Explosives and Gases, 150
Miller's, Prof., Ether Drift Experiments, Prof. H. Thirring, 81
Mind: and Matter, 618; What is, R. J. Bartlett, 549
Mineralogical Society, Jubilee of the, 458, 535
Minimum Work, The Physiological Principle of, II., C. D. Murray, 143
Minnesota University, Research in, 357
Moisture and Surface Action, Prof. W. A Bone, 675
Molecular: Orientation, Physical Phenomena and, at Interfaces, 607; Structure, Prof. J. Kenner, 857
Molecules: Electrostatic Moments of, R. J. Clark, 555; of Carbon Compounds, The Influence of General Electron Displacement on the Reactivity of Conjugated Systems in the, Prof. R Robinson, 627; The Electrical Polarity of, Prof C. V. Raman and K. S Krishnan, 302; The Movements of, Prof. A. Liversidge, 303
Mollusca of Japan, Pleistocene and Tertiary, Prof. M. Yokoyama, 819
Mollusques d'eau douce, Les, Prof. E Chemin, 765
Molybdates, Constitution of the, A. Travers and Malaprade, 681
Molybdic Acid, Constitution of Solutions of, A. Travers and Malaprade, 394
Money, The Mystery of, W H. Coates, 760
Mongolia, Cretaceous Mammal Skulls from, Dr. W. K. Gregory and G. G. Simpson, 698
Monumenta Medica. Under the general editorship of H. E. Sigerist 3: The Earliest Printed Literature on Syphilis; being Ten Tractates from the Years 1495–1498, 188
Moose, Geographie der, Prof. T. Herzog, 260
Morocco, The Regular Triangulation of, G. Perrier, 898
Morris, Malcolm, memorial lecture, the, Prof H. J. Fleure, 815
Mosaic Diseases, The Possible Identity of Different, M. N. Walker, 747
Mosquito, Malaria and the, 452
Mosquitoes, Dusting by Aeroplane against, W. V. King and G. H. Bradley, 26
Mountain Lagoon and the Kurrajong Fault, A Grady and H. Hogbin, 467
Mount Wilson, An Ecological Study of the Flora of, Part iii., J. McLuckie and A. H. K. Petrie, 215
Mucors, Sexes of, Biochemical Differences between the, Sophia Satina and Blakeslee, 63
Mud-cracks, Contrasted Types of, E. M. Kindle, 208
Mule, Common, Fertility in the, Prof. E. Warren, 746
Muller, Hugo, lecture, the, Prof. S. P. L. Sørenson, 670
Mumetal Magnetic Shield, A, Prof. A. V. Hill, 319
Muscle, Lactic Acid in, The Formation of, Prof. Meyerhof; Prof. A. Harden, 895
Muscular Action, A. Mallock, 46
Music and Psychology, The Borderland of, F. Howes, 407
Mussel, The Respiratory Exchange of the, J. R. Bruce, 673
Mycenæ, The Shaft Graves of, and their Contents in relation to the Beehive Tombs, Sir Arthur Evans, 313
Mycenæan Treasure in Greece, Discovery of, A. J. B. Wace, 424
Mycology and Plant Pathology, Dr. G. H. Pethybridge, 640
Mythen und Erzählungen eines Melanesierstammes aus Paparatava, Neupommern, Südsee: Gesammelt und versehen mit Einleitungen und Erklärungen, Rev. P. A. Kleintitschen, 688

Namaqualand, The Changed Conditions of, W. A. Humphrey, 179
Naos pagoda (Salter): The Type of a New Genus of Silurian Corals, W. D. Lang, 69
National: French Phytopathological Congress, The, 355; Physical Laboratory, Annual Visitations of the, 66
Natural History, March-April, 169; July, 745
Natural History of the Oxford District, The, edited by Commander J. J. Walker, 369
Naturalista viaggiatore, Il, Gestro e Vinciguerra. Seconda edizione, 691
Naturalist's Pilgrimage, A, R. Kearton, October 16, Suppt., 23
Nature: -Gods, 4; The Worship of, Vol. I., Sir James George Frazer, 4; Thought and Personal Experience, Dr. W. Tudor Jones, 189; to Man in Aboriginal America, The Relation of, Prof. C. Wissler, 260
Naturforscher und Erfinder: Biographische Miniaturen, Prof. L. Darmstaedter, 620

Naucrates ductor, The Eggs of the Pilot-fish of, K. H. Barnard, 228
Navy, Health of the, Statistical Report of the, 1923, Surgeon Vice-Admiral Sir Joseph Chambers, 205
Nematoda, Families and Genera of, A Synopsis of the, Dr H. A. Baylis and R. Daubney, 44
Neoplasms, 404
Nervous Mechanism of Plants, The, Sir Jagadis Chunder Bose, 654
Netherlands East Indies: The Geology of the, Lectures delivered as Exchange-Professor at the University of Michigan in 1921–22, Prof. H. A. Brouwer. Recorded and prepared by L. M. Gould, 80
Neuroglia Cells, Dr. C. Da Fano, 317
Newcomen Society, J. W. Hull elected president of the, 814
New: Guinea: Expedition to, led by Dr. M. W. Sterling, 168; Tectonic Features of, Prof. A. Holmes, 848; Hebrides: Depopulation and Disease in the, Dr. P. A. Buxton, 62; Natural History of the, J. R. Baker, 119; The Southern, an Ethnological Record, C. B. Humphreys, October 16, Suppt., 22; South Wales: Report of the Director-General of Public Health for 1924, 168; The Internal Structures of the Pentamendæ of, F. W. Booker, 611; The Native Flora of, Part xi., R. H. Cambage, 574; Upper Permian Insects of, Part ii., Dr. R. J Tillyard, 323; York State, climate of, R. A. Mordoff, 319; Zealand: Australia and, Scientific and Industrial Research in, 597; Flora, Manual of the, T F. Cheeseman. Second edition, revised and enlarged by the author. Edited by W. R. B. Oliver, 151; Industrial and Scientific Research Department of, Dr. E. Marsden appointed Permanent Secretary of the, 202; Proposal for a Botanical Reserve in, Dr. L. Cockayne, 277
Newton, Sir Isaac, Forthcoming celebration of the bicentenary of the death of, 813
Nickel: and Cobalt: Influence of, on the Action exercised by Insulin on the Dog, G. Bertrand and M. Mâchebœuf, 250; in the Pancreas, The Relatively High Proportion of, G. Bertrand and N. Mâchebœuf, 71; in Coinage, Development of the Use of, Capt. F. R. Barton, 466; in the Presence of Iron, Two Causes of Error in the Electrolytic Determination of, C. Marie and J. Bertheloot, 863; Single Crystals of, Magnetic Properties of, W Sucksmith and Dr. H. H. Potter, 730
Nicotine in Tobacco, The Determination of, R. R. T. Young, 610
Nigeria: Northern: The Peoples of, 219; The Useful Trees of, H. V. Lely, 656; Rainfall and Vegetation in, J. R. Ainslie, 172; The Northern Tribes of, an Ethnographical Account of the Northern Province of Nigeria, together with a Report on the 1921 Decennial Census, C. K. Meek. 2 Vols., 219
Nikolaieff, Excavations near, Prof J. Borozdin, 564
Nile Flood and World Weather, The, E. W. Bliss, 825
Nitrates in Animal and Vegetable Tissues, E. Kohn-Abrest and S. Kawakibi, 611
Nitric Oxide: and Oxygen, The Rate of Reaction of, Hasche, 748; The Catalytic Decomposition of, T. E. Green and C. N. Hinshelwood, 427
Nitriles, The Preparation of, by the Diazo Reaction, A. Korczynski and B. Fandrich, 432
Nitrites and Nitrates, The Spectrophotometric Determination of, by Diphenylamine Sulphate, E. Tassilly and R. Savoire, 899
Nitrogen: Absorption Bands in, Dr. H. Sponer, 696; Active: Dr. E. B. Ludlam and L. H. Easson, 590; E. J. B. Willey, 735; E. J. B. Willey and Dr. E. K. Rideal, 427; in Iron-Chromium Alloys, F. Adcock, 643; On the Phosphorescence of, Prof. J. C. McLennan, H. J. C. Ireton, and K. Thompson, 408; Variations of Some Forms of, in a Pure-Culture of Infusoria, A. Lwoff and Mlle. Nadia Roukhelman, 359
Nitrogenous Fertilisers, Synthetic, Production and Use of, 469
Nitrous Oxide, The Synthesis of, D. L. Chapman, R. A. Goodman, and R. T. Shepherd, 245
Nobel: prize for medicine, award of the, to Prof. J. Fibiger, 778; prizes, awards of, for 1925 and 1926, 741
Nomogenesis. or Evolution Determined by Law, Prof. L. S. Berg. Translated by J. N. Rostovtsow, 617
Non-ferrous Metals Industry in the Liége District, The, L. Boscheron, 466
Non-polar Solid Compounds, On the Heat Capacity of, E. O. Salant, 143
North: Africa, Magnetic Variation in, Dr. L. Palazzo, 134; Carolina, Pleistocene Plants from, Dr. E. W. Berry, 893; -East Land, The Climate of, K. S. Sandford, 460; Sea, Bottom Currents in the, J. N. Carruthers, 354
Northampton Polytechnic Institute, Courses at the, 646
Northern Polytechnic, Prospectus of the, 501
Novæ, Dr. J. Lunt, and others, 61
November Rainfall, 852
Nursehound (*Scyliorhinus Stellaris*), A Breeding-Ground of the, in the Fal Estuary, Dr. J. H Orton, 732
Nursery School to University: From, a Labour Policy, 871

O and *N* Series of Low Frequency, The Discovery of the Characteristic, A. Dauvillier, 756
Observation, Mathematical Proof *versus*, Prof W. H. Hobbs, 915
Ocean Currents: A Practical Method for Determining, Lieut.-Commander E. H. Smith, 538, The Measurement of, 538
Oceanic Isostasy in Relation to Geological Tectonic, Sir Joseph Larmor, 375
Oceans: Aspects of the, Dr. H. R. Mill, 78, A Study of the, Prof. J. Johnstone, 78
Office d'information scientifique et technique, Paris, News bulletins of the, 21
Ohm's Law, Deviation from, Interpretation of, K. T. Compton, 682
Oil, The Geological Search for, Dr. M. Stuart, 500
Old Red Sandstone Flora of Scotland, Contributions to the Study of the, iii., iv., v., Prof. W. H. Lang, 70
Optical: Illusion Due to Contrast, An, G. P. Thomson, 323; Recording of Sound, The Application of Teaching Purposes of the, combined with the Kinematograph, R. Lutembacher and L. Gaumont, 791, Rotatory Dispersion, Part 3, Prof. T. M. Lowry and W. R. C. Coode-Adams, 861; Spectra of Different Atoms of the same Electronic Structure, Some Relations between the, ii., D R. Hartree, 323; *Society, Transactions of the*, Subject Index to Vols. 1-25, Prof. A. F. C. Pollard, 350; System, Focal Point of an, An Accurate Method of Ascertaining the Position of the, C. Beck, 898
Optics: and Poetry, Rev. H. C. Browne, 697; Physical, The Principles of, An Historical and Philosophical Treatment, Prof. E. Mach. Translated by Drs. J S. Anderson and A. F. A. Young, 437; Pure and Applied, Dr. L. C. Martin, 437
Ordovician and Silurian Fossils from Girvan, Some New, F. R. Cowper Reed, 70
Oregon Basin, Wyoming, Oil and Coal Resources of the, D. F. Hewett, 784
Organic Evolution, The Solid Foundation of, 329
Organo-Metallic Compounds, W. H. George, 85
Ornithological Congress at Copenhagen, The International, 247
O II, The Ionisation Potential of, J. S. Bowen and Prof. R. A. Millikan; Prof. A. Fowler, 410
Output, Restriction of, A. Angles, 462
Overseas Life, Educational Training for, 253
Oxford University: and Field Museum Expedition to Kish, Results of the, E. Mackay, 349; Conferment of Honorary Degrees, 241
Oxidation, Passivity, and Corrosion, U. R. Evans, 51
Oxygen: Spectral Line $\lambda=5577{\cdot}35$ Å.U., on the, Prof J. C. McLennan, J. H. McLeod, and W. C. McQuarrie, 441; The Discovery of, Sir P. C. Rây, 172
Oyster Mortality on the George's River, N.S.W., 1924–25, The Cause of an. T. C. Roughley, 827

Palæolithic: Age in Britain, The Upper, D. A. E. Garrod, 833; Implements near Norwich, Discovery of, 316
Palæontographical Society, election of officers, 565
Paläontologie (Paläozoologie), Grundzüge der, Prof K. Zittel. Neubearbeitet von Prof. F. Broili und Dr. M. Schlosser. Abt 1. Sechste Auflage. Abt 2. Vierte Auflage, 369

Palestine, Sir Flinders Petrie to excavate in, 709
Palladium: Hydrogen Equilibrium, The, L. G. Gillespie and F. P. Hall, 64; Series Spectra of, On the, Prof. J. C. McLennan and H. G. Smith, 33
Pamirs and Amu-Daria Basin, Physical Anthropology of the, T. A. Joyce, 783
Panama and Costa Rica, Land Mollusca of, Dr. H. A. Pilsbry, 426
Papua, Rigo District, Plants from the, C. T. White, 574
Paramagnetic Nickel-chromium Alloys, The Dilatometric Anomaly of the, P. Chevenard, 35
Paramagnetism at Low Temperatures, Investigations on, Part ii., L. C. Jackson, 33
Parasitic Fungi in Britain, G. H. Pethybridge, 244
Parsons, Sir Charles, and the Steam Turbine, 678
Patagonian *Lusus Naturæ*, Another, G. A. Gardner, 262
Patent Law and Unemployment, E. W. Hulme, 694, The writer of the article, 695, 840; Office: Statistics: 428; a correction, 458; The British, E. E. Towler, 517
Pea, Sweet, Genetics of the, Miss J. Latter, 171
Peat: Investigation in Canada, 859; Studies in, Part 1, Prof. J. Reilly and G. T. Pyne, 141
Pediculate Fishes of the Suborder Ceratioidea, C. Tate Regan, 774
Peirce's, The Elder, E. B. Wilson and C. R. Doering, 396
Penal System, Psychological Aspects of our, Dr. J. Drever, August 7, Suppt., 18, 446
Pendulous Jets, The Damping of, Prof. P. Kirkpatrick, 261
Pendulum Observations, Dutch, in the Atlantic and the Pacific, Dr. J. J. A. Muller, 930
Penetrating Radiation on the Jungfrau, Variation of, W. Kolhörster and G. von Salis, 518
Pennsylvania University Museum, Addition of an Egyptian Wing, 780
Pentosans and Cold Resistance in Plants, Prof. Doyle and Miss Phyllis Clinch, 567
Perfumes, Cosmetics, and Soaps, with Especial Reference to Synthetics, W. A. Poucher. 2 Vols., 113
Perkin medal, award of the, to Dr. J. Teeple, 781
β Persei, The Spectrum of, Dr. W. J. S. Lockyer, 459
Perseids: The Coming, 97; The August, of 1926, W. F. Denning, 280
Peru, North-West, Stone Implements from, C. B. Brown, 26
Peruvian Quipus, The, Baron Nordenskiöld, 26
Petroleum: Supply in America, The Future of, Dr. A. C. Fieldner, 423; Surface Indications of, A. Beeby Thompson, 851
Petzval Optical Condition, On the, G. C. Steward, 790
Pflanzen als Gesteinsbildner, J. Pia, 585
Pflanzenanatomie, Handbuch der, Herausgegeben von Prof. K. Linsbauer: Lief. 13 (II., 2 B., Bg. 1-4). 2 Abt., 2 Teil. Bd. IX., 2, 9; Lief. 15. Abt. 2, Teil 2. Band 9. Lief. 14. Abt. 2, Teil 2. Band 10, 836
Pharmaceutical Chemistry, A Text-book of, J. O. Bentley and J. E. Driver, 113
Pharmacist, The Training of the, Dr. J. F. Tocher, 564
Phathander (*Zenopus lævis*, The Structure of the, Part i., C. von Bonde and D. B. Swart, 215
Phenological Observations in the British Isles, 1925, Report on the, J. E. Clark, I. D. Margary, and R. Marshall, 106
Philadelphia, Academy of Natural Sciences of, Yearbook of the, 1925, 350
Philistine Temples, Two, Identification of, A. Rowe, 315
Philosophy: Comparative, P. Masson-Oursel, 297; Problems of, an Introductory Survey, Prof. G. W. Cunningham, 296; Propaganda and, 543
Phosphorus: and Arsenic in Organic Substances, The Determination of, R. Poggi and A. Polverini, 935; Glow of, The Inhibition of the, H. J. Emeléus, 319; Tin, Arsenic, Antimony, Lead, Bismuth, Silicon, Titanium, Zirconium, and Thorium, Double Decompositions between the Halogenides of, T. Karantassis, 107, Trioxide, The Slow Oxidation of, C. C. Miller, 245; Vapour, Oxidation of, Chariton and Walta, 893
Photographic: Photometry: a Study of Methods of Measuring Radiation by Photographic Means, Dr. G. M. B. Dobson, I. O. Griffith, and Dr. D. N. Harrison, 689; Plate: showing a Picture in Stereoscopic Relief, A, Dr. E. Estanave, 167; The, as an Instrument for the Measurement of Visible and Invisible Radiations, Prof. C. Fabry, 128; Theory, Prof. R. A. Sampson, 374; Exposures, Intermittency in, R. Davis, 427
Photographisch-chemische Industrie, Die, die Erzeugung und Verarbeitung photographisch-chemischer Präparate, 185
Photography: at Low Pressures, O. Masaki, 748; International Congress of, Report of the 6th, 241; Stereoscopic, its Application to Science, Industry, and Education, A. W. Judge, 185, The Science of, 185; Three-colour, The History of, E. J. Wall, 185
Photogravure, Elements of, Photo Printing from Copper Plates: Screen Photogravure simply explained, with Full Working Instructions and an Explanatory Chapter on Modern Rotary Gravure Printing, C. N. Bennett, 513
Photometric Integrators, Paint used for, Effect of Slightly Selective Absorption in the, J. W. T. Walsh and W. Barnett, 898
Photometry: J. W. T. Walsh, 581; Modern; 581; A. P. Trotter, 770; L. C. M., 771
Photons, The Conservation of, Prof. G. N. Lewis, 874
Physical and Mental Inheritance, Aspects of, Prof. R. R. Gates, 663
Physico-chemical: Investigations made in the Italian Cruiser *Marsigli* in the Straits of Messina, Results of the, M. Picotti, 935; Methods, Prof. J. Reilly, Prof. W. N. Rae, and Dr. T. S. Wheeler, 908
Physics: A Numerical Drill Book on, Prof. L. W. Taylor, October 16, Suppt., 26; General, for Students: a Text-book on the Fundamental Properties of Matter, E. Edser. Reprinted, with addition, 800; Recent Fundamental Work in, Prof. R. A. Millikan, 893. The New, 865
Physikalisch-chemische Mineralogie und Petrologie: die Fortschritte in den letzten zehn Jahren, Prof. W. Eitel, 152
Physiological: Congress in Stockholm, The Twelfth International, 499, Optics and Psychology, Prof. W. Peddie, 74
Physiology, Evolutionary, 361
Physische Erdkunde: die Gestaltung der Erdoberfläche, Prof. R. Lehmann, 656
Phytopathology and Private Enterprise, 355
Pickett-Thomson Research Laboratory, Annals of the. Vol. 2, No. 2, July 1926, 832
Piezo-electric Quartz Resonator, The, and its Equivalent Electric Circuit, D. W. Dye, 70
Pilot: Balloons, Abnormal Rates of Ascent of, in the Lower Levels of the Atmosphere at Melbourne, E. Kidson, 106; -fish (*Naucrates ductor*), The Eggs of the, K. H. Barnard, 228
Pitcher Plant, The Protozoa of the, Prof. R. W. Hegner, 926
Pith Dust in Kundt's Tubes, Use of, Prof. R. V. Cook, 157
Pithecanthropus: *erectus*, a Skull of the Type, Prof. Heberlein, 491, Skull found at Trinil, Java, The, Dr. Dubois, 887
Pitman's Building Educator, edited by R. Greenhalgh. Part 1, 872
Plagiostomi, The Vascular System of the, C. von Bonde, 502
Planarians: Inhibition of Regeneration in, by Grafting: Technique of Grafting, H. W. Rand and Amy Browne, 682; Two-headed or Two-tailed, Inhibition of Regeneration in, H. W. Rand and Mildred Ellis, 682
Planetarium, Suggested Purchase of a, 924
Planetismal Hypothesis, The, Prof. E. H. L. Schwarz, 339
Planets: Minor. 566; Naming of, 205
Plant: Cells, Dr. D. T. McDougal, 856; Growth in the Sea, Dr. W. R. G. Atkins and others, 746; Illustrations, New, Dr. O. Stapf, 496; Stimulus and Response, Sir J. C. Bose, 94
Plants: Cultivated, Origin of, Prof. N. Vavilov; W. B. Turrill, 392; Life of, Sir Frederick Keable, 297

"Plasmochin," a New Drug, 528
Platinum: in South Africa, Dr P. A. Wagner, 568; The Displacement of, by Hydrogen under High Pressures, V. Ipatief and A. Andreevsky, 250
Pleasure and Pain: a Theory of the Energic Foundation of Feeling, P. Bousfield, 257
Pleistocene of the Gran Chaco, A Gigantic Poison Fang of a Snake obtained from the (?), Prof. J Graham Kerr, 71
Poetry, Optics and, Rev. H C. Browne, 697
Poland, Meteorology and Geophysics in, Prof. H. Arctowski and others, 134
Polarisation Apparatus, Early, 99
Polishing of Surfaces, The, J M Macaulay, 339
Pollucite, The Study of, A. Kastler, 35
Polonium and Lead, Radioactivity of, Special Actions of the Sun on the, Mlle. St. Maracineanu, 395
Pomology, Systematic, Essentials of, Prof B D. Drain, 368
Pons-Winnecke Comet and Meteors, W. F. Denning, 61
Porcelains, Translucency of, Prof. C. W. Parmelee and P. W. Ketchum, 100
Port Sanitary Work, International Agreements affecting, Sir George Buchanan, 537
Positive Ray Spectral Line, The Distribution of Intensity in a, Part 2, M C. Johnson, 754
Post-Cretaceous Igneous Activity in Western India, Prof. K. K. Mathur and V. S. Dubey, 769
Potassium and some Alkali Halides, Thermal Properties of, E. F. Flock and W. H Rodebush, 857
Potato: Mosaic and Temperature, C. M. Tompkins, 710; Trials, Demonstration of, at Ormskirk, 278
Potatoes, Internal Rust Spot of, W. A. Millard, 804
Power Alcohol and other Petrol Substitutes, 416
Prehistoric: Bronze, Analysis of, A. L. Armstrong, 532; Earthworks in North Cardiganshire, I. T Hughes, 98
Prehistory: in Britain, M C Burkitt, 652; in France, The Canadian School of, Dr. H. M. Ami, 626
Press, Science and the: 757; Dr. W. M. Cumming, 842
Priestley, Joseph, honour to, by the American Chemical Society, 422
Priestley's Life in America, Dr. E. F. Smith, 744
Primary and Secondary Vortices in Oscillating Fluids: their Connexion with Skin Friction, the late Mrs. Hertha Ayrton, 34
Primitive Time Reckoning and the Calendar, Dr. M. P. Nilsson, 103
Princeton University, appeal for funds, 788
Promiscuity and Primitive Marriage, Lt.-Col. E. F. G. Tucker and L. H Gilbert, 783
Propaganda and Philosophy, 543
Proteins: in Phenol, The Molecular Weights of, E. J Cohn and J B Conant, 396; The Molecular Weights of the, E. J. Cohn and J. B. Conant, 675
Proteo-bismuth Precipitates, Influence of some Radioactive Elements on the Catalytic Activity of Certain, E. Laborde, J. Bressoles, and L. Jaloustre, 395
Protoplasmic Viscosity as Determined by a Temperature Coefficient of Biological Reactions, Dr. J. Bělehrádek, 478
Protozoa, The Biology of the, Prof. G. N. Calkins; Dr. D. W Cutler, 763
Physical Phenomena and Molecular Orientation at Interfaces, 607
Psychical: Phenomena and their Interpretation, Prof. C. Richet, 876; Research, Science and: A. A. Campbell Swinton, 299, 442, 553, 659, 692; H. Price, 553; Sir Arthur Conan Doyle, 370, 553, 659; Dr. R. J. Tillyard, 147, 300, 370, 587, 735; W. W. L., 588, 693; J. Reid Moir, 694; Sir Bryan Donkin, 480, 658, E. J. Dingwall, 480; Dr. J. P. Lotsy, 370, Sir Oliver Lodge, 622, Dr. J. W. French, 589
Psycho-analysis for Normal People, Geraldine Coster, 477
Psychology: and Crime, Sir Frank Beaman, 707; Experimental, A Text-book of, with Laboratory Exercises, Dr. C. S. Myers and F. C. Bartlett. Third edition, Part 2: Laboratory Exercises, 729; Industrial, 462, International Congress of, 606
Pterostylis, The Genus, Rev. H M. R. Rupp, 251
Publications biologiques d'École des hautes Études vétérinaires, Brno. Vol. 3, 60
Public Health: in Germany, The Development and Present State of, Prof. R. Abel, 672; (Smoke Abatement) Bill, The, 21
Pueblo Bonito, Deforestation at, 892
Pulmonary Tuberculosis, Sanatorium Treatment of, Dr. P. Stocks, 171
'Pwdre Ser' (The Rot of the Stars), Dr. H. A. Baylis, 552
Pyramid, Great, Surveys of the, F. S. Richards; Sir Flinders Petrie, 226
Pyrosulphuryl Chloride, V. Grignard and P. Muret, 718, 826
Pyruvic Acid, The Oxidation of, by Ceric Ions, C. Fromageot, 107

Quantum: Algebra, on, P. A. M. Dirac, 323; Mechanics: and the Magnetic Moment of Atoms, Prof. E. Fermi, 876; New, Magnetic Susceptibilities and Dielectric Constants in the, Prof. J H. Van Vleck, 226; Principles and Line Spectrum, Prof. J. H. Van Vleck, 129; Theory: and Intensity Distribution in Continuous Spectra, Dr. J. R. Oppenheimer, 771, of the Problem of the Two Bodies on the, Dr. J. R. Oppenheimer, 323; of Vibration-rotation Bands, on the, Dr. J. R. Oppenheimer, 323; The, and the Behaviour of Slow Electrons in Gases, F. Zwicky, 396
Quaternary Water-alcohol Mixtures, The Miscibility of, P. Brun, 359

Rabbit, A supposed New 'Mutation' in the, J. G. Dollman, 69
Race and History: an Ethnological Introduction to History, Prof. E. Pittard. Translated by V. C. C. Collum, 545
Races et peuples de la terre, Les, Dr. J. Deniker. Deux. édition, 545
Racial: Characters of the Human Skin, etc., Prof. H. J. Fleure, 815; Evolution, The Regional Balance of, Prof. H. J. Fleure, August 7, Suppt., 18, 380
Radcliffe Observatory, Meteorological Observations at the, 1921–25, 315
Radiation: On the Law of, Prof. G. Gianfranceschi, 302; Penetrating, E. Condon, 143; Processes, Elementary, The Coupling between, Dr. W. Rothe, 172; Supplementary Note on, Sir Oliver Lodge, 81; Theory of Chemical Action, Prof. F. Giordani, 712, without Quanta, Prof. L. V. King, 354
Radiations and Chlorophyll, J. Amar, 71
Radioactive. Bodies, A New Method for Measuring the Absorption of the β- and γ-radiation of, D. K. Yovanovitch and Mlle A. Dorabialska, 142; Minerals: Calculation of the Ages of, Prof. A. Holmes and Dr. R. W. Lawson, 478; from Australia, Ages of, Prof. L. A. Cotton, 244
Radioactivity, A Manual of, Dr. G. Hevesy and Dr. F. Paneth. Translated by Dr. R. W. Lawson, 475
Radioaktivitat über die Geschichte der Erde? Was lehrt uns die, Prof. O. Hahn, October 16, Suppt., 25
Radio: -communication, with Special Reference to Waves of Short Wave-length, 669; Measurements made by the U.S. Bureau of Standards, L. W. Austin, 457; Service, Overseas, in Great Britain, Col. Crawley, 423; Telegraph Service, A Commercial High-speed, between Great Britain and Canada, 638; The Past, Present, and Future of, C. F. Elwell, 93; Waves, Propagation of, E. F. W. Alexanderson, 28
Radium: Le, découverte de la radioactivité et du radium, origine de l'énergie radioactive, le radium dans la nature, ses emplois usuels, F. Honoré, 9; Radiation, The Chemical Effects of the Penetrating, A. Kailan, 899
Raffles Museum, Singapore, Report for 1925, 816
Railways, the Electrification of, Dr. Huber-Stockar, 492
Rainfall: Interception by Plants, J Phillips, 837; Lt.-Col. E. Gold, 915; Pressure, and Temperature at certain European Stations, Periodicities in, D. Brunt, 826
Rainmaker among the Lotuko, S. Sudan, The, Prof. and Mrs. C. G. Seligman, 673
Raleigh, Sir Walter, The Letters of (1879–1922). Edited by Lady Raleigh. 2 Vols., 7
Ramsay memorial fellowship awards, 322

Rand, A Fundamentalist Conference in, 707
Rare: Earth and Alkali Metals, Double Sulphates of the, vi., F. Zambonini and S. Restaino, 502; Earths, On the, 17
Rat Destruction, A Practical Handbook on, C. L. Claremont, 407
Ravenea, Madagascar Palm Trees, H. Jumelle, 681
Raw Materials, International Interests in, Sir Thomas Holland, 887
Rayleigh, Lord, Sir Arthur Schuster, December 18, Suppt., 47
Rays and Skates; a Revision of the European Species, Dr R. S. Clark, 800
Reaction, Fluorescent Power and Velocity of, The Parallelism between the, J. Perrin and Mlle. Choucroun, 395
Reactions: Anomalies of certain, A. Angeli, 35; between Solid Bodies reduced to the Colloidal State, E. Sterkers and R. Bredeau, 179
Real Variable, The Theory of Functions of a, and the Theory of Fourier's Series, Prof. E. W. Hobson. Second edition. Vol. 2, 112
Realism: Direct, A Theory of, and the relation of Realism to Idealism, Dr. J. E. Turner, 438
Rectal Alimentation, 858
Red: Algæ, The Distribution of, in Relation to Illumination, Drs. W. R. G. Atkins and H. H. Poole, 155; Rain at Bordighera, Italy, Prof. G. H. Bryan, 697
Reflection as a Special Case of Refraction, T. Smith, 141
Reflector, 25-foot, Design of a, F. G. Pease, 531
Reflex: Camera, A New, J. H. Dallmeyer, Ltd., 28; Regulation of Posture, Dr. F. M. Walshe, 736
Refrigeration, Domestic, 234
Regional Surveys, List of, 204
Relativity: and the Dayton Miller Experiments, Prof. H. Wildon Carr, 641; Rotation and, A. Jaques and J. S. Morgan, 194; Three Men Discuss, J. W. N. Sullivan, 80
Religion: and Folklore of Northern India, W. Crooke, Prepared for the Press by R. E. Enthoven, 255; and Science, Archbishop of York; Dr. J. G. Adami, 562; Rev. J. C. Hardwick, Sir Oliver Lodge, 563; Science and, 577
Remission of Sins at the Shrine of a Moslem Saint, 389
Research: and Citizenship, Sir Walter Fletcher, 887; and the Imperial Conference, 793; and the Land: an Account of Recent Progress in Agricultural and Horticultural Science in the United Kingdom, V. E. Wilkins, 799; Taxation of, 1; Work, The Classification of, Dr. W. L. Balls, 298
Resilience of some Metals used for Exhaust Valves, The Influence of Prolonged Maintenance, at a Red Heat, on the, J. F. Saffy, 899
Resistance Properties of a certain Net-work containing Inductances and Capacities, On some, and their Analogies in a Mechanical System, E. B. Moullin, 323
Respiratory Syncope, The Treatment of, by Inhaling, L. Ambard and F. Schmid, 899
Retina, The Reddish Blue Arcs and the Reddish Blue Glow of the, Christine Ladd-Franklin, 215
Retrospect, Sir J. J. Thomson, December 18, Suppt., 41

REVIEWS AND OUR BOOKSHELF.

Agriculture, Forestry, and Horticulture:
Bourcart (Dr. E.), translated from the French and adapted to British Standards and Practice. Insecticides, Fungicides, and Weed Killers. Second English edition, revised and enlarged by T. R. Burton, October 16, Suppt., 24
Bruce (A. B.), and Dr. H. Hunter, Crop and Stock Improvement, 910
Cotton-growing Countries, Present and Potential: The, Production, Trade, Consumption, 616
Drain, (Prof. B. D.), Essentials of Systematic Pomology, 368
East (Prof. E. M.), and Prof. W. H. Weston, Jr., A Report on the Sugar Cane Mosaic Situation in February, 1924, at Soledad, Cuba, 45
Fawcett (Prof. H. S.), Citrus Diseases and their Control. With Sections on Oriental Citrus Diseases, by H. A. Lee, 655
Hunter (Dr. H.), The Barley Crop: a Record of some Recent Investigations, 871
Johnson (W. H.), Cotton and its Production, 765
Lely (H. V.), The Useful Trees of Northern Nigeria, 656
Waters (H. J.), and F. G. King, Animal Husbandry, 766
Weaver (Prof. J. E.), Root Development of Field Crops, 258
Wilkins, (V. E.), Research and the Land: an Account of Recent Progress in Agricultural and Horticultural Science in the United Kingdom, 799
Yapp, (Prof. W. W.), and Prof. W. B. Nevens, Dairy Cattle: Selection, Feeding, and Management, 765

Anthropology and Archæology:
Childe (V. Gordon), The Dawn of European Civilisation, 401
Crooke (W.), Religion and Folklore of Northern India. Prepared for the Press by R. E. Enthoven, 255
Deniker (Dr. J.), Les races et les peuples de la terre. Deux. édition, 545
Frazer (Sir James George), The Worship of Nature. Vol. 1, 4
Garrod (Miss D. A. E.), The Upper Palæolithic Age in Britain, 833
Glotz (Prof. G.), translated by M. R. Dobie. Ancient Greece at Work: an Economic History of Greece from the Homeric Period to the Roman Conquest, 79
Grierson (Sir George A.), Bihar Peasant Life: being a Discursive Catalogue of the Surroundings of the People of that Province. Second edition, 472
Humphreys (C. B.), The Southern New Hebrides: an Ethnological Record, October 16, Suppt., 22
Kleintitschen (Rev. P. A.), Mythen und Erzahlungen eines Melanesierstammes aus Paparatava, Neupommern, Südsee: Gesammelt und versehen mit Einleitungen und Erklarungen, 688
Mackenzie (D. A.), The Migration of Symbols: and their Relations to Beliefs and Customs, 476
Meek (C. K.), The Northern Tribes of Nigeria: an Ethnographical Account of the Northern Provinces of Nigeria, together with a Report on the 1921 Decennial Census. 2 Vols., 219
Meyerhof (Max), Le monde islamique, October 16, Suppt., 21
Pittard (Prof. E.), translated by V. C. C. Collum, Race and History: an Ethnological Introduction to History, 545
Sampson (Dr. J.), The Dialect of the Gypsies of Wales: being the Older Form of British Romani preserved in the Speech of the Clan of Abram Wood, 291
Spelæological Society, Proceedings of the, for 1925. No. 3, Vol. 2, 652
Wilder (Prof. H. H.), The Pedigree of the Human Race, 260
Wissler (Prof. C.), The Relation of Nature to Man in Aboriginal America, 260

Biology:
Australia: Save, a Plea for the Right Use of our Flora and Fauna, by various writers, edited by Sir James Barrett, 218
Baker (E. C. Stuart), Birds. Vol. 3. Second edition (The Fauna of British India, including Ceylon and Burma, edited by Sir Arthur E. Shipley), 45
Baylis (Dr. H. A.), and R. Daubney, A Synopsis of the Families and Genera of Nematoda, 44
Berg (Prof. L. S.), translated by J. N. Rostovtsow, Nomogenesis: or Evolution determined by Law, 617
Bigelow (Prof. R. P.), Directions for the Dissection of the Cat, 407
Biologischen Arbeitsmethoden, Handbuch der. Herausgegeben von Prof. E. Abderhalden Lief. 184. Abt. 9: Methoden zur Erforschung der Leistungen des tierischen Organismus. Teil 2, 1 Hälfte, Heft 4. Methoden der Susswasserbiologie, 691

Borradaile (Dr. L. A.), A Manual of Elementary Zoology. Fifth edition, 513
Bose (Sir Jagadis Chunder), The Nervous Mechanism of Plants, 654
Calkins (Prof. G. N.), The Biology of the Protozoa, 763
Cheeseman (T. F.), Manual of the New Zealand Flora. Second edition, revised and enlarged by the Author. Edited by W. R. B. Oliver, 151
Chemin (Prof. E.), Les mollusques d'eau douce, 765
Claremont (C. L.), A Practical Handbook on Rat Destruction, 407
Clark (A. H.), Animals of Land and Sea, 259
Clark (Dr. R. S.), Rays and Skates: a Revision of the European Species, 800
Darwin (Major L.), The Need for Eugenic Reform, 39
Dennert (Prof. E.), Die intraindividuelle fluktuierende Variabilität: eine Untersuchung über die Abänderung des Pflanzenindividuums und die Periodizität der Lebenserscheinungen, 873
Ellis (A. E.), British Snails: a Guide to the Non-Marine Gastropoda of Great Britain and Ireland, Pliocene to Recent, 909
Gemeinhardt (Dr. K.), Die Gattung Synedra in systematischer, zytologischer und ökologischer Beziehung, 729
Genetica, Bibliographia, Onder redactie van Dr. J. P. Lotsy en Dr. H. N. Kooiman. Deel 1, 766
Gestro e Vinciguerra, Il naturalista viaggiatore. Seconda edizione, 691
von Goebel (Prof. K.), with Biographical Supplement by Frau Prof. Ganzenmüller, translated by H. M. Bower, and edited botanically by Prof. F. O. Bower, Wilhelm Hofmeister: the Work and Life of a Nineteenth Century Botanist, 473
Hampson (Sir George F.), Descriptions of New Genera and Species of Lepidoptera Phalæna of the Subfamily Noctuinæ (Noctuidæ) in the British Museum (Natural History), October 16, Suppt., 24
d'Herelle (Dr. F.), translated by Dr. G. H. Smith, The Bacteriophage and its Behaviour, 183
Hering (Dr. M.), Biologie der Schmetterlinge, 43
Herzog (Prof. T.), Geographie der Moose, 260
Hinton (M. A. C.), Monograph of the Voles and Lemmings (Microtinæ), Living and Extinct. Vol. 1, 579
Hodge (A. E.), and A. Derham, Goldfish Culture for Amateurs: How to Breed and Rear Goldfish in Aquaria and Ponds, October 16, Suppt., 23
Index Kewensis Plantarum Phanerogamarum. Supplementum Sextum: Nomina et Synonyma Omnium Generum et Specierum ab initio anni MDCCCCXVI usque ad finem anni MDCCCCXX nonnulla etiam antea edita complectens. Ductu et consilio A. W. Hill, October 16, Suppt., 22
Jones (Prof. F. Wood), The Mammals of South Australia, Part 3, 477
Kearton (R.), A Naturalist's Pilgrimage, October 16, Suppt., 23
Keeble (Sir Frederick), Life of Plants, 297
Kennard (A. S.), and B. B. Woodward, Synonymy of the British Non-Marine Mollusca (Recent and Post-Tertiary), 656
Kerr (Prof. J. Graham), Evolution, 329
Latter (O. H.), Biology, 513
Loomis (Prof. F. B.), The Evolution of the Horse, 873
Machin (A.), The Ascent of Man by Means of Natural Selection, 506
Markgraf (Dr. F.), Kleines Praktikum der Vegetationskunde, 766
Marret (L.), Les fleurs de la Côte d'Azur (De Toulon à Menton), 9
Maulik (S.), The Fauna of British India, including Ceylon and Burma. Edited by Sir Arthur E. Shipley, assisted by Dr. H. Scott. Coleoptera: Chrysomelidæ (Chrysomelinæ and Halticinæ), October 16, Suppt., 23
Morgan (Prof. T. H.), The Theory of the Gene, 435
Natural History of the Oxford District, The, edited by Comdr. J. J. Walker, 369
Nicholson (E. M.), Birds in England: an Account of the State of our Bird-life and a Criticism of Bird Protection, October 16, Suppt., 23
Nuttall (G. H. F.), C. Warburton, and L. E. Robinson, Ticks: a Monograph of the Ixodoidea. Part 4: The Genus Amblyomma, Dr. L. E. Robinson, 151
Osborn (Prof. H. F.), Evolution and Religion in Education: Polemics of the Fundamentalist Controversy of 1922 to 1926, 652
Paton (Prof. D. Noel), The Physiology of the Continuity of Life, 902
Pflanzenanatomie, Handbuch der, Herausgegeben von Prof. K. Linsbauer. Lief. 13 (II., 2B., Bg. 1-4). 2 Abt., 2 Teil: Pteridophyten und Anthophyten. Band IX. 2: Die Vegetationsorgane der Anthophyten. Organe besonderer physiologischer Dignität. A: Die Absorptionsorgane der parasitischen Samenpflanzen, Prof. A. Sperlich, 9. Lief. 15. Abt. 2, Teil 2. Band 9. Lief. 14. Abt. 2, Teil 2. Band 10, 836
Pia (J.), Pflanzen als Gesteinsbildner, 585
Pycraft (W. P.), Camouflage in Nature, 795
Reiss (Dr. P.), Le *pH* intérieur cellulaire, 836
Savory (T. H.), British Spiders: their Haunts and Habits, October 16, Suppt., 22
Smith (Miss Annie Lorrain), A Monograph of the British Lichens: a Descriptive Catalogue of the Species in the Department of Botany, British Museum. Part 2. Second edition, 440
Stempell (W.), Zoologie im Grundriss. Dritte, vierte und fünfte Lief., 835
Tabulae Biologicae, Herausgegeben von C. Oppenheimer und I. Pincussen. Band 2, 873
Thorburn (A.), British Birds. New edition. In 4 vols. Vol. 3, 585
Tierwelt der Nord- und Ostsee, Die, Herausgegeben von G. Grimpe und E. Wagler. Lief. 2 (Teil 2. d_1, 12. h_1). Teil 2. d_1: Noctiluca, von A. Pratje, Teil 12. h_1: Teleostei Physoclisti, 10. Heterosomata, von W. Schnakenbeck. Lief. 3 (Teil 9. c_1, 9 c_2, 12 i_1). Teil 9 c_1: i. Opisthobranchia; ii. Pteropoda, von H. Hoffman; Teil 9 c_2: Scaphopoda, von Tera van Bentham Jutting; Teil 12. i_1: 1. Amphibia; ii. Reptilia, von R. Mertens, 223. Lief. 4. Teil 7, c_1. Teil 12, c Teil 12, g_1, 836
Walker (N.), An Introduction to Practical Biology: a Course of Work based chiefly upon the Plant and arranged for Use without Special Apparatus in either the Class-room or the Home, 440
Wicken Fen, The Natural History of, edited by Prof. J. S. Gardiner. Part 3, 620
Zoologie, Handbuch der. eine Naturgeschichte der Stämme des Tierreiches, Gegründet von Prof. Willy Kükenthal, Herausgegeben von Dr. T. Krumbach. Dritter Band: Tardigrada, Pentastomida, Myzostomida, Arthropoda: Allgemeines, Crustacea, Arachnoidea Erste Lief. Zweite Lief. Fünfter Band: Solenogastres, Mollusca, Echinodermata. Erste Lief. Zweite Lief., 114

Chemistry:

Allen's Commercial Organic Analysis, edited by S. S. Sadtler, Dr. E. C. Lathrop, and C. A. Mitchell. Vol. 4. Fifth edition, 222
Alterthum (Dr. H.), Wolfram: Fortschritte in der Herstellung und Anwendung in den letzten Jahren, 80
Applied Chemistry, Reports of the Progress of. Vol. 10, 1925, 583
Arrhenius (Dr. O.) Kalkfrage, Bodenreaktion, und Pflanzenwachstum, 584
Bentley (A. O.), and J. E. Driver, A Text-book of Pharmaceutical Chemistry, 113
Chemistry: Industrial, a Manual for the Student and Manufacturer, edited by A. Rogers. Fourth edition. In 2 Vols., 548
Cole (S. W.), Practical Physiological Chemistry. Seventh edition. October 16, Suppt., 27
Colloid Chemistry. Theoretical and Applied, collected and edited by J. Alexander. Vol. 1: Theory and Methods, 585
Cox (Dr. H. E.), The Chemical Analysis of Foods: a Practical Treatise on the Examination of Foodstuffs and the detection of Adulterants, 115

Dale (Dr. H. H.), Prof. J. C. Drummond, Prof. L. J. Henderson, and Prof. A. V. Hill, Lectures on certain Aspects of Biochemistry, 403
Darmstaedter, Prof. Dr. phil. Dr. jur. h.c. Ludwig, Ehrenmitglied des Staatsinstituts für experimentelle Therapie und des Georg Speyer Hauses in Frankfurt am Main zu seinem 80 Geburtstage am 9 August 1926
Davidson (A), Intermediates for Dyestuffs, 689
Dobson (Dr. G. M. B.), I. O. Griffith, and Dr. D. N. Harrison, Photographic Photometry: a Study of Methods of Measuring Radiation by Photographic Means, 689
Duval (J.), Le problème de chimie: recueil de problèmes inédits avec leurs solutions à l'usage de la Classe de mathématiques spéciales des candidats au S.P.C.N., au M.P.C., au Baccalauréat (M.E.), aux Grandes Écoles et à divers concours. Lois générales, métalloïdes, chimie organique, 691
Eucken (Prof. A.), translated and adapted by Dr. E. R. Jette and Prof. V. K. Lamer, Fundamentals of Physical Chemistry: for Students of Chemistry and Related Sciences, 42
Evers (N.), The Chemistry of Drugs, 113
Fürth (Prof. O.), Lehrbuch der physiologischen und pathologischen Chemie in 75 Vorlesungen: für Studierende, Ärzte, Biologen und Chemiker. Band 1, Vorl. 1 bis 16, 800
Haslam (Prof. R. T.), and Prof. R. P. Russell, Fuels and their Combustion, 905
Heaton (N.), Volatile Solvents and Thinners used in the Paint and Varnish Industries, 114
Hevesy (Dr. G.), and Dr. F. Paneth, translated by Dr. R. W. Lawson, A Manual of Radioactivity, 475
Immunochemical Studies, edited by Prof. C. H. Browning, 910
Joel (Dr. E.), Das kolloide Gold in Biologie und Medizin: die Goldsolreaktion Liquor Cerebrospinalis, 77
Judge (A. W.), Stereoscopic Photography: its Application to Science, Industry, and Education, 185
Karrer (Prof. P.), Einführung in die Chemie der polymeren Kohlenhydrate: ein Grundriss der Chemie, der Stärke, des Glykogens, der Zellulose und anderer Polysaccharide, 77
Levy (Dr. S. I.), An Introduction to Industrial Chemistry, 548
Lewis (W. K.), and Prof. A. H. Radasch, Industrial Stoichiometry: Chemical Calculations of Manufacturing Processes, 905
Lloyd (Dr. Dorothy Jordan), Chemistry of the Proteins and its Economic Applications, 910
Morrell (Dr. R. S.), and H. R. Wood, The Chemistry of Drying Oils, 79
Pascal (Prof. P.), Explosifs, poudres, gaz de combat: leçons professées à la Faculté des Sciences de Lille, 150
Photochemical Reactions in Liquids and Gases: a general discussion held by the Faraday Society, October 1925. October 16, Suppt., 26
Photographische-chemische Industrie, Die: die erzeugung und Verarbeitung photographisch-chemischer Präparate, 185
Poucher (W. A.), Perfumes, Cosmetics and Soaps, with especial reference to Synthetics. 2 Vols. Second edition, 113
Rideal (Dr. E. K.), An Introduction to Surface Chemistry, 653
Schotz (Dr. S. P.), Synthetic Rubber, 510
Thorpe (Sir Edward), A Dictionary of Applied Chemistry. Vol. 6. Revised and enlarged edition. October 16, Suppt., 26
Tinkler (Prof. C. K.), and Helen Masters, Applied Chemistry: a Practical Handbook for Students of Household Science and Public Health. Vol. 2: Foods, 8
Vernon (C. G.), An Introduction to Chemistry, October 16, Suppt., 26
Waite (A. E.), The Secret Tradition in Alchemy: its Development and Records, 869
Wall (E. J.), The History of Three-colour Photography, 185
Zsigmondy (Prof. R.), und P. A. Thiessen, Das kolloide Gold, 77

Engineering:

Civil Aviation: a Report by the Joint Committee on Civil Aviation of the U.S. Department of Commerce and the American Engineering Council, 149
Cotton (H.), Electrical Technology: a Textbook for the following Examinations, National Certificate, City and Guilds, A.M.I.E.E., B.Sc. Engineering. In 8 Parts. Part 1, 691
Lacey (J. M.), Hydrology and Ground Water: a Practical Text-book for the use of Civil Engineers, Surveyors, Students, and all those who deal with the control of Water, 440
Marsh (T. A.), Combustion in the Power Plant: a Coal Burner's Manual. Second printing, 9
Murray (W. S.), Superpower: its Genesis and Future, 334
Thomas (Dr. W. N.), Surveying. Second edition, 440

Geography and Travel:

Birkeland (K. B.), The Whalers of Akutan: an Account of Modern Whaling in the Aleutian Islands, 620
Buchanan (Capt. A.), Sahara, 189
Fairgrieve (J.), Geography in School, 45
Fitzgerald (W.), The Historical Geography of Early Ireland, 334
Keltie (Sir John Scott), and S. C. Gilmour, Adventures of Exploration. Book 5: Australia and New Zealand, 910
Lehmann (Prof. R.), Physische Erdkunde: die Gestaltung der Erdoberfläche, 656
Little (O. H.), The Geography and Geology of Makalla (South Arabia). With two Appendices by Prof. G. Stefanini and P. Pallary, 332
Practical Hints to Scientific Travellers, edited by Prof. H. A. Brouwer. 3 Vols., 44
Statesman's Year Book, The, 1926, edited by Sir John Scott Keltie and Dr. M. Epstein, 45
Travel and Travellers of the Middle Ages, edited by Prof. A. P. Newton, 407
Whitbeck (Prof. R. H.), Economic Geography of South America, 115

Geology and Mineralogy:

Brouwer (Prof. H. A.), The Geology of the Netherlands East Indies: Lectures delivered as Exchange-Professor at the University of Michigan in 1921-22, recorded and prepared by L. M. Gould, 80
Coleman (Prof. A. P.), Ice Ages: Recent and Ancient, 293
Davison (E. H.), Handbook of Cornish Geology, October 16, Suppt., 24
Eitel (Prof. W.), Physikalisch-chemische Mineralogie und Petrologie: die Fortschritte in den letzten zehn Jahren, 152
Geological Survey, Scotland, Memoirs of the: The Economic Geology of the Central Coalfield of Scotland. Area 5: Glasgow East, Coatbridge and Airdrie; with Chryston, Glenboig, Greengairs, Slamannan, Caldercruix, and Salsburgh. Dr. C. T. Clough, L. W. Hinxman, W. B. Wright, E. M. Anderson, and R. G. Carruthers; with contributions from Dr. R. Kidston, Dr. G. W. Lee. Second edition, with additions by M. Macgregor, 656
Geologisch dargestellt, Die Kriegsschauplätze 1914–1918. Herausgegeben von Prof. J. Wilser. Heft 2 (zu Heft 1 gehörig): Lothringen. Von Prof. E. Kraus. (Abschnitt Jura) von Dr. W. Klüpfel. Heft 3: Zwischen Maas und Mosel. Von Prof. R. Lais. Heft 13: Sudostmazedonien und Kleinasien. Von Prof. O. H. Erdmannsdoerffer, Prof. C. Lebling, Prof. K. Leuchs, Dr. K. Oswald, Dr. A. Wurm, 152
Hatch (Dr. F. H.), The Petrology of the Igneous Rocks. Eighth edition, revised with the assistance of Dr. A. K. Wells, 8
Johnstone (Prof. J.), A Study of the Oceans, 78
La Touche (T. H. D.), A Bibliography of Indian Geology. Part iv. Palæontological Index, 334

Miller (Prof. W. J.), An Introduction to Historical Geology with special reference to North America. Second edition, 189

Soulier (P.), Le relief de la terre : ses origines, ses lois, son évolution ; principes nouveaux de géographie physique, 259

Tams (Prof. E.), Die Frage der Periodizität der Erdbeben : eine Darstellung des gegenwärtigen Standes der einschlägigen Untersuchungen, 5

Withers (T. H.), British Museum (National History). Catalogue of the Machæridia (Turrilepas and its Allies) in the Department of Geology, 512

von Zittel (Prof. K. A.), Grundzüge der Paläontologie (Paläozoologie), Neubearbeitet von Prof. F. Broili und Dr. M. Schlosser Abt. 1. : Invertebrata. Sechste verbesserte und vermehrte Auflage. Abt. 2 : Vertebrata. Vierte vermehrte und verbesserte Auflage, 369

Mathematical and Physical Science :

Ambronn (Dr. R.), Methoden der angewandten Geophysik, 620

Arrhenius (Prof. S.), Aus dem Schwedischen übersetzt von Dr. Finkelstein, Erde und Weltall, 656

Bagchi (Dr. H.), A Course of Geometrical Analysis, 766

Bardet (Dr. J.), Atlas de spectres d'arc : tableaux d'analyse pour les recherches spectrochimiques, 509

Biologischen Arbeitsmethoden, Handbuch der, Herausgegeben von Prof E. Abderhalden Lief. 187. Abt. 2 : Physikalische Methoden, Teil 2, Heft 1. Das Interferometer, seine Anwendung zur Untersuchung von Gasen und Flüssigkeiten, von P. Hirsch ; Ultramikroskopie, von Marie Anna Schirmann, Refraktometrie, von H. Kessler, 437

Bromwich (Dr. T. J. I'a), An Introduction to the Theory of Infinite Series Second edition, revised with the assistance of Dr. T. M. MacRobert, 112

Brown (F. G. W.), Higher Mathematics : for Students of Engineering Science, 80

Clark (C. H. Douglas), The Basis of Modern Atomic Theory, 365

Cullis (Prof. W. E.), Matrices and Determinoids. Vol. 3, Part 1., 295

Dakin (A.), Practical Mathematics, Part 2, October 16, Suppt., 27

Danjon (A.), Description du ciel, 620

Descartes, René, The Geometry of, Translated by David Eugene Smith and Marcia L. Latham, with a facsimile of the first edition, 1637, 400

Dunoyer (L.), translated by J H. Smith, Vacuum Practice, 331

Durell (C. V.), and R. M. Wright, An Introduction to the Calculus, 513

Edser (E.), General Physics for Students : a Text-book on the Fundamental Properties of Matter Reprinted, with additions, 800

Exakten Naturwissenschaften, Ergebnisse der. Fünfter Band, 729

Experimentalphysik, Handbuch der, Herausgegeben von W. Wien und F. Harms. Band 1, 909

Forbes (Prof. G.), The Wonder and the Glory of the Stars, 512

Hahn (Prof. O), Was lehrt uns die Radioaktivität über die Geschichte der Erde ? October 16, Suppt., 25

Helmholtz's Treatise on Physiological Optics. Translated from the third German edition. Edited by Prof. J. P. C. Southall. Vol. 3 : The Perceptions of Vision, 74

Hills (W. D.), Mechanics and Applied Mathematics : Statics, Dynamics, Hydrostatics. Part 2 : Applied Mathematics, October 16, Suppt., 27

Hobson (Prof E. W.), The Theory of Functions of a Real Variable and the Theory of Fourier's Series. Second edition, Vol. 2, 112

Honoré (F.), Le radium : découverte de la radioactivité et du radium, origine de l'énergie radioactive, le radium dans la nature, ses emplois usuels, 9

Karpinski (Prof L. C.), The History of Arithmetic, 407

Kayser (Prof. H.), Tabelle der Hauptlinien der Linienspektra aller Elemente nach Wellenlänge geordnet, 509

Korn (Prof. A.), Die Konstitution der chemischen Atome : Mechanische Theorien in Physik und chemie, 365

Langworthy (Florence), Reflections on the Structure of the Atom, October 16, Suppt., 26

Lebedef (P.), Traduit du russe par T. Kousmine, Pression de la lumière, 45

Loney (Prof. S L.), Solutions of the Examples in a Treatise on Dynamics of a Particle and of Rigid Bodies, 656

Mach (Prof. E.), translated by Dr. J. S. Anderson and Dr A. F A. Young, The Principles of Physical Optics : an Historical and Philosophical Treatment, 437

Mair (D. B.), Fourfold Geometry : being the Elementary Geometry of the Four-Dimensional World, 368

Mawson (Sir Douglas), Australasian Antarctic Expedition, 1911–14, Scientific Reports, Series B. Vol. 2, Part 1. Records of the Aurora Polaris, 366

Nodon (Dr A.), Éléments d'astrophysique : introduction à l'étude de l'énergétique solaire et stellaire, 8

Osgood (Prof. W. F.), Advanced Calculus, October 16, Suppt., 27

Phaff (Rear-Admiral), International Hydrographic Bureau Special Publication No. 12 : Investigation of Harmonic Constants, Prediction of Tide and Current, and their Description by Means of these Constants. Supplement to Special Publication No. 12 : Tables for the Calculation of Tides by means of Harmonic Constants, October 16, Suppt., 25

Reilly (Prof. J.), Prof. W N. Rae, and Dr. T. S. Wheeler, Physico-Chemical Methods, 908

Roberts (Prof. Maria M.), and Prof. Julia T. Colpitts, Analytic Geometry. Second edition, October 16, Suppt., 28

Rothé (E.), Le tremblement de terre, 223

Schmidt (Prof. W.), Probleme der kosmischen Physik. Band 7 : Der Massenaustausch in freier Luft und verwandte Erscheinungen, October 16, Suppt., 26

Siddons (A. W.), and R. T. Hughes, Practical Geometry : based on the various Geometry Books by Godfrey and Siddons Theoretical Geometry : based on the various Geometry Books by Godfrey and Siddons, October 16, Suppt., 28

Størmer (Prof. C.), Résultats des mesures photogrammétriques des Aurores boréales observées dans la Norvège méridionale de 1911 à 1922, 797

Sullivan (J. W. N.), Three Men discuss Relativity, 80

Taylor (Prof L. W.), A Numerical Drill Book on Physics, October 16, Suppt., 26

Walsh (J. W. T.), Photometry, 581

Wegemann (Prof. G.), Grundzüge der mathematischen Erdkunde, 513

Weiss (Prof. P.), et G. Foex, Le magnétisme, 584

Woods (Prof. F. S.), Advanced Calculus : a Course arranged with special reference to the needs of Students of Applied Mathematics, October 16, Suppt., 27

Medical Science :

Crookshank (Dr F. G.), Migraine and other Common Neuroses : a Psychological Study, 223

Cushny (Prof. A. R.), The Secretion of the Urine. Second edition, 477

Hamer (Sir William H.), and Dr. C. W. Hutt, A Manual of Hygiene, 799

Hill (Prof. Leonard), Sunshine and Open Air : their Influence on Health, with special reference to the Alpine Climate. Second edition, 330

Imperial Social Hygiene Congress, Wembley, October 1925, Proceedings of the, 762

Jackson (Prof. C. M.), The Effects of Inanition and Malnutrition upon Growth and Structure, 152

Kato (Prof. G.), The Further Studies on Decrementless Conduction, 476

MacLean (Prof. H.), Modern Views on Digestion and Gastric Disease, 439

Monumenta Medica. 3 : The Earliest Printed Literature on Syphilis ; being Ten Tractates from the Years 1495–98. In complete Facsimile, with an Introduction and other accessory material by Prof. K Sudhoff, adapted by Dr C. Singer, 188

Nicholson (Dr. G. W.), The Nature of Tumour Formation: the Erasmus Wilson Lectures delivered before the Royal College of Surgeons of England, on Feb. 23, 25, and 27, 1925, 404
Paterson (Dr. D.), and Dr. J. F. Smith, Modern Methods of Feeding in Infancy and Childhood, 439
Pickett-Thomson Research Laboratory, Annals of the. Vol. 2, No. 2, July 1926, 832
Roberts (Morley), Malignancy and Evolution: a Biological Inquiry into the Nature and Causes of Cancer, 404
Stopes (Dr. Marie C.), The Human Body, 115

Metallurgy:
Metals, Institute of, The Journal of the, edited by G. Shaw Scott. Vol 35, No. 1, October 16, Suppt., 28
Monypenny (J. H. G.), Stainless Iron and Steel, 3
Steel-making Processes: The Physical Chemistry of, a General Discussion held by the Faraday Society and the Iron and Steel Institute, June 1925, 296

Meteorology:
Cave (C. J. P.), Clouds and Weather Phenomena: for Artists and other Lovers of Nature, 369
Dobson (Dr. G. M. B.), The Uppermost Regions of the Earth's Atmosphere: being the Halley Lecture delivered on 5 May 1926, 221
Hobbs (Prof. W. H.), The Glacial Anticyclones: the Poles of the Atmospheric Circulation, 111

Miscellaneous:
Abercrombie (Prof. P.), and others: The Making of the Future. The Coal Crisis and the Future: a Study of Social Disorders and their Treatment, 9
Annual Register: The, a Review of Public Events at Home and Abroad for the year 1925 Edited by Dr. M. Epstein, 260
Ashley (Sir William), Business Economics, 835
British Scientific and Technical Books, A Catalogue of, Suppt, 1925, arranged by Daphne Shaw, October 16, Suppt., 28
Chambers's Encyclopædia: a Dictionary of Universal Knowledge. New edition. Edited by Dr. D. Patrick and W. Geddie. Vol. 8, 691
Coal: Ways to Reconstruction. Being a Sequel to "The Coal Crisis and the Future," 334
Cobham (Alan J.), My Flight to the Cape and Back, 189
Commission Internationale de l'Éclairage en succession à la Commission Internationale de Photométrie. Sixième session, Genève, Juillet 1924, 333
Darmstaedter (Prof. L.), Naturforscher und Erfinder: Biographische Miniaturen, 620
Dowd (Mary T.), and Jean D. Jameson, Food, its Composition and Preparation: a Textbook for Classes in Household Science. Second Edition, 909
Doyle (Sir Arthur Conan), The History of Spiritualism. 2 Vols., 147
'Eötvös' Torsion Balance, The, 406
Essex: an Outline Scientific Survey; including Geology, Botany, and Zoology, edited by G. E. Hutchings, 188
Gamble (S. G.), A Practical Treatise on Outbreaks of Fire, 728
Holmyard (E. J.), Science: an Introductory Textbook, 297
Marmer (H. A.), The Tide, 907
Nursery School to University: From, a Labour Policy, 871
Oman (Sir Charles), Castles, 115
Radcliffe (W.), Fishing from the Earliest Times. Second edition, 907
Raleigh, The Letters of Sir Walter (1879–1922), edited by Lady Raleigh. 2 Vols., 7
Rawnsley (W. F.), Edward Thring, Maker of Uppingham School, Headmaster 1853 to 1887, 729
Science and Civilization, Essays arranged and edited by, F. S. Marvin, 547
Science in Schools, Teaching, J. Brown, October 16, Suppt., 28
Scotland, Rural, during the War, D. T. Jones, J. F. Duncan, H. M. Conacher, and W. R. Scott. With an Appendix by J. P. Day, and an Introduction by W. R. Scott, October 16, Suppt., 24
Seton-Watson (Dr. R. W.), Sarajevo: a Study in the Origins of the Great War, 619
Sherrington (Sir C. S.) The Assaying of Brabantius and other Verse, 363
Soddy (Prof. F.), Wealth, Virtual Wealth, and Debt: the Solution of the Economic Paradox, 760
Stewart (H. F.), Francis Jenkinson, Fellow of Trinity College, Cambridge, and University Librarian: a Memoir, 476
Teggart (Prof. F. J.), Theory of History, 187
Webb (Beatrice), My Apprenticeship, 831
Wells (H. G.), Mr. Belloc objects to "The Outline of History," 872; The Outline of History: a Plain History of Life and Mankind. New edition, Parts 1-24, 872; The World of William Clissold: a Novel at a New Angle. 3 Vols., 723

Philosophy and Psychology:
Aristotle, The Works of, translated under the editorship of Prof. W. D. Ross. Categoriae and De Interpretatione, by E. M. Edghill; Analytica Priora, by A. J. Jenkinson; Analytica Posteriora, by G. R. G. Mure, 152
Boody (Dr. Bertha M.), A Psychological Study of Immigrant Children at Ellis Island, 406
Bousfield (Dr. P.), Pleasure and Pain: a Theory of the Energic Foundation of Feeling, 257
Bretherton (C. H.), Midas: or, The United States and the Future, 76
Coster (Geraldine), Psycho-Analysis for Normal People, 477
Cunningham (Prof. G. W.), Problems of Philosophy: an Introductory Survey, 296
Dingwall (E. J.), The "Margery" Case, 618
Edgell (Dr. B.), Mental Life: an Introduction to Psychology, 549
Fuller (Col. J. F. C.), Atlantis: America and the Future, 76
Furfey (Dr. P. H.), The Gang Age: a Study of the Preadolescent Boy and His Recreational Needs, 257
Geil (Dr. W. E.), The Sacred 5 of China is the 5th Book on China, 223
Hazlitt (Victoria), Ability: a Psychological Study, October 16, Suppt., 21
Hempelmann (Prof. F.), Tierpsychologie: vom Standpunkte des Biologen, 867
Herrick (Prof. C. J.), Brains of Rats and Men: a Survey of the Origin and Biological Significance of the Cerebral Cortex, October 16, Suppt., 21
Howes (F.), The Borderland of Music and Psychology, 407
Inge (Dean W. R.), Science and Ultimate Truth: Fison Memorial Lecture, 1926, 109
Jones (Dr. Tudor), Nature, Thought and Personal Experience, 189
Judd (Prof. C. H.), The Psychology of Social Institutions, 585
Magson (Dr. E. H.), How we Judge Intelligence: an Investigation into the Value of an Interview as a Means of estimating General Intelligence, 687
Masson-Oursel (P.), Comparative Philosophy, 297
Matthews (Rev. Dr. W. R.), God and Evolution, 543
Morgan (Prof. C. Lloyd), Life, Mind, and Spirit: being the Second Course of the Gifford Lectures delivered in the University of St. Andrews in the year 1923 under the general title of "Emergent Evolution," 582
Myers (Dr. C. S.), and F. C. Bartlett, A Text-book of Experimental Psychology: with Laboratory Exercises. Third edition. Part 2: Laboratory Exercises, 729
Newman (Prof. H. H.), The Gist of Evolution, 543
Phelps (Edith M.), Selected Article on Evolution, 543
Richmond (Dr. Winifred), The Adolescent Girl: a Book for Parents and Teachers, 257
Santayana (G.), Dialogues in Limbo, 188

Sorley (Prof. W R.), Tradition: the Herbert Spencer Lecture, 1926, 110
Thalbitzer (Dr. S.), translated by M. G. Beard, Emotion and Insanity, 405
Turner (Dr. J E.), A Theory of Direct Realism: and the Relation of Realism to Idealism, 438
Watson (J. M.), Science as Revelation, 543

Technology:
Bennett (C. N.), Elements of Photogravure, Photo Printing from Copper Plates: Screen Photogravure simply explained, with full Working Instructions and an Explanatory Chapter on Modern Rotary Gravure Printing, 513
Mitchell (C. Ainsworth), Vinegar: its Manufacture and Examination Second edition, 834
Pitman's Building Educator, edited by R. Greenhalgh. Part I, 872

Rhamnose, Natural, The Optical Inverse of, E. Votoček and F. Valentin, 250
Rhodes: Trust, Statement for 1925–26, 824; University College, Grahamstown, Dr. N. J. G. Smith appointed professor of botany in the, 393
Rhodesia Museum, Report for 1924, 493
Rhynie Crustacean, The, Dr. W. T. Calman, 89
Richard of Wallingford: and his Rectangulus, Dr. R. T. Gunther, 773; Commemoration of, 812
Rinderpest, Insects and the Transmission of, S. K. Sen, 460
Rivers memorial medals of the Royal Anthropological Institute awarded to Prof. E. Westermarck and Dr. A. P. Maudslay, 814
Rockefeller Foundation: International Health Board of the, Report for 1925, 816; The, G. E. Vincent, 853
Rock Salt, An Artificial Blue Colouration of, at Room Temperature, K. Przibram, 827
Rocks: Igneous, The Petrology of the, Dr. F. H. Hatch. Eighth edition, revised with the assistance of Dr. A. K Wells, 8; The Compressibility of, L. H. Adams and R E. Gibson, 354
Roman Catholic Church, Scientific Work of Priests of the, Dr. J. J. Walsh, 851
Romani, Welsh, Dr. J. Sampson; Prof. R. L. Turner, 657
Rontgen Society, election of officers, 316
Root Development of Field Crops, Prof. J. E. Weaver, 258
Ross Institute and Hospital: The, opening by the Prince of Wales, 124
Rotation and Relativity, A. Jaques and J. S. Morgan, 194
Rotatory Power of certain Active Bodies, The Influence of the Viscosity on the Specific, P. and J. Achalme, 179
Rothamsted Conferences, I., 129
Royal: Air Force Display of July 3, The, 58; Botanic Gardens, Peradeniya, Annals of the, New Form of the, 494; English Arboricultural Society, Summer meeting of the, 424; Institution, Prof. J. S. Huxley appointed Fullerian professor of physiology at the, 853: Meteorological Society: *Memoirs* of the, 530, The Howard prize awarded to Cadet B. W Harman, 130; Photographic Society's Exhibition, The, 430; Society: Anniversary Meeting of the, Presentation of medals, 821; medallists, The; recommended officers of the, 705; of Arts, Albert medal of the, Prof. P. Sabatier awarded the, 24; of Edinburgh, electing officers of, 672; of Medicine, the gold medal of the, presented to Prof J. S. Haldane, 853
Rubber: Natural or Synthetic?, 510; Synthetic, Dr. S. P. Schotz, 510
Rubidium- and Cæsium-like Doublets of Stripped Atoms, R. C. Gibbs and H. E White, 682
Rubrene: A Coloured Hydrocarbon, C. Moureu, C. Dufraisse, and P. M. Dean, 142; Peroxide: C. Moureu, C. Dufraisse, and P. M. Dean, 214; New Experiments, C. Moureu, C. Dufraisse, and C. L. Butler, 358
Ruby Mine District of Burma, Minerals from the, F. D. Adams and R. P. D. Graham, 568
Rural Scotland during the War, D. T. Jones, and others, October 16, Suppt., 24
Russia, Scientific: Activity in, 566; Work and Institutions in, position of, Prof. R. R. Gates, 599
Russian: Geographical Society: The, 859; The Seventy-fifth Anniversary of the Eastern Siberian Section, 924; Scientific Expeditions to Arctic Russia and Siberia, 168
Rutherford, Sir Ernest, Prof. N. Bohr, December 18, Suppt., 51
Ruwenzori, Expeditions to, G. N. Humphreys, 528

Sahara, Capt. A. Buchanan, 189
St. Andrews University: A. D. Peacock appointed professor of natural history in University College, Dundee; Miss E. Philip Smith appointed lecturer in botany in University College, Dundee; Miss Christina H. Sutherland appointed assistant in natural history in the United College, St. Andrews, 32; conferment of a doctorate upon Prof. W. J. Walker, 68; Dr. J. D. McBeath Ross appointed lecturer in physical chemistry in University College, Dundee; J. M. Hay appointed lecturer in mechanical engineering and machine design in University College, Dundee, 609; Installation of Dr. F. Nansen as Rector; conferment of honorary degrees, 715
Salix triandra, Biochemical Researches on the Composition of, M. Bridel and C. Béguin, 359
Salmon Fisheries, Literature of, W. J. M. Menzies, 642
Salters' Institute of Industrial Chemistry, awards of the, 387
Salt-water Fish, The Accommodation of, to Supersaturated Waters, C. Richet and Oxner, 755
Samoa, Weather in, 674
Samoan Foraminifera, J. A. Cushman, 856
Samples taken at Random from a Bivariate Normal Population, the Mode of Distribution of the Constants of, Prof. Karl Pearson, 33
San Blas Indians, Music of the, Frances Densmore, 317
Sarajevo: a Study in the Origins of the Great War, Dr. R. W. Seton-Watson, 619
Scenery, Forms in, Grouping of, Dr. Vaughan Cornish, 892
Schmetterlinge, Biologie der, Dr. M. Hering, 43
Schroedinger and the Lanczos Theories, Solution of the Problem of the Simple Oscillator by a Combination of the, C. Eckart, 396
Schroedinger's Quantum Theory and the Stark Effect, Dr. P. S. Epstein, 444
Schultenite, a New Mineral from South-West Africa, Dr. L. J. Spencer, 754
Science: A Half-way House of, Helene E. Bargmann, 867; an Introductory Textbook, E. J. Holmyard, 297; and Engineering, Prof. W. F. Durand, 387; and Psychical Research, Dr. R J. Tillyard, 147, 300, 370, 587, 735; A. A. Campbell Swinton, 299, 442, 553, 659, 692; Dr. J. P. Lotsy; Sir Arthur Conan Doyle, 370, 553, 659; Sir Bryan Donkin, 480, 658; E. J. Dingwall, 480; H. Price, 553; W. W. L, 588, 693; Dr. J. W. French, 589; Sir Oliver Lodge, 622, J. Reid Moir, 694; and Religion, 577; and Spiritualism, 721; and the Press, 757; Dr. W. M. Cumming, 842; and Ultimate Truth: Fison Memorial Lecture, 1926, Very Rev. W. R. Inge, 109; as Revelation, J. M. Watson, 543; Education, and Mr. H. G. Wells, Prof. H. E. Armstrong, 723; forthcoming books of, 570; History of, Postulates in the, G. A. Miller, 682; in Antiquity, Dr. J. Newton Friend, 236, in Schools, Teaching, J. Brown, October 16, Suppt., 28; Museum: Report on the, 1925, 316; South Kensington: Exhibition of Television Apparatus at the, 388; Exhibition of National Physical Laboratory Apparatus, 706; An Exhibit of Adhesives at the, 924; Religion and, Archbishop of York; Dr J. G. Adami, 562; Rev. J. C. Hardwick; Sir Oliver Lodge, 563; Service *Weekly News-Letter*, The, 671; The Influence of, E. J. Holmyard, 547, The State and, 181
Scientific: Achievement and Aptitude, 685; and Industrial Research: Advisory Council to the Committee of the Privy Council for, Profs. V. H. Blackman, F. G. Donnan, and F. A. Lindemann appointed members of the, 424; in Australia and New Zealand, 597; and Technical Books, Recent, July 31, Suppt., iii.; August 28, Suppt., v.; September 25, Suppt., v.; October 30, Suppt., v.; November 27, Suppt., v.;

December 25, Suppt., iii.; Education, Man and Method in, Sir Thomas Holland, August 7, Suppt., 20; Instruments, A Royal Collection of, R. S. Whipple, 896; Journals, The Disposal of, B. M. Headicar, 10, Method, Francis Bacon and, Dr. C D. Broad, 523; Research and Service, Prince of Wales, August 7, Suppt., 9; Travellers, Practical Hints to, edited by Prof. H. A. Brouwer. 3 Vols., 44
Scolopendra, Origin of Yolk in the Eggs of, Prof Vishwa Nath and Tasdique Husain, 660
Scorpions, The Alimentary Canal of, Profs E. N. Pavlovsky and E. J. Zarin, 132
Scots and Corsican Pines, Values of, W. E Hiley, 642
Scottish · Marine Biology, 818; Sea Trout, G. H. Nall, 206
Script for Use in the Munda Group of Languages, P. O. Bodding, 889
Scurvy, Experimental · The Energy Metabolism in the Course of, X. Chahovitch, 107; The True Specific Régime of, N. Bezssonoff, 899
(*Scyliorhinus stellaris*), A Breeding Ground of the Nursehound, in the Fal Estuary, Dr. J. H Orton, 732
Sea Action Committee, Sixth (interim) Report of the, 491
Sea-birds: their Relation to the Fisheries and Agriculture, Dr. W. E. Collinge, 920
Selenium . Cells, The Sensitivity of, Prof. A. O. Rankine, 13; The Optical Properties of, in the Conducting Form, Miss P. Nicol, 288, The Thermal Properties of the Various Varieties of, P. Mondain-Monval, 142
Sepik River, New Guinea, A British Expedition to the, 356
Series Spectra of the First Long Period, Dr. R. J. Lang, 119
Serpentine of Piossasco (Piedmont), The Minerals of the, E. Repossi and V Gennaro, 719
Sex, Blood Reactions and, Dr F A. E. Crew, 85
Shadouf, The Egyptian, and the Rate of Human Work, H. S. Rowell; P. J. H. Unna, 481
Sheffield, University: of, Recent Developments in the, 55; New Metallurgical and Engineering Research Laboratories, Address by Sir Robert Hadfield at the opening of the, 128; Department of Glass Technology, Experimental Researches and Reports. Vol. 8, 351
Shineton Shales of the Wrekin District, etc., The, C. J. Stubblefield and O. M. B Bulman, 934
Shirley Institute Memoirs. Vol. 4, 1925, 786
Sierra Leone, The Topographical Survey of, 890
Silica, The Action of, on Electrolytes, Prof. J. N. Mukherjee, 517
Silicic Acid Gel, Behaviour of, during the Drying-up Process, K. Krishnamurti, 843
Silicon: -aluminium Alloys, Some Mechanical Properties of, J. D Grogan, 466, Aluminium and, The Alloys of, Dr. A G C. Gwyer, H. W L. Phillips, and others, 498, Dioxide, The Polymorphism of, and the Structure of Tridymite, R. E. Gibbs, 718; Tetrachloride, The Absolute Density and Coefficient of Expansion of, P. L Robinson and H. C Smith, 303; The Atomic Weight of, P. L Robinson and H. C. Smith, 319
Silumin and its Structure, B. Otani, 466
Silver: Halides, Adsorption of Dyes to, Dr. S. E. Shepherd, 913, Impregnation of Zenker-fixed Sections, A Method of, A. Piney, 718, Iodide: in Gelatin Iodobromide Emulsions, E. Huse and C. E. Meulendyke, 84, The Photochemical Decomposition of, E. J. Hartung, 245; Ionisation Potential of, G. Piccardi, 35; The Atomic Weight of, H. L. Riley and H. B. Baker, 857
Simeis Observatory Reflecting Telescope, The, 97
Simia, *S. satyrus*, and *Pithecus*, The Zoological Names, and their Possible Suppression, O. Thomas and M. A. C. Hinton, 411
Singapore Coolies, Craniometry of, Dr G. Harrower, 243
Single Crystals of Metals, The Production of, and some of their Properties, Prof. H. C. H. Carpenter, 266
'Sira' Immersion Oil and Mountant, 566
Sitona hispidula, The Inheritance of Brachypterous and Macropterous Wings in, Dorothy J. Jackson, 192
Skin Constrictor (Psychogalvanic) Reflex, The, Prof. R. J. S. McDowall and Dr. H. M. Wells, 644
Skoparin, Our Knowledge of, F. Hemmelmayr and J. Strehly, 288
Skull of Pithecanthropus Type in Java, The Discovery of a, 639
Skylight at Sunrise and Sunset, Intensity and Polarisation of, Dr. K R. Ramanathan, 337
Smith, William, a mural tablet to, unveiled by Dr. F. A. Bather, 93
Smithsonian Institution, Explorations and Field Work of the, 1925, 350
Smoke Abatement: Bill, The, 21; Conference at Birmingham, 430
Smokeless Fuel for Power, A. S. E Ackermann, 569
Snails: British, a Guide to the Non-Marine Gastropoda of Great Britain and Ireland, Pliocene to Recent, A. E. Ellis, 909
Snell memorial medal of the National Institute of Agricultural Botany, award of the, to Dr. R. N. Salaman, 96
Soap Bubbles, Acoustic Pressures in Case of, Dr. C. Barus, 574
Social . Institutions, The Psychology of, Prof. C. H. Judd, 585, Selection in a Mixed Population, M. J. Herskovits, 791
Sodium, The Estimation of, L. Barthe and E. Dufilho, 142
Soil, Separation of the Finer Particles and Colloidal Constituents of the, by Centrifugation, J. Dumont, 358
Solar: Activity during 1925, G. A. Favaro, 641; and Terrestrial Relationships, Report of Commission on, 167, Atmosphere, Visual Observations of the, Dr. G. E. Hale, 143, Prominence, Large, A. M. Newbegin, 131; Prominences: and the Filaments, Correlation between the, Da Costa Lobo, 359, Persistent, A. A. Buss, 412; Radiation: Dr Abbot, 280, and Weather Forecasting, C F. Marvin and H. H Kimball, 817; Station in South Africa, The New, 242; Research, Some New Possibilities in, Dr. G. E. Hale, July 3, Suppt., 1; Surveys, 19
Solid Solutions, Thermal Anomalies of certain, P. Chevenard, 466
Solvents and Thinness, Volatile, used in the Paint and Varnish Industries, N. Heaton, 114
Sôma, Prof G. J. Dubreuil, 460
South: Africa: A Dinocephalian from, Prof. W. K. Gregory, 353; The Freshwater Isopodan and Amphipodan Crustacea of, K. H. Barnard, 251; The Universities of, Prof. H. C. Notcutt, 753, African: Grasses, E. P. Phillips, 934; Heterosomata, The Chorology of the, with Some Relative Problems, C. von Bonde, 179; Meteorites, On the, Vaalbult, Witklip, and Queen's Mercy, Dr. G. T. Prior, 105; Mollusca, J. R. le B. Tomlin and H. C. Burnup, 317, America, Economic Geography of, Prof. R. H. Whitbeck, 115
Spanish Petrology, Dr. H S. Washington, 674
Special Libraries and Information Bureaux, Association of the Conference of the, 528, 853
Specialised Information in Great Britain and Ireland, A Directory of Sources of, G. F. Barwick appointed editor of, 24
Species: Concept, The, F. Okland, 493; Fluctuations in the Abundance of a, considered Mathematically, Prof. V. Volterra, 558; Origin of, The Problem of the, as it appeared to Darwin in 1859 and as it appears to us To-day, Prof. H. F. Osborn, 270, 591; Variability of, Dr. R. A Fisher and E. B. Ford, 515
Spectra of Metals of the Second Group, Explanation of the, Prof. M. Saha, 695
Spectres d'arc: Atlas de, tableaux d'analyse pour les recherches spectrochimiques, Dr. J. Bardet, 509
Spectrographic Junction between the X-ray Region and the Extreme Ultra-violet, R Thoraeus, 771
Spectrographs and Spectrometers, Improved, Adam Hilger, Ltd., 785
Spectroheliocope, Observations with the, Dr. G. E. Hale, 420
Spectrometers, Direct Reading Wave-length, Bellingham and Stanley, Ltd., 820
Spectroscope, A Small Ultra-violet, R. and J. Beck, Ltd, 427
Spectroscopic Apparatus, The Limit of Resolution of, V. Ronchi, 287
Spectroscopist, Aids for the, 509
Speech, Stress and Rhythm in, J. W. Jeaffreson, 928

Speed Records, The Law of, Prof. A. E. Kennelly, 711
Spelæological Society, Proceedings of the, for 1925. No. 3, Vol 2, 652
Spencer, Herbert, lecture, 1926, Prof. W. R. Sorley, 110
Sperrylite Crystal from the Transvaal, A, Dr. L. J. Spencer, 105
Sphygmo-manometer, A New, W. A. Baum and Co., Inc., 272
Spiders: British, their Haunts and Habits, T. H. Savory, October 16, Suppt., 22; of the Genus *Epeira diadema*, Unexpected and Striking Psychic Facts manifested by, for keeping their Webs in a Vertical Plane, B. Roussy, 395; Spermatogenesis in, Mme. Julia Sokolska; Prof. E. Warren, 207
Spiers, F. S, proposed memorial to, 95
Spinal Cord, On the Rhythmical Functions of the, W. A. Jolly, 467
Spiral Nebulæ, Dr. G. E. Hale, 817
Spirit Thermometers, W. F. Higgins, 390
Spiritualism: Science and, 721; Sir William Crookes and, Lord Rayleigh, 843; The History of, Sir Arthur Conan Doyle. 2 Vols., 147
Spontaneous Respiration in Cases of Apparent Death, A Biological Sign marking the Return of, S. Jellinek, 863
Spraying Crops from Aeroplanes, G Fox Wilson, 412
Square Roots, Accurate, Prof F. Schlesinger, 338
Stainless Iron and Steel, J H. G. Monypenny, 3
Stanford University. Prof. J W. McBain, Miss M. E. Laing, and Miss M H. Norris to go to, 458; A High-voltage Laboratory at, 890
Starch-Formation in the Presence of Different Salt Ratios, Dr. V. S. Iljin, 747
Stars: Companion, Names for, Prof. F. Schlesinger, 49; The Constitution of the, Prof. K. Grant, 373; The Scintillation of the, V. Oberguggenberger, 251, The Wonder and the Glory of the, Prof. G. Forbes, 512
State, The. and Industrial Research Associations, J. W. Williamson, 676; Dr. W. L. Balls, 770; and Science, 181
Statesman's Year Book, The, 1926, edited by Sir John Scott Keltie and Dr. M. Epstein, 45
Static and Dynamic Tensile and Notched-bar Tests, A Comparison of, K. Honda, 466
Statistical Mechanics, General Forms of, with special reference to the New Quantum Mechanics, R. H. Fowler, 861
Stature and Chest-girth Formula of Normality and Normal Values, Relations between, F. Frassetto, 791
Steam Turbine: Sir Charles Parsons and the, 678; Installations, The Use of High Pressures for, S S Cook, 450
Steel: Hardened, Testing of, A. Lundgren, 605; Heat Conduction in, C. Benedicks, H. Backstrom, and P. Sederholm, 675; -making Processes The Physical Chemistry of, a General Discussion held at the Faraday Society and the Iron and Steel Institute, June 1925, 296
Steels. Cementation of, by Silicon, L. Guillet, 214; Resistant, T. G. Elliot and G. B Willey, 283; Rust-Resisting, 3; The Influence of Gases on the Properties of, L Guillet and A. Roux, 826
Sternoptychidæ, Mediterranean, P. Jesperson and A. V. Tåning, 99
Stibiobismuthinite, The Nature of, E. Quercigh, 503
Stimuli in Plants, Transmission of, Prof. N. G. Ball, 589, 654
Stock, Double Garden, Origin of the, Miss E. R. Saunders, 934
Stoichiometry: Industrial, Chemical Calculations of Manufacturing Processes, W. K. Lewis and Prof. A. H. Radasch, 905
Stokes's Theorem, Extension of, Véronnet, 791
Stone Age of Ceylon, The, E. J. Wayland, 193
Storm and Stress, 257
Stress and Rhythm in Speech, J. W. Jeaffreson, 928
Strontium in Sea Water, The Detection and Determination of, A. Desgrez and J. Meunier, 790
Submarine Cables, Loading, J. J. Gilbert, 927
Sucker-fish, The Eggs of the, H. C. Delsman, 805
Sugar Cane Mosaic Situation in February, 1924, at Soledad, Cuba, The, Prof. E. M. East and Prof. W. H. Weston, jr., 45
Sugars, Optical Properties of, G. T. Keenan, 785
Sulphide Solutions, Influence of a Current of Inert Gas on the Decomposition of, A. Desgrez, L. Lescœur, and Mlle. S. Manjean, 681
Sulphites in Foods, A Simple Method of Testing for, A E. Parkes, 755
Sulphur. Chloride, The Action of, on Mercaptan, J. S. Thomas, 467; Lengthened Chain Compounds of, Dr. G. M. Bennett, 555, Prof. P. C. Rây and K C. Bose-Rây, 283
Sumatra and Formosa, expedition by Prof. H. H. Bartlett to, 130
Sunshine: and Health, 330; and Open Air: their Influence on Health, with special reference to the Alpine Climate, Prof. Leonard Hill. Second edition, 330; Seasonal, in Great Britain, L. C. W. Bonacina, 194
Sunspot Activity, 205
Sunspots: and Magnetic Storms, S. B. Nicholson, 495; Large, 61; Naked-eye, Recent, 459; Recent, 925; Recent, and Magnetic Storm, 603; The Great Activity of a Group of, followed by a Magnetic Storm and an Aurora Borealis, L. d'Azambuja and H. Grenat, 791; Theory of, Prof. V. Bjerknes, 891
Superpower, its Genesis and Future, W. S Murray, 334
Supraconductivity, W. Meissner, 675
Surface: Actions, Researches on, R. Dubrisay, 142, Tension in Solutions of Common Salt, The Growth of, Dr. E. Kleinmann, 245; The Drop-weight Method of Measuring, T. Iredale, 48
Surfaces, Molecules, and Ions, N. K. Adam, 653
Surveying: Dr. W. N. Thomas. Second edition, 440, Instruments: Ancient, Sir Henry Lyons, 923; Catalogue of, C. F. Casella and Co., Ltd., 643
Swamp Cypresses, The, Prof. A. Henry and Marion McIntyre, 63
Sweden: Forest Ecology in, O. Tamm and C. Malstrom, 532; Rural Electrification in, Dr. Ekstrom, 815
Swedish Rainfall, 318, 497
Switchgear, Outdoor, 387
Sydney University, J. Anderson appointed professor of Philosophy, Dr. W. S. Dawson professor of psychiatry, H. Finnemore lecturer in Pharmacy, and Dr. T. Iredale lecturer in Chemistry, 897
Sylvester Programme in Algebra, The, 295
Symbols, The Migration of, and their Relation to Beliefs and Customs, D. A. Mackenzie, 476
Symmetrical Polyatomic Dipole-gases, The Dielectric Constant of, on the New Quantum Mechanics, R. de L. Kronig, 791
Synedra, Die Gattung, in systematischer, zytologischer und okologischer Beziehung, Dr. K. Gemeinhardt, 729
Synthetic: Ammonia and Nitrate Co., acceptance of post with the, by Sir Frederick Keeble, 313; Nitrogenous Fertilisers, Production and Use of, 469

Tabanidæ of the Canadian Prairie, The, Prof. A. E. Cameron, 496
Tabula Smaragdina, Prof. J. Ruska, 352
Tabulæ Biologicæ, Herausgegeben von C. Oppenheimer und L. Pincussen. Band 2, 873
Tantalum, Niobium, and their Mineral Associates, The Analytical Chemistry of, W. R. Schoeller and C. Jahn, 755
Tar, Complex Aromatic Hydrocarbons in Low-temperature, Prof. G. T. Morgan and D. D. Pratt, 805
Tartaric Acid, The Rotary: Dispersion of, E. Vellinger, 826; Power of, R. Lucas, 250
Taxation of Research, 1
Taxonomy in Biology, 901
Taylor's Theorem, On the Descriptive Form of, S. Pollard, 790
Tears, Prof. M. Canney, 98
Technical and Intellectual Values, A. E. Evans, 119
Teleoptics? Television or, Sir Herbert Maxwell, 194
Television: 18; Electric, A. A. Campbell Swinton, 590; or Teleoptics? Sir Herbert Maxwell, 194

Tellurium, The Uses of, 569
Temperatures of certain Months in the Year, Relation between the, L. Besson, 863
Tennessee, Echoes of, 652
Termites, Prevention of Damage by, Dr. T. E. Snyder, 171
Terre : Le Relief de la, ses origines, ses lois, son évolution ; principes nouveaux de géographie physique, P. Soulier, 259
Terrestrial Magnetic : Perturbations, Distribution in Time of, and the Corresponding Distribution in the Sun of the Regions which emit a Corpuscular Radiation, Dr. H. Deslandres, 71 ; Storms, etc., The Law of Distribution of, Dr. H. Deslandres, 359
Tertiary : Man in Asia ; the Chou Kou Tien Discovery, Dr. D. Black, 733 ; Marls in North Carolina, L. B. Kellum, 643
Tetrahydro-naphthalene and Naphthalene Hydrocarbons, A New General Method for the Synthesis of the, G. Darzens, 826
Thermionic : Emission, Equations for, P. Freedman, 193 ; Valves at Low Frequencies, The Input Impedances of, L. Hartshorn, 934
Thermometry, W. F. Higgins, 565
Thompson, Boyce, Institute for Plant Research, Yonkers, The, Prof. J. M. Coulter, 456
Thomson, Sir J. J. : Sir Oliver Lodge, December 18, Suppt., 49 ; Seventieth Birthday, Messages of Congratulation from Abroad, 879–884
Thorium C+c′, Range of α-Rays of, Fraulein L. Meitner and K. Freitag, 208
Thring, Edward, Maker of Uppingham School, Headmaster 1853–87, W. F. Rawnsley, 729
Thunderstorms, Electric Fields of, Measurements of the, B. F. J. Schonland and J. Craib, 251
Thyroxine, The Chemical Constitution of, 65
Ticks : a Monograph of the Ixodoidea, G. H. F. Nuttall, C. Warburton, and L. E. Robinson. Part 4 : The Genus Amblyomma, by Dr. L. E. Robinson, 151
Tidal Institute, Liverpool, Report for 1925, 563
Tide : -predicting Machines, Dr. A. T. Doodson, 787 ; The, H. A. Marmer, 907
Tides : A Popular Work on, 907 ; and Sea Seiches, Prof. J. Proudman, 568
Tierpsychologie : vom Standpunkte des Biologen, Prof. F. Hempelmann, 867
Tierwelt der Nord- und Ostsee, Die, Herausgegeben von G. Grimpe und E. Wagler. Lief. 2 (Teil 2. d_1, 12. h_1). Teil 2. d_1 : *Noctiluca*, von A Pratje ; Teil 12. h_1 : *Teleostei Physoclisti*, 10. *Heterosomata*, von W. Schnakenbeck. Lief. 3 (Teil 9. c_1, 9. c_2, 12 i_1). Teil 9. c_1 : i. *Opisthobranchia* ; ii. *Pteropoda*, von H. Hoffman ; Teil 9. c_2 : *Scaphopoda*, von Tera van Bentham Jutting ; Teil 12. i_1 : i. *Amphibia* ; ii. *Reptilia*, von R. Mertens, 223. Lief. 4 (Tiel 7. c_1 : Teil 12. c : Teil 12. g_1, 836
Tin, The Potentiometric Titration of, with Potassium Bromate, K. Sandved, 610
T. phoxini, A Tetracotyle, in the Brain of the Minnow, Prof. J. H. Ashworth and Janet C. W. Bannerman, 826
Tolmiea Menziesii, Formation of Organs from Adventitious Buds of, G. Reimann, 251
Tombak Tobacco, New Observations on, H. Jumelle, 718
Torpedo marmorata, Action of Curare on the Electrical Apparatus of, A. Chauchard, 250
Town Planning, Geography and, 505
Tradescant, John, Memorial window to, at Oxford, 813
Tradition : The Herbert Spencer lecture, 1926, Prof. W. R. Sorley, 110 ; The Value of, Dr. P. H. Buck, 892 ; Truth and, Prof. H. Wildon Carr, 109
Transmissive Factors, The Immutability of, with Reversal of Light, D. S. Perfect, 141
Transmutation Experiments, M. W. Garrett, 84
Transvaal, Ancient Bronze from the, P. Wagner, 496
Travel and Travellers of the Middle Ages. Edited by Prof. A P. Newton, 407
Tremblement de Terre, Le, E. Rothé, 223
Triethylamine and Diethylamine, 461
Triphenylcarbinol and of Phenylfluorenecarbinol, The Hydrogenation of, under Pressure, V. Ipatief and B. Dolgof, 395
Trivalents and Quadrivalents, The Attractions of the Ends of Chromosomes in, Dr. J. Belling, 227
Tropical : Africa, The Economic Development of, Hon. W. Ormsby-Gore, August 7, Suppt., 16 ; Cyclone, The, E. V. Newnham, 524
Truth and Tradition, Prof. H. Wildon Carr, 109
Tubercle Virus, Intra-uterine Transmission of the, A. Calmette, J. Valtis, and M. Lacomme, 898
Tuberculosis : Pulmonary, Winter Climate and the Incidence of, J. R. Miner, 206 ; The Gold Treatment of, 240
Tumour Formation : The Nature of, the Erasmus Wilson lectures delivered before the Royal College of Surgeons of England, on February 23, 25, and 27, 1925, Dr. G. W. Nicholson, 404
Tungsten : Crystals, The Deformation of, Dr. C. J. Smithells, H. P. Rooksby, and W. R. Pitkin, 466 ; Physical Properties of, The Effect of Working on the, J. W. Avery and Dr. C. J. Smithells, 825
Turtles, The Growth of, G. H. Parker, 396
Twilight Phenomena, P. Gruner, 711
Type-metal Alloys, The Tempering of, A. Travers and Houot, 214

Ultra-violet Light, The Action of, upon Wool, L. Meunier and G. Rey, 718
Undulatory Mechanics, The Symmetrical Top in the, R. de L. Kronig and I. I. Rabi, 805
Unemployment, Patent Law and : E. W. Hulme, 694 ; The Writer of the Article, 695 ; E. W. Hulme ; The Writer of the Article, 840
U.S.A. : A Bibliography of Research, 203 ; Broadcasting in the, 203 ; Civil Aviation in the, 149 ; General University Extension in, 897 ; Naval Observatory, Washington, The, 925 ; River Surveys, 643 ; Rural Schools as Centres of Medical Service and Community Life, Dr. N. P. Colwell, 213
Universities' : Duty of Self-adjustment to Social Changes, The, H. Phillips, 716 ; English Provincial, Demand and Supply, 556 ; Municipal, The Functions of, G. F. Zook, 465 ; of the British Empire, 138
University : College of North Wales : The opening of the New Science Laboratories of the, 705 ; opening of new War Memorial Laboratories for Science Departments, 897 ; Laboratories and Research, Sir J. J. Thomson, 772 ; Tutorial Class (Extra-mural), Teaching and its Problems, R. S. Lambert, 249
Upper : Air : Meteors and the Constitution of the, Prof. F. A. Lindemann, 195 ; Phenomena, 221 ; Wind Variations, L. F. Richardson, D. Proctor, and R. C. Smith, 893
Uranus, The Polar Compression of, C. Wirtz, 25
Urine, The Secretion of the, Prof. A. R. Cushny. Second edition, 477

Vacuum Practice, L. Dunoyer. Translated by J. H. Smith ; Dr. Norman R. Campbell, 331
Vapour at the Interface of Two Immiscible Liquids, Reactions Depending upon the, G. Harker and R. K. Newman, 287
Variabilitat : Die intraindividuelle fluktuierende eine Untersuchung uber die Abänderung des Pflanzenindividuums und die Periodizitat der Lebenserscheinungen, Prof. E. Dennert, 873
Variability, Biometric Work on, Prof. J. Philiptschenko, and others, 99
Varieties, The Problem of the Adaptation of, F. L. Engledow, 815
Vascular System in the Human Embryo, Development of the, prior to the Establishment of the Heart, G. D. M'Intyre, 71
Vegetable : Marrow, Sterility in the, Miss Eleonora Armitage, 592 , J. Parkin, 697 ; Seeds, Action of the High-Frequency Oscillating Electromagnetic Field on, E. Benedetti, 935
Vegetation, The Study of, E. P. Farrow, 130
Vegetationskunde, Kleines Praktikum der, Dr. F Markgraf, 766
Vegetative Propagation, Problems of, Dr. R. C. Knight, 784
Venereal Disease, 762

Ventilation: and Heating in certain Factories, A Physiological Study of the, H. M. Vernon and T. Bedford; assisted by C. G. Warner, 536; in Factories, 536
Vertebrate Development, Dr. K. M. Wilson, and others, 353
Vertical Oscillation in the Atmosphere, A Simple Method of, D. Brunt, 826
Vesuvian Sublimates, some Noteworthy, G. Carobbi, 935
Vesuvius: Presence of Sodium and Potassium Fluosilicates among the Products of the Present-day Activity of, F. Zambonini and G. Carobbi, 681; Presence in the Products of the Present-day Activity of, of a Cæsiferous Variety of Potassium Fluoborate, F. Zambonini, 287
Vicia faba, Effect of X-rays on, H. Komuro, 819
Vienna Academy of Sciences, election of an honorary member and of foreign corresponding members; award of a prize to Dr. C. Batsch, 96
Vinegar: its Manufacture and Examination, C. Ainsworth Mitchell. Second edition, 834
Vitalism and Mechanism, L. du Sablon, 244
Vittarieæ, A Critical Examination of the, S. Williams, 70
Vocational Selection, Recent Progress in, Miss W. Spielman, 462
Voles and Lemmings: (Microtinæ), Living and Extinct, Monograph of the, M. A. C. Hinton. Vol. 1, 579; The Evolution of, 579
Vortex Distribution behind an Aerofoil, Fage and Simmons, 605

Wales: University: College of, and National Library of, Bequests to, by Sir John Williams, 393; of, conferment of an honorary doctorate on Sir T. W. Edgeworth David and on Dr. A. H. Church, 176
Water: and Salt Solutions, The Evaporation of, from Surfaces of Stone, Brick, and Mortar, Prof. A. P. Laurie and J. Milne, 826 , Turbine, a Large, 387
Wave: -Theory of Matter and Electro-magnetism, A Possible Connexion between the, H. Bateman, 839; Wind and, Velocity of, The Relation between, Dr. Vaughan Cornish, 665
Waves, Wind, and Speed of, Dr. Vaughan Cornish, 207
Weald, Geology of the, 63
Wealth, Virtual Wealth, and Debt: the Solution of the Economic Paradox, Prof. F. Soddy, 760
Weather: of August, The, 386; and Agriculture, 134; Forecasting, Long-range, Prof. R. De C. Ward, 386; The, April-June, 59; World, E. W. Bliss, 856
von Weimarn, Note on a Theory of, W. W. Taylor, 71
Wellcome: Bureau of Scientific Research and Museum of Medical Science, reopening of the, 887; Historical Medical Museum, The, 608
Welsh Romani, Dr. J. Sampson; Prof. R. L. Turner, 657, 805
West: African Development, 613, 649; India Hurricanes, Father Sarasola, 207
Western America, A Tertiary Inter-basaltic Flora from, Dr. F. H. Knowlton, 747
Whales of Akutan: The, an Account of Modern Whaling in the Aleutian Islands, K. B. Birkeland, 620
Wheat Breeding, Modern, Sir Rowland Biffen and F. L. Engledow, 281
Wicken Fen, The Natural History of. Edited by Prof. J. Stanley Gardiner. Part 3, 620
Wigan and District Mining and Technical College, Calendar of the, 501
Wild Hybrid Swarms, The Naming of, Dr. L. Cockayne and H. H. Allan, 623
Wind and Wave, Velocity of, The Relation between, Dr. Vaughan Cornish, 665
Windmills, The Use of, 203
Winter Thunderstorms in the British Islands, January 1-March 31, 1925, Report on, S. M. Bower, 106
Wireless: Communication, Magnetic Storms and Sir Joseph Larmor, 662; T. L. Eckersley, 803; Time Signals, Uniformity in the Issue of, Progress in, 24; Transmission, The Kerr Effect in, Prof. E. V. Appleton, 514; Waves: Curved Path of, A. Mallock, 443; Polarisation of, J. Hollingworth, 409
Wirtschaftspraxis, Nachschlagebuch der Nachschlagewerke fur die, Dr. P. Heile, 279
Wolfram: Fortschritte in der Herstellung und Anwendung in den letzten Jahren, Dr. H. Alterthum, 80
Wood, Trueman, Lecture, The, Dr. R. J. Tillyard, 888
Wood's Light, The Antirachitic Power of, G. Mouriquand, M. Bernheim, and Mlle. Theobalt, 142
Wool, Spirals and Waves in, Prof. J. E. Duerden, 153
Woollen and Worsted Industries, British Research Association for the, Dr. S. G. Barker appointed director of research, 494

Xenopus from the Cape Flats, A New Species of, W. Rose and J. Hewitt, 502
X-ray: Region and the Extreme Ultra-violet, Spectrographic Junction between the, Dr. A. Dauvillier, 551, 853; Reflection, Intensity of, Effect of Crystal Size upon the, R. J. Havighurst, 215; The Intensity of Reflexion of, from Crystals at Low Temperatures, R. W. James, 862
X-rays: and Living Matter, Prof. J. A. Crowther, 86; Intensity of Reflection of, by Lithium, Sodium, and Calcium Fluorides, R. J. Havighurst, 215; Internal Absorption and 'Spark' Lines, Dr. H. Robinson, 224; of Long Wave-length, Action of, on Micro-organisms, J. J. Trillat, 718; Soft, K. T. Compton and C. H. Thomas, 820

Yakima and Klickitat Indians of the Columbia River Region, The Pit-house Sites of the, H. Krieger, 59
Yeast: Beer, Do the Water-soluble Vitamins (B), contained in, Exist beforehand in the Culture Medium? Mme. L. Randoine and R. Lecoq, 179; Extracts of Different Origin, The Inequality of the Proportion of Water-soluble Vitamins (B) in, Mme. L. Randoin and R. Lecoq, 107
Yocco, a New Drug containing Caffeine, E. Perrot and A. Rouhier, 142
Yorkshire Philosophical Society, Sir Arthur Keith and C. R. Peers elected honorary members of the, 781

Zieria macrophylla, The Essential Oil of, A. R. Penfold, 467
Zinc, The Spectrum of, D. M. Smith, 592
Zircon, The Crystalline Structure of, W. Binks, 755
Zoological: Names *Simia*, *S. satyrus*, and *Pithecus*, The, and their Possible Suppression, Dr. C. W. Stiles, 49; Nomenclature: Suspension of *Sarcoptes*, type *passerinus*, in favour of *Sarcoptes*, type *Scabiei*, Dr. C. H. Stiles, 339; International Code of, Dr. F. A Bather, 412; Hubner's (1806) 'Tentamen,' Dr. C W. Stiles, 591; Society of London, award of the silver medal of the, to Capt. H. C. Brocklehurst, 777; Society of Scotland, Report of the, 240
Zoologie, Handbuch der: eine Naturgeschichte der Stamme des Tierreiches. Gegrundet von Prof. Willy Kükenthal. Herausgegeben von Dr. T. Krumbach. Dritter Band: *Tardigrada, Pentastomida, Myzostomida, Anthropoda*: *Allgemeines, Crustacea, Arachnoidea*. Erste Lief. Zweite Lief. Funfter Band: *Solenogastres, Mollusca, Echinodermata*. Erste Lief. Zweite Lief., 114; im Grundriss, W. Stempell. Dritte, vierte, und fünfte Lief., 835
Zoology: Elementary, A Manual of, Dr. L. A. Borradaile. Fifth edition, 513; The Tenth International Congress of, to be held at Budapest, 425

The various Supplements should be collated and bound together at the end of the volume, in front of the advertisements.

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

SATURDAY, JULY 3, 1926.

CONTENTS.

PAGE

Taxation of Research 1
Rust-Resisting Steels 3
Nature-Gods 4
The Periodicity of Earthquakes 5
Sir Walter Raleigh 7
Our Bookshelf 8
Letters to the Editor:
- The Disposal of Scientific Journals.—**B. M. Headicar** 10
- New Facts regarding the Phases of Migratory Locusts.—**H. Bennett Johnston** 10
- Effect of Polarised Radiations on Animal Metabolism.—**Prof. S. S. Bhatnagar, R. B. Lal,** and **K. N. Mathur** 11
- Energy Levels of the Carbon Monoxide Molecule.—**O. S. Duffendack** and **Gerald W. Fox** . . 12
- Hydrogen as Anion.—**Prof. Henry E. Armstrong, F.R.S.** 13
- The Sensitivity of Selenium Cells.—**Prof. A. O. Rankine** 13
- Luminous Night Clouds.—**V. Malzev** . . . 14
- Magnetic Properties of Single Crystals of Iron.—**E. B. Wedmore** 14

Climatic Changes during Geological Times. By **C. E. P. Brooks** 15
On the Rare Earths 17
Television. By **A. R.** 18
Solar Surveys 19
Obituary:—
- **Mr. J. J. Fletcher** 20
- **Prof. C. J. Lintner.** By **A. R. L.** 20

News and Views 21
Our Astronomical Column 25
Research Items 26
Explosions in Gaseous Media. By **C. C.** . . . 29
The Eastman Universal Colorimeter. By **L. C. M.** . 30
The World's Forestry Congress 30
University and Educational Intelligence . . . 31
Contemporary Birthdays 32
Societies and Academies 33
Official Publications Received 36
Diary of Societies and Conferences 36
Some New Possibilities in Solar Research. By **Dr. George E. Hale, For. Mem. R.S.** . . . Supp. 1

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Taxation of Research.

THE question of the taxation of educational and scientific institutions has very recently come prominently before the public, and indications exist that the Treasury is contemplating an important change in connexion with the policy hitherto pursued in granting exemption from income-tax to such institutions. The recent judgment of the House of Lords in the case of the Brighton College *v.* Marriott amounts to a declaration that any profits of an educational establishment which are used for educational purposes are the result of carrying on a trade and therefore taxable. The judgment in question may have far-reaching consequences, for it must be remembered that Brighton College is not only a public school, but also a "charitable institution." Following closely on the above-mentioned judgment comes the public announcement from responsible officers of the Chemical Society of the receipt by this Society of a notification that the Inland Revenue authorities are about to challenge its right, as a "charitable institution," to recover the tax deducted at the source from the interest on its invested capital (see NATURE, June 19, p. 859).

The matter was carried a stage further on June 21, when the question of exempting certain classes of educational institutions from income-tax in respect of any profits forming part of their income which was applicable to educational purposes *only*, was raised in the House of Commons in connexion with the suggested new clauses to the Finance Bill (see "Parliamentary Debates," vol. 197, No. 86). The Chancellor of the Exchequer, in dealing with the matter during the debate, indicated that he was unwilling at the present time to extend the limits of exemption of 'charities,' and admitted that, in view of the judgment in the Brighton College case, it was likely that some institutions which in the course of previous years had not been called upon to pay, might, during the course of the year, on the merits of the particular case, be brought into the ambit of taxation for the first time.

Although unable to hold out any expectations that he would make any proposal before the report stage of the Bill, Mr. Churchill stated that he could not feel that the present restrictions, though necessary, were the last word that should be said in defining what was a "charity" deserving of exemption from income-tax and what was not; he undertook, therefore, to examine very carefully whether the frontiers of charitable exemptions could not be defined with some nearer approximation than at present.

The question of the exemption of 'charities' from income-tax is briefly reviewed in the Report of the Royal Commission on the Income Tax (1920, Cmd. 615, p. 67; H.M.S.O., 3*s.* net); *inter alia*, the Commissioners say: "The issues involved in this matter are very wide; we have taken no evidence on the general question and we think it is not covered by our Terms of Reference. We therefore content ourselves with expressing the opinion that for the purposes of Income Tax 'charities' should be specifically defined by Parliament." It is to this recommendation, then, that Mr. Churchill has undertaken, if it is possible effectively to do so, to give effect. It is perhaps significant that the Commissioners point out that "attempts made in the past, notably by Mr. Gladstone in 1863, to repeal or curtail the relief enjoyed by charities aroused strong opposition and that in the end nothing was done"; they further state that "any proposal for limiting the exemption would have a serious effect upon the available income of many institutions." It is hoped that Mr. Churchill will give due weight to the foregoing observations.

The legislature has not entirely overlooked in its taxing statutes the claims of scientific institutions, as such; indeed, in the first of the Income Tax Acts, that of 1842 (5 & 6 Vict. c. 35), provision was made for exempting from income-tax certain premises of institutions existing for the promotion of education, literature, science and the fine arts. Again, in an Act of 1843 (6 & 7 Vict. c. 36), provisions were inserted entitling such institutions, under extremely strict conditions, to exemption in respect of local rates. Later, when corporation duty was, as a compensatory measure, first imposed under the Customs and Inland Revenue Act 1885 (48 & 49 Vict. c. 5) upon the yearly value, income or profits accruing from real and personal estate permanently vested in bodies, corporate and unincorporate, which escapes liability to probate, legacy and succession duty, provision was again made for exempting such institutions from the duty in question. At the present day a scientific institution, as such, is entitled to exemption from income-tax under Schedule A (property tax) in respect of any building which is the property of such institution and is used solely for its own purposes. No payment may, however, be demanded or made for any instruction therein by lectures or otherwise, nor may the building be occupied by any officer or other person paying rent for the same (Income Tax Act, 1918, 8 & 9 Geo. V. c. 40).

A latent intention on the part of the legislature to benefit scientific institutions to some extent, great or small, is certainly present in the statutes referred to above, and at various times scientific institutions have endeavoured to avail themselves of the privileges in respect of exemption from taxation which seem to be offered to them. But how extremely difficult it is for such institutions to satisfy the Courts that their constitution and activities are of the character to qualify them to obtain the benefits which, to an ordinary layman, it seems that the legislature intended such institutions to enjoy, can be gathered from an examination of the cases in the Law Reports which relate to the claims for exemption from taxation made under the provisions of statutes particularly applying to them. It will be found that even on a particular set of facts, eminent judges have sometimes held opposing views in regard to the right to exemption.

Briefly stated, to obtain exemption from income-tax or corporation duty under the provisions of the above-mentioned statutes, a scientific institution has to satisfy the Courts that the primary object of such institution is the promotion of science in the abstract; its property and income are legally appropriated by a Royal Charter or other compelling instrument and applied in fact to that object; and further, if the object of the professional interest of its members is to be inferred, this must at least be secondary to the main and chief object. In consequence of the foregoing state of affairs, the important partial exemptions from income-tax which accrue to scientific institutions, as a rule, are granted, not by reason of the provisions of the statutes conferring privileges specifically on such institutions, but under the provisions of taxing statutes containing an exemption in favour of property dedicated to 'charitable purposes,' an expression which in a legal sense has an extremely wide meaning and is applied to all trusts known to the law of England as 'charitable uses.'

The great value of the work done by the members of the leading scientific institutions has not been contested at any time. It is fully recognised that such institutions are great clearing-houses of specialised knowledge and that they greatly stimulate scientific research. In thus promoting the advance of science and the development of industries, scientific institutions confer considerable benefits, indirectly it is true, on the whole community, and it is desirable therefore that nothing shall be done which may restrict their usefulness. A strong case can really be made for giving the widest interpretation to the exempting clauses of statutes under which scientific bodies are at present entitled to enjoy remission from taxation; further, it is certain that the national exchequer would gain more from measures taken to secure this end than from the adoption of a course which may result in seriously cutting down existing privileges.

Rust-Resisting Steels.

Stainless Iron and Steel. By J. H. G. Monypenny. Pp. ix + 304 + 22 plates. (London: Chapman and Hall, Ltd., 1926.) 21*s.* net.

THE loss to our civilisation through the rapid attack by atmospheric and marine influences upon the iron and steel upon which it is really based has been estimated by Sir Robert Hadfield to reach the large sum of 500,000,000*l.* per annum. There is no need to criticise such an estimate, since obviously the computation is necessarily only achieved by empirical methods. The fact, however, is that there has been probably no more useful field for pure and applied science than that provided by the problem of producing rust-resisting steels.

It may be said that two decades ago the metallurgical world did not seriously contemplate the production of rustless steel as likely to be an early practical achievement; not because investigators were not giving much attention to the subject, but rather because of the curious misapprehension concerning the nature of the laboratory tests that were likely to give indication of resistance to atmospheric attack. This, of course, means that there was no accurate appreciation of the true mechanism of corrosion. For example, the literature teems with experiments upon the degree of resistance of iron and steels of diverse composition to sulphuric and hydrochloric acids of different concentrations. These acids attack the metal with the liberation of hydrogen. Such acids are not usually prevalent under natural conditions, and the rustless steels now produced which resist ordinary corrosion are not passive to the acids mentioned.

Mr. Monypenny is to be congratulated upon having produced a book of merit, in which will be found a reasonably full and accurate account of the composition and characteristics of the rustless steels which are now available. The development of these steels has been particularly rapid, and is based, fundamentally, upon the alloying of the metal chromium with the steel. If experimental samples are prepared from a range of steels of low carbon content, but with gradually increasing chromium content, and are placed in nitric acid of spec. grav. 1·20, it will be found that when a chromium content of 10 per cent. is passed, almost complete passivity is attained. The phenomenon can be, at present, satisfactorily explained by the assumption that a protective film of the desired characteristics is immediately formed on the surface of the specimen, which inhibits further action. Such explanation is completely in accord with experimental facts to date. Laboratory tests with nitric acid appear to be indicative of resistance to ordinary atmospheric effects. If, however, the range of corroding media is extended, such a simple form of test fails, and hence the practical extension of the employment of such steels to a wider range of corroding media has necessitated practical experiment under the necessarily complex actual service conditions, coupled with the gradual modification in the composition of the steel to meet those conditions. The development has taken the direction of increasingly high chromium content together with the addition of nickel. It is also claimed that other elements can be advantageously added.

If the steelmaker is to use the metal chromium in quantity, he is dependent upon his supplies of the metal, which is usually in the form of the alloy ferro-chromium. Until comparatively recently, the supplies of ferro-chromium available were very high in carbon content, but the rapid development in the metallurgy of chromium reduction has now rendered available rich alloys of chromium and iron of suitably low carbon content. These developments are made possible by the use of suitable electric furnaces and cheap power. When it is also recorded that the rustless steels are best prepared in electric steel-making furnaces, it will be realised that here, as in many other developments, the actual application of the discoveries has been dependent upon parallel progress in entirely dissimilar fields of investigation and technology.

Turning to Mr. Monypenny's book, it will be found that after a short historical account of the development of the steels, the results of a detailed study of the influence of chromium are given. The succeeding sections of the book are devoted to practical notes on the handling of the steels in various manufacturing operations, such as forging, welding, pickling; the effects of heat treatment on the mechanical and physical characteristics; and the "resistance to corrosion" as affected by composition and treatment. So far, the book, generally speaking, deals with the simple carbon chromium steels. The next section deals with the newer types of rustless steel. The principal item in this connexion is the 'austenitic' type of material obtained with the increased chromium content together with a substantial addition of nickel. The final section of the book indicates various applications in which these steels have been found successful and, incidentally, gives practical notes and hints, which should be of considerable value to intending users.

Generally speaking, the matter dealt with is clearly and logically arranged, and the reader should find little difficulty in obtaining the information he desires concerning the main characteristics of the materials, and in following the main arguments. The work is, naturally, not of the reference type where the answer to a particular problem can be readily obtained, but rather one for the student, who, by relating the various facts represented, can find out for himself the answer to many of his problems. The book will be welcomed as covering a field which is so comparatively new that adequate treatment has not previously been given to it.

There are a few points where the author's handling of the subject is open to criticism. Much of his data for typical stainless steels is obtained on alloys containing 11 to 12 per cent. of chromium, whereas practice has established the best range as being between 12 and 14 per cent. On p. 46, in dealing with heterogeneity, the statement is made that after freezing, diffusion of carbon rapidly takes place. This is only relatively true, and, in any case, only applies to diffusion on a microscopic scale. In a mass of moderate size, diffusion of the carbon is very slow indeed.

The deduction made by the author in Chap. v., that sulphur, when present in stainless steels, "obviously is not present in the same form as in ordinary steels," will require experimental proof. On p. 103 the value of maximum stress in torsion for a sample of 55 tons tensile stainless material is apparently the value deduced on the assumption that the torque at this stage gives a distribution of a stress similar to that when the strain is entirely elastic. The real value of maximum shear stress is probably much less than this.

With regard to the author's treatment of the influence of other elements than the essential chromium and nickel on the characteristics of these steels, we have an impression that the deductions are a little hastily formed on perhaps too little experimental data. This is best instanced in the case of the influence of silicon. The author's comments concerning the influence of this element are not in accord with the fact that a very considerable tonnage of stainless steel is used with a silicon content round about 1·0 per cent., and had the author more thoroughly explored this particular field, both as regards the composition of his samples and the variation in the hardening and tempering temperatures, he would not have been led to the conclusion that silicon so readily induces brittleness.

In discussing the non-production of very high tensile stainless steel-drawn wire, the reason given by the author on p. 138 does not appear adequate. The 'hardening-up' effect should help rather than hinder the production of high tensile properties. The present writer considers the difficulties in the way of such operations are due to other causes.

More data are obviously needed on the austenitic chromium-nickel steels, and in this respect the special adaptability of such materials for many purposes might have been emphasised to a greater extent. The superiority of such materials, from the point of view of corrosion, over the stainless steels, is so pronounced as to constitute an advance in the problem of resisting corrosion only comparable with the initial introduction of the chromium steels.

Mr. Monypenny is to be congratulated upon the production of an excellent work. The book is handsomely produced, and the reproductions of the photographs and microstructures are a credit to both the author and the publishers.

Nature-Gods.

The Worship of Nature. By Sir James George Frazer. Volume 1. Pp. xxvi+672. (London: Macmillan and Co., Ltd., 1926.) 25*s.* net.

THIS volume contains the author's twenty Gifford lectures for 1924 and 1925, expanded and regrouped into sixteen chapters dealing with the worship of the sky, the earth, and the sun. It is to be followed by another which is designed "to complete the survey of the worship of the sun, and to deal with the personification and worship of other aspects of nature, both inanimate and animate," or, as the publishers' announcement has it, "the worship of the Moon, the Stars, Fire, Water, Wind, Plants, and Animals." The "Worship of Nature" is thus the counterpart of the author's last previous compilation, "The Belief in Immortality and the Worship of the Dead"; and in the present "Introduction" (p. 17) he indicates his belief that if "we survey the natural religion of primitive peoples in all parts of the world, we shall probably discover that it everywhere assumes one of two forms which, far from being incompatible with each other, are usually found to be embraced simultaneously and with equal confidence by the worshippers. One of them is the worship of nature, the other is the worship of the dead."

This survey of the "natural religion of primitive peoples in all parts of the world" Sir James Frazer has not achieved yet. In his three volumes on the "Belief in Immortality and the Worship of the Dead," he dealt only with Micronesians, Polynesians and the natives of Australia, the Torres Straits Islands, New Guinea, and Melanesia, and then stopped. In examining the "Worship of Nature" he has selected as arbitrarily; taking in turn, for the worship of the sky, the 'Aryan' and the non-Aryan peoples of antiquity (with the curious omission of Celts and Teutons), the 'civilised' peoples of the Far East (omitting among others the Japanese); then Africa (in four main sections), and nothing more. For the worship of the earth the specimen peoples are similar but not identical; Vedic Indians, ancient Greeks, Romans, Babylonians and Assyrians, Egyptians, Chinese, peoples of modern India, Africa, and America; and for the sun (in this volume), the same, with the omission of China, Africa and America, and the inclusion of the Arabs, Japanese, and Indonesians.

Reasons for selecting these peoples are not given, except that by contrast with the procedure adopted in Pettazoni's "L' Essere celeste nelle credenze dei populi primitivi" (Rome, 1922), the "superior antiquity of the documents" about Aryan beliefs, and the "higher interest" of them, are regarded as justification for treating these beliefs first. Consequently, the separate chapters stand in no organic connexion with each other; there is no attempt made to compare their contents, or to draw any general conclusions. Even on the connexion between the sky-gods of various Aryan peoples there are only the briefest observations (p. 36), and on the significance of Ahura Mazda the compiler is "content to record the two views without attempting either to judge or to reconcile them" (p. 35). From the author of "The Golden Bough" this is disappointing.

Within the separate topics, the method is that adopted in "The Belief in Immortality": to select the most trustworthy authority, and summarise the principal statements in more or less systematic order; but what the system is, we are left to judge for ourselves. But whereas in Micronesia, for example, this method is so far justified that there is usually only one authoritative record for each people, or at most the observations of two or three observers, its application to peoples who have been so carefully and repeatedly studied as the Aryan peoples of antiquity has an appearance of economy of effort. The chapter on the worship of earth in China, for example, is almost wholly extracted from Chavannes' "Les T'ai Chan" (Paris, 1910); in Babylonia, from King's "History of Sumer and Akkad"; in Egypt, from Wiedemann and Erman; and on the worship of the sun in Japan, from Aston's "Shinto, the Way of the Gods" The result is very readable, diverting in its frequent long episodes quoted verbatim, its eloquent verbal landscape-painting, and its sardonic and sometimes broad humour at the expense of the more ingenuous "devices of the heathen"; but it does not advance learning greatly. In the work of a beginner it would run the risk of being described as the method of "scissors and paste"; in that of a veteran, we naturally look for another explanation. But Sir James Frazer does not help us. Is he insinuating that there is nothing more to say, except that this and that people may be accepted as worshippers of the sky, earth, sun, and the like; or is he speaking to us in parables, and reserving his own conclusions for yet another volume? The lame conclusion of "The Belief in Immortality" (p. 326) favours the former inference: "accordingly, we are justified in concluding that the belief in immortality and the worship of the dead were fundamental features of the ancient Micronesian religion," as if it were possible in any intelligible sense to speak of "the" ancient Micronesian religion, any more than of "the" ancient Micronesian race.

Occasionally, however, something rather more positive is foreshadowed. Summing up an account of the Shilluk and Lango chief-gods, whose name *jok* or *juok* means in the Dinka language "the spirit of a dead ancestor," Sir James Frazer is at some pains to contest the obvious inference, on the strength of "the analogy of African sky-gods or Supreme Beings in general," who, for the most part, he thinks, "are sharply distinguished from the ancestral spirits not only in name but in function"; and so, in spite of the embarrassing *jok*, he concludes that "so far as they go, these facts support the view that African sky-gods or Supreme Beings in general are not deified ancestors, but simply personifications of the great celestial phenomena, whether the sky, or the rain, or the sun"; a thesis which we should like to hear him defend before a jury of *jok*-ists.

From this and a few similar hints, it looks as if Sir James Frazer's contribution to the "natural theology" which the Gifford lectures were founded to elucidate may turn out to be a "spiritualistic hypothesis," as he calls it in his introduction (p. 10), which "has undergone a process of simplification and unification analogous to that undergone by the materialistic theory: as the materialistic hypothesis has reduced the multitudinous forms of matter to one substance, hydrogen, so the spiritualistic hypothesis has reduced the multitude of spirits to one God." But it is not quite clear how far the copious information collected in this volume is intended to take us in the verification of this hypothesis. Sky-gods, and earth-gods, and sun-gods, are about as much like the "one God" of the spiritualistic hypothesis as hydrogen is to the "one substance" of the materialist. All that emerges from this first volume of Sir James Frazer's new book is the rather cautious generalisation that some people worship some nature-gods. But perhaps the second volume may go further.

The Periodicity of Earthquakes.

Die Frage der Periodizität der Erdbeben: eine Darstellung des gegenwärtigen Standes der einschlägigen Untersuchungen. Von Prof Dr. Ernest Tams. (Sammlung geophysikalischer Schriften, No. 5.) Pp. ix + 128. (Berlin: Gebrüder Borntraeger, 1926.) 9·60 gold marks.

OF those who have studied earthquakes, few have escaped the lure of earthquake statistics, or failed to attempt the detection of some influence, external to the earth, in determining, or at least influencing, the time of occurrence. For some it has been an introduction to seismology, to some also the end of their activity in this field, to others merely an incident in a wider treatment of the subject, but sooner or later the call comes to all, and is always fraught with danger. Figures have a fascination which may be fatal; once involved in them the temptation is great to try them in one way after another until some definite conclusion seems to have been reached. The literature of the science contains many examples of such misdirected labour, often simply useless, sometimes misleading, much of which would have been avoided had those who knew their earthquakes been also acquainted with the principles of statistical investigation, or those who were familiar with mathematics understood the character of the data with which they dealt.

To the latter class the book under review makes small appeal; to the former it will be useful. Of the two parts into which it is divided, the first is devoted to a description of the methods which are used in computation; the regular method of harmonic analysis is described in sufficient detail, as also is the approximate method of overlapping means, elaborated by Dr. Davison, and in both cases examples of working are given. The author decides in favour of the latter, for ordinary use, as giving similar results to the former, with sufficient accuracy and with a much less laborious computation; but he does not seem to be acquainted with a simpler method of analysis than that described, which takes no longer, and uses no more paper, than the Davison method, besides having the advantage of giving a result in the form conventionally adopted, and with greater precision, though with not greater real accuracy. This last mentioned has, however, on its part, an advantage, in that the computation proves itself at every stage, and mistakes can be detected immediately, whereas in the other method the only proof possible is a repetition of the entire calculation, from beginning to end. Finally, a section of this part of the book is devoted to the consideration of variations in frequency due to causes which are not periodic in their recurrence.

As a whole, the treatment is satisfactory and adequate, but there are two points which do not seem to be sufficiently emphasised. The first, and it is one which it is important to impress on those to whom the work is addressed, is that while a given periodicity may be expressed as the sum of a series of harmonic periods, harmonic analysis does not assert that it must be interpreted as the result of such combination; in other words, the method can only be properly applied where the cause of the effect looked for is one that acts in a manner which makes the method applicable. The other point not dealt with, though even more important, is that where the record is so imperfect, and the data so unprecise, as in any non-instrumental record of earthquakes, it is essential to deal with averages of a large number of shocks. A somewhat extensive experience has shown the reviewer that the lower limit of this number must be put at about 400 times the number of separate groups into which the series has to be divided for the purpose of discussion. If the effect to be investigated needs a division into only two groups, then a record covering 800 shocks may suffice, but for anything analogous to a harmonic analysis, at least four times this number are required; needless to say, the more the number exceeds these limits the better, so long as the record is homogeneous for the purpose in view, but smaller numbers will give irregular and contradictory results.

The second part of the book is devoted to a consideration of the different periods, correlated with the solar or lunar day, month, year, or longer periods, and the non-periodic variations which have been correlated with variations in barometric pressure, rainfall, shifting of the poles, and so on. The treatment is rational and sufficient, and the conclusion come to by the author may be fully accepted, that though, in several cases, it has been shown that the cause investigated may possibly have some small effect in determining the time of occurrence of an earthquake, the connexion has not been established in any single instance.

The conclusion might have been strengthened had some recently published papers reached the author, by which doubt is cast on the reality of some periods which might naturally be expected to exist. Prof. H. H. Turner has suggested that the so-called annual period is not really annual, but differs from the exact year by about ten hours, so that the epoch of maximum frequency works round the calendar in about 850 years; and the Italian record, by far the most accurate and complete of any that is available, indicates that the maximum frequency, of the well-marked diurnal period, has advanced steadily through the thirty years which have been tabulated, at the rate of about five minutes a year. If these small differences are real, what is the meaning of the periods of about ten hours less than twelve complete months, or about three-quarters of a second more than twenty-four hours, respectively? They cannot be correlated directly with the revolution of the earth on its own axis, or round the sun, and they throw doubt on the exactitude of other periods which are supposed to have been detected. Everything is in doubt; we have no proof, or even reasonable probability, of the existence of any periodicity, and those who think that they have time to spare for the pursuit may find justification for an attempt to succeed where others have failed.

Among the variations in frequency which might be attributed to influences external to the earth, the one which shows the nearest approach to probability is the slightly greater frequency of shocks during the day, and the correspondingly lesser frequency at night, in summer as compared with winter. As this has been found to hold good for every suitable record which has been tested, and as it also holds good, with the necessary change in nomenclature, for lunar times and seasons, it may be accepted as a fairly well established fact. Seeing that it is also just such a variation as might be expected, if the gravitational stresses, set up by the sun and moon, had some effect in determining the time of occurrence of an earthquake, the two may reasonably be correlated as cause and effect. But if—and the reservation is an important one—this conclusion is correct, then the smallness of the effect shows how trivial is the influence of the cause, and how predominatingly the earthquake is a phenomenon of the earth, earthly.

Sir Walter Raleigh.

The Letters of Sir Walter Raleigh (1879–1922). Edited by Lady Raleigh. Vol. 1. Pp. xxix + 272 + 4 plates. Vol. 2. Pp. xv + 273-579 + 5 plates. (London: Methuen and Co., Ltd., 1926.) 30*s.* net.

IN this selection from his private letters we have a portrait drawn by his own hand of the late Sir Walter Raleigh, well known in academic circles as a distinguished critic and man of letters, and among his intimate friends as one of the most engaging and delightful companions. To have read Raleigh's books was not enough. He had a side not to be found there, in some ways still more interesting and attractive. Admirable as his writings were, many of his acquaintances prized them less highly than his conversations, when he was wholly himself, less weighted with a sense of responsibility, and accustomed to give a free and joyous vein to his whimsical humour. For Raleigh's social gifts were such that, though he preferred light to serious subjects, his hearers were too content with the fare he provided to ask for any other. So delicate was its flavour that his brand of nonsense was, for so long as he cared to distribute it, better than any sense. Nor was this surprising, for it was a nonsense sparkling with intelligence, and far removed from that 'silliness' which he disliked in man and books. It was his way to approach truth by way of humour, and to judge even of his own writings by the standard of good sense, the standard of things able to survive all-humorous assaults upon them, as when he said of his "Shakespeare," "I don't want to write anything that William himself would have thought rot."

These volumes are, in Raleigh's case, a supplement, and an important supplement, to his public utterances. If they are less carefully considered, they are, because more spontaneous and instructive, a better index to his mind and character. His letters cannot replace, indeed, the charm of his conversation, but they recall it, and preserve some quality or relish of it for those who had never the fortune to hear his living voice. He enjoyed talking on paper to his friends, as he enjoyed talking to them in person, and in these letters he is speaking rather than writing. There are wines that will not bear bottling or exportation, and often the qualities in a man adjudged the most attractive by his contemporaries are either wholly hidden from succeeding generations, or but dimly guessed at. Certainly the future, which can only judge of Raleigh by his books, will miss something of the singular pleasantness that informed his daily speech. The letters cover a wide range of topics, from his early experiences as a professor in Aligarh to the late War; too wide to be illustrated by quotation, but certainly not the least interesting, are those written soon after he left Cambridge, "the place of my early friendships, dreams and idleness," which reflect the impressions of the scenery and society of the East upon a mind quick to receive and eager to record them.

Raleigh's interests, it may with truth be said, were human rather than bookish; for a professor and writer, indeed, unusually remote from the study. He would rather, he said, "have missed Cambridge than India"; and was never quite convinced of the value either of lectures or examinations. Academic machinery creaked rather dismally in his ears The play of life as it passed before his observant eye had a fascination for him beyond anything that the poets or historians had to say of it, a fascination that into words no virtue could digest Life, he felt, needed no assistance from the artist to give it either interest or significance.

Raleigh emphatically placed living above art or science, and had more sympathy with men and their doings than with the makers of books about either. For this reason his most passionate admiration went out to adventurers, and more especially to young adventurers, the high-spirited soldiers, or voyagers or airmen, rather than to those who recorded or sang of their exploits. That his life should have in the end been sacrificed to his enthusiasm for, and determination to do justice to, the pioneers of flying is a sufficiently convincing proof of his preferences, and it was characteristic of him that as an Oxford professor, past middle life, he drilled and marched and did what he could to make himself a soldier. "The last three days I've been marching and lying out on the Downs in torrents of rain, and housed in billets. Billets is 60 beds for every 100 soldiers. . . . Weather disregarded. You have to get through barbed wire like a knife, and tear your clothes much or little."

Sir Walter's friends owe a debt of gratitude to Lady Raleigh for these volumes, and to Mr. Nichol Smith for his brief but admirable memoir of their author, for they will recall many delightful hours in his company. In all their readers they cannot but arouse regret that so rare a spirit has passed beyond the term of human acquaintanceship.

Our Bookshelf.

The Petrology of the Igneous Rocks. By Dr. F. H. Hatch. Eighth edition, revised with the assistance of Dr. A. K. Wells. Pp. xxiv+566. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1926.) 15*s.* net.

WITH the collaboration of Dr. A. K. Wells, this well-known text-book has been revised and extended until now it is virtually a new book. Among the new features are chapters dealing with the consolidation of magmas; the classification of igneous rocks; changes in composition subsequent to consolidation (including pneumatolytic, hydrothermal and other phases of metamorphism as well as weathering); petrographic provinces; and cycles of igneous activity in the British Isles.

Dr. Hatch was a member of the Committee on British Petrographic Nomenclature (1920), and he has naturally adhered to most of the decisions then reached. A welcome simplification of the unwieldy nomenclature of the subject has been achieved, but unnecessary confusion has been introduced by adopting first a classification of types into *acid*, *intermediate* and *basic* divisions, and then a subdivision of some of the groups, such as the syenite group, into *oversaturated*, *saturated* and *undersaturated* divisions. The term 'acid' is sometimes used to mean that a rock is oversaturated, and sometimes to imply a silica percentage not less than 66. It is a pity that the older terms were not altogether dropped. On p. 186 the terms *salic* and *femic* are wrongly used for *felsic* and *mafic* respectively. A useful suggestion due to Prof. Watts has been adopted: the naming of a rock according to its texture with the qualifiers 'intrusive' or 'extrusive' added where necessary. Thus one may have an *intrusive basalt* or an *extrusive dolerite*, and a common source of futile indecision among students is thereby removed, in the only logical way.

The book is now thoroughly up-to-date. It contains abundant references to the splendid work carried out at the Geophysical Laboratory at Washington. Heteromorphous rocks are discussed, eclogite being recognised as a heteromorphous phase of gabbro. The work of Dr. Brammall and Dr. Harwood on the minerals of the Dartmoor granite is included, and the book may be said to present a very complete and well-balanced survey of the subject up to the end of 1925. Controversial and speculative matters are wisely given little space, and students using the book may rely upon it as a sound and authoritative exposition of a delightful subject.

Applied Chemistry: a Practical Handbook for Students of Household Science and Public Health. By Prof. C. Kenneth Tinkler and Helen Masters. Vol. 2: *Foods.* Pp. xi+276+3 plates. (London: Crosby Lockwood and Son, 1925.) 15*s.* net.

THIS book deals with certain branches of the chemistry of foods which have particular interest to students working for the B.Sc. (Household and Social Science) degree of the University of London. It forms a companion volume to that produced by the same authors in 1920 on water, detergents, textiles, fuels, etc. The general treatment is elementary, but the authors have adopted the policy of giving references to standard works wherever possible. In addition to such subjects as milk, edible oils, foods their analysis and calorific value, raising agents, vinegar and preservatives (subjects which are found generally in food analysis books), a separate chapter on the cooking of foods is included. In introducing this somewhat novel subject in an elementary text-book, it is explained that this operation is still primarily an art and not a science, and that our knowledge of the chemistry and physical changes which take place in the preparation and cooking of foods is at present very meagre. Nevertheless, the authors in some thirty-five pages have collected a large amount of scientific data on cooking foods and on the use of condiments, and have given an exceptionally good exposition of the subject.

In many cases interesting chemical determinations bearing directly on food analysis, etc., have been considerably restricted for want of space, yet the determination of specific gravity, specific rotatory (spelt rotatary) power, calorific value, and hydrogen ion concentration—subjects usually well treated in practical physico-chemical text-books—receive a comparatively large amount of attention. The book is well produced with clear diagrams, and the price reasonable judging by present-day standards.

J. REILLY.

Éléments d'astrophysique: introduction à l'étude de l'énergétique solaire et stellaire. Par Dr. Albert Nodon. Pp. viii+244. (Paris: Albert Blanchard, 1926.) 20 francs.

THE author has produced a useful book of reference based on his public lectures delivered at Bordeaux. The contents are divided into two parts. Part 1 contains some seventy paragraphs, in which are outlined the recent advances in astrophysics made possible by well-known theoretical and practical investigators. Part 2 includes tables of notation, physical constants, explanatory notes, and bibliography arranged with reference numbers so as to amplify the paragraphs of Part 1. Although the book is intended, presumably, for general scientific reading, the arrangement of the subjects will scarcely commend itself to the beginner. Commencing with an account of modern ideas on the structure of the atom and the phenomena of radiation, the author then passes to such matters as the opacity of stellar atmospheres and radiation pressure. Paragraphs dealing with the sun follow those on stellar spectra, giant and dwarf stars, etc.

Many of the illustrations receive no explanation in the text, and a knowledge of instrumental equipment is assumed. We consider that the lack of detail in some of the résumés detracts considerably from their value. No explanation is given, for example, of St. John's schematic section of a sunspot, reproduced on p. 100, neither is any reference to be found to the work of Evershed, A. Fowler, and Maunder on sunspots and their spectra. The usefulness of Part 2 would have been increased by fuller explanation or wider bibliography on matters (such as the distances and numbers of the spiral nebulæ) where conclusions are not yet generally accepted.

The Making of the Future. The Coal Crisis and the Future: a Study of Social Disorders and their Treatment. By P. Abercrombie, V. Branford, C. Desch, P. Geddes, C. W. Saleeby, and E. Kilburn Scott. Pp. xi + 111 + xlvi. (London: Leplay House Press; Williams and Norgate, Ltd., 1926.) 8*s.* 6*d.*; paper, 6*s.*

In this volume the coal problem is attacked from various angles by the several contributors, though a certain coherency is obtained, since most of the writers would appear to subscribe to the viewpoint of the 'sociologist.' The quality is, however, somewhat uneven, and it is to be feared that many readers will become impatient of the terminology and verboseness of certain of the writers. About one-half of the volume is devoted to an account of the "Conditions of Eutopian Repair and Reconstruction." This, though it may interest some readers, would have been improved by compression, as it is somewhat vague and at times irrelevant. The appendices do not appear to bear very directly on the problems of the coal industry. Several of the papers, however, are more concise and contain some interesting matter. Prof. Desch and Mr. Kilburn Scott contribute readable articles on the technical aspects of coal utilisation; Dr. Saleeby pleads on hygienic grounds for the elimination of the smoke nuisance, while Prof. Abercrombie describes the planning of the Kent coal-field on the basis of regional surveys.

Handbuch der Pflanzenanatomie. Herausgegeben von Prof. K. Linsbauer. Lief. 13 (II., 2B.; Bg. 1-4). 2 Abteilung, 2 Teil: *Pteridophyten und Anthophyten.* Band IX. 2: *Die Vegetationsorgane der Anthophyten. Organe besonderer physiologischer Dignitat. A: Die Absorptionsorgane der parasitischen Samenpflanzen.* Von Prof. Dr. Adolf Sperlich. Pp. iv + 52. (Berlin: Gebrüder Borntraeger, 1925.) 4·50 gold marks.

THE section of this handbook of plant anatomy at present under notice discusses briefly the ascertained facts as to the haustoria of the parasitic or semi-parasitic flowering plants. Dr. Sperlich divides them into three groups: he gives most space to the haustoria of (1) the Rhinantheæ, Orobanchaceæ, and Balanophoraceæ, and (2) the less parasitic Santalaceæ, Loranthaceæ, and Olacaceæ, with which group he includes the wholly parasitic Rafflesiaceæ. He puts in a special section, but discusses very briefly, the more root-like but still morphologically distinctive organ, the haustorium of Cuscuta. Curiously enough, with reference to recent papers recently referred to in NATURE of February 6, p. 210, and subsequent correspondence (NATURE, March 27, p. 452), no citation is given of the paper by Mrs. Thoday (Sykes) upon Cuscuta, and the question of the possible presence and function of the phloem in the haustorium is not touched upon.

Les fleurs de la Côte d'Azur (De Toulon à Menton). Par Léon Marret. (Encyclopédie pratique du naturaliste, 21.) Pp. 428 + 112 planches. (Paris: Paul Lechevalier, 1926.) 40 francs.

THIS flora, which is well illustrated with text figures and some coloured plates, will be found of great service to botanists and plant lovers visiting the Riviera. It is divided into four main sections. In the first portion the native wild vegetation is described and figures are given of the more important wild plants of the region. The second portion is devoted to "Les Cultures ornementales"; that is, the introduced plants to be found in the gardens and parks of the Côte d'Azur. In the third part the industrial plants are dealt with; and finally a large section is devoted to "Les Cultures alimentaires." In the first portion the plants are referred to under their ecological formations, those of the sand dunes, maquis, garrigues, rocky situations, marshes and meadows, and mountains, and much interesting and useful information is given. The illustrations are scattered throughout the volume, and the reader may find it a little difficult to identify any particular plant or to find his way easily about the book. It is, however, a very useful volume and worthy of careful study by any one interested in the rich native and exotic vegetation of the Riviera.

Combustion in the Power Plant: a Coal Burner's Manual. By Thomas A. Marsh. Second printing, corrected. Pp. xi + 255. (London, Bombay and Sydney: Constable and Co., Ltd., 1926.) 12*s.* net.

As the title indicates, this book deals with the author's experience in the operation of steam boilers in central power plants, and in the main with American plants. Thus much of the contents has little direct bearing on conditions elsewhere. Twenty-five per cent. of the space is devoted to describing the coals of the United States and their behaviour in boiler furnaces.

The discussion of the relative suitability of the various patterns of stoker to different fuels does contain information of general application, and the author's experience of this and other problems of steam-raising on the large scale will be useful to boiler-house operators. They will also be entertained, for this is no dignified scientific treatise, and the writer never disdains enforcing an argument by means of an anecdote. H. J. H.

Le radium: découverte de la radioactivité et du radium, origine de l'énergie radioactive, le radium dans la nature, ses emplois usuels. Par F. Honoré. Pp. viii + 145. (Paris: Gauthier-Villars et Cie, 1925.) 18 francs.

M. HONORÉ is a member of the staff of *L'Illustration*, and his book is virtually an enlarged edition of a series of articles which he contributed to that journal. It therefore gives an attractive and popular account of the discovery, manufacture, properties and applications of radium and associated substances, which should appeal to educated members of the general public. Strangely enough, the artificial disintegration of elements by means of α-rays does not appear to be mentioned in this book.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Disposal of Scientific Journals.

THE "Universities' Library for Central Europe" was established towards the end of 1920 in order to co-ordinate and consolidate the securing by gifts, exchange and purchase, British books, journals, etc., for students, teachers and libraries in the universities of Central Europe. The last year or two has seen a change in the character of our work owing to the fact that the urgency for the distinctly charitable aspect of it has somewhat relaxed, and our task, while less serious from this point of view, in other directions has been considerably extended.

We have administered the book-funds of various universities and institutions in Austria, Czechoslovakia, Finland, Germany, Hungary, Poland and Rumania, established small select libraries in six different places abroad, on the subject of international problems, for the use of discussion groups of university students, and at the request of the Under-Secretary of State at the Foreign Office, have assisted the Parish Public Library at Malines, Belgium, with works of English literature. We have also arranged for regular and direct exchange of publications between Russian scientific institutions on one hand and similar institutions in Great Britain, India and Egypt on the other. Acting in conjunction with the League of Nations Committee on Intellectual Co-operation, we have undertaken to accept literature from other European countries for distribution anywhere in the United Kingdom, and similarly, the Universities' Library distributes all over Central Europe books and periodicals received from universities and learned societies in Great Britain.

In response to a suggestion made by the Editor of NATURE arising out of recent correspondence in the columns of this journal, the Committee has agreed to provide within the Society, a clearing-house for the reception and distribution of scientific books and periodicals from and between individuals and institutions in Great Britain. It is apparent that there are many persons and libraries which at times have to dispose of files of periodicals and other surplus works owing to the exigencies of space. This material often has no great market value, and yet no lover of his subject cares to destroy or sell it as waste paper. Even the indiscriminate giving of this literature does not always result in its most advantageous placing, and undoubtedly the systematic collection and distribution of such books and periodicals is a matter of national importance.

The organisation for such a work already exists, as will be seen, in the above Society, but such an addition to its activities will naturally entail some increase of expenditure; this may not be much more than the cost of packing and transport, but even so, the existing very limited funds of the Society are earmarked for its Continental work, and it will be readily appreciated that this Society must depend upon donations in order to enable it to carry out this further extension of its activities. It is therefore with confidence that we appeal to all readers of NATURE to contribute a small sum to enable this work to be fully developed. Any gift, however small, will be gratefully acknowledged. Any person or institution having surplus scientific literature which it is desired to place in a suitable library or other institution in the United Kingdom, is invited to communicate with me at this address.

B. M. HEADICAR,
Hon. Secretary.

Universities' Library for Central Europe,
London School of Economics,
Houghton Street, London, W.C.2, June 18.

New Facts regarding the Phases of Migratory Locusts.

THE work on *Locusta migratoria* L., which was published in Russia 1912–14, has been regarded by most entomologists as throwing an important new light on the origin of locust swarms. According to the Russian entomologists, two species, *Locusta migratoria* L. and *Locusta danica* L., are to be regarded as forms of the same species, differing in habits, yet intimately related, in that the two forms may emerge from the same egg-mass, occur in the same hopper swarms, and, as was demonstrated by laboratory experiments, can, by suitably altering the conditions, be changed from one form to the other.

Generalising from the observations of these workers and from the examination of a wide range of examples of migratory locusts from various countries, Uvarov (*Bull. Ent. Res.*, vol. 12, pp. 135-163, 1921) formulated the Phase Theory of the Periodicity and Migration of locusts, according to which periodical swarms are dependent for their inception upon the accelerated breeding of other non-migratory and closely related forms, which persist over a wide range in those countries subject to invasion by swarms. These two forms were named by Uvarov 'phases,' in the case of the South Russian species, the solitary locust being the *danica* phase, and the swarming the *migratoria* phase.

Working about the same time in South Africa on *Locustana paradalina* (Walk.), Faure (*Jour. Dept. Agric.*, Union S. Africa, Sept. 1923) has shown that this locust possesses these two phases, and that the solitary phase, which mingles with the swarms of migratory locusts, is also the locust which occurs on the veldt singly and in small loose swarms during the off-season of the migratory phase.

Another important locust of the Old World is *Schistocerca gregaria* Forsk. (=*S. peregrina* Oliv.), which ranges from India to N. Africa, and occurs as a major pest in some years in the Sudan.

As the result of certain recent observations made by the writer, it is claimed that this locust also comes within the terms of the Phase Theory, in that another species of the same genus (*S. flaviventris* Burm.) has now been ascertained to be the solitary phase of *S. gregaria*.

The opportunity for proving the existence of this relationship, which had already been suspected, was met with when, following the abnormally heavy rains in December 1925, *S. flaviventris* gave evidence of great breeding activity on the Red Sea coast north of Port Sudan early in the present year.

During the previous summer, *flaviventris* locusts could be found singly in this district. After the rains these were attracted to the beds of the watercourses which flow intermittently from the hills on the west towards the Red Sea. Here breeding went on undisturbed for some three months, probably three broods at least being produced, until by March adult locusts very strongly approaching the migratory locust in structure and external appearance were found in large numbers.

The threatened destruction of certain grain and cotton crops compelled the adoption of control measures. Following this, the incipient *gregaria* phase was thrown back to the *flaviventris* phase This result was due apparently to the thinning out of the hopper swarms by the vigorous use of poison bait.

It is not proposed to draw too sweeping conclusions from these facts, since it is realised that much further work is needed before their true significance can be demonstrated It is claimed, however, that the following additions to our knowledge have been made; namely, the working out of the main facts of the life-history of the *flaviventris* locust in the Sudan, the observation of the habits of the larval stages of both phases in the field and the proof by laboratory breeding tests, confirmed by field observations, of the convertibility of the solitary hopper into the swarming hopper by the overcrowding of individuals in breeding cages. The reverse process has also been tested with success, namely, the transformation of the black-marked swarming hopper into the green solitary hopper by the segregation of single individuals of the former in breeding cages These experiments were based on the work of Plotnikov in Russia on *L. migratoria*.

In this connexion it was observed that after the treatment of any area with poison and the resultant destruction of a large proportion of the swarming hoppers, the remaining hoppers, which owing to moulting being in progress or for other reasons had missed the bait, invariably tended to assume the colour of the solitary hopper

It is believed that in the case of this outbreak on the Red Sea coast, a migration of *gregaria* locusts did not take place. Whereas in March these were plentiful and breeding in the beds of watercourses, in May *flaviventris* adults alone could be found. The last brood, on attaining the winged state, dispersed into the surrounding country, there to assume their solitary life until next winter.

As regards the practical significance of these facts, it is perhaps not too much to assume that should they be found applicable to other regions in the Sudan, the basis for working out a practicable method for the control of the *gregaria* phase may be in sight, since by the early thinning out of the solitary phase in its breeding haunts, the production of the swarming phase can be prevented.

H BENNETT JOHNSTON.

Wellcome Tropical Research Laboratories,
Khartoum, Sudan,
May 30.

Effect of Polarised Radiations on Animal Metabolism.

IN a previous note (NATURE, February 27, 1926) it was shown that *V choleræ* and *B typhosis* grow more rapidly in polarised light than in ordinary light of the same intensity. Further work on the same subject has been continued by us, and a paper embodying the results obtained on the growth of *B. coli* and *V choleræ* has already been communicated to the *Indian Journal of Medical Research*.

The investigation has now been extended to higher animals, namely, rabbits and guinea-pigs, to see if the metabolic activity is accelerated by exposure to polarised radiations, as suggested by us in our previous note to NATURE as one of the possible explanations for the rise of temperature in the afternoon in the normal individual as well as in certain pathological conditions. The amount of carbon dioxide exhaled by the animals has been taken in these experiments as a measure of their metabolic activity.

Two female rabbits of about equal weight, pure white in colour, were put into two air-tight glass chambers of equal size with plane glass sides just big enough to accommodate the animals easily. Through a tightly fitting rubber cork fixed on the lid, two tubes were provided to serve as inlet and outlet for air. The outlet tube went right near the bottom of the chamber, while the inlet tube stopped short near the lid Before entering the chambers the incoming air was made to pass through potassium hydroxide solution and a tower containing fused calcium chloride and soda-lime in order to free it completely from water vapour and carbon dioxide The outgoing air from each chamber, after passing through two U-tubes containing pumice stone saturated with sulphuric acid, was bubbled through a strong solution of potassium hydroxide in potash bulbs with tubes of fused calcium chloride fixed at their ends, as ordinarily employed for accurate organic analysis, and then passed through tubes of baryta water to ensure that the whole of the carbon dioxide was being absorbed by the caustic potash.

The current of air through the system was maintained by means of a filter pump attached to a water-tap The rate of current in the two systems, as indicated by the number of bubbles in the baryta tubes, was controlled and equalised by means of stop-cocks. Further confirmation of the equal amount of air passing through the two chambers was obtained by allowing atmospheric air to pass through each system, after disconnecting the device for intercepting carbon dioxide from the empty chamber, and weighing the increase in the two potash-bulbs due to the absorption of carbon dioxide. The animals were next put in the chambers, which were enclosed in the two partitions of a darkened wooden box, and control experiments were performed to measure the amount of carbon dioxide exhaled by the animals in the dark in half an hour Before putting the animals in the chambers they were starved for six hours or more.

The chambers were lighted up with polarised and ordinary light of the same intensity by means of two tubes 7 cm. in diameter projecting from a wooden box containing a 100-watt metallum half-watt opal glass bulb The lamp was rigidly fixed in front of one of the tubes, and the light in the other tube was obtained by reflection from a pile of plates inclined at the Brewsterian angle The intensities of the polarised and the unpolarised beams were equalised by interposing blocks of glass placed vertically in the path of the beams until the radiant energy falling on a thermopile from the two sources produced equal deflexions in a sensitive galvanometer. The average polarisation as tested by Savart's polariscope (cf. Wood, "Physical Optics," p. 298, 1923 edition) was more than 90 per cent For the sake of closer comparison results are given in ratios between the amounts of carbon dioxide exhaled by the two animals per kilogram of the body weight in a constant period of half an hour.

TABLE I

Rabbit A exposed to polarised light
Rabbit B exposed to unpolarised light.

Animal.	Weight.	Ratio in dark A/B.	Ratio in light A/B	Ratio A/B in dark after exposure to light.
Rabbit A . Babbit B .	533 gm. 562 ,,	0·965 . 1	1 050 . 1	0·877 : 1

TABLE II.

Animals Interchanged.

Rabbit B exposed to polarised light
Rabbit A exposed to unpolarised light.

Animal	Weight	Ratio in dark B/A.	Ratio in light B/A.	Ratio B/A in dark after exposure to light
Rabbit B . Rabbit A .	569 gm 553 ,,	1·009 : 1	1·022 : 1	0·867 1

Note.—The weight of both the rabbits increased during the course of the experiments

TABLE III.

Guinea-pig A exposed to polarised light.
Guinea-pig B exposed to unpolarised light

Animal.	Weight.	Ratio in dark A/B	Ratio in light A/B.	Ratio A/B in dark after exposure to light.
Guinea-pig A . Guinea-pig B .	473 gm 517 ,,	0·881 . 1	0·969 : 1	. .

Note.—The animals were white in colour, but there was a big dark brown patch on the side of guinea-pig B.

From Tables I. and II. it would appear that when the animals were placed in the dark after exposure to light the order of their metabolic activities was reversed, that is, the animal exposed to the polarised light showed diminished activity compared to its fellow exposed to the ordinary light. This would seem to suggest that there is compensatory rest after the increased metabolic activity induced by the polarised radiations.

Further work is in progress

S. S. BHATNAGAR.
R. B. LAL.
K. N. MATHUR.

University Chemical Laboratories,
University of the Punjab,
Lahore, India.

Energy Levels of the Carbon Monoxide Molecule.

IN a recent letter to NATURE (vol. 117, p. 376, 1926), Dr. R. C. Johnson shows that the third positive carbon bands are related to those recently discovered by Cameron (*Phil. Mag.* (7) 1, p. 405, 1926), and that the final states of the Cameron bands are identical with the final states of the fourth positive carbon bands As the fourth positive bands are known to belong to the neutral carbon monoxide molecule from Leifson's absorption experiments (*Astro. Jour.*, 63, 73, 1926), Johnson concludes that Cameron's bands and the third positive bands also belong to the neutral carbon monoxide molecule. We have recently completed some experiments on the excitation of the carbon monoxide spectra by electron impacts which support the views of Johnson, and they enable us to extend the scheme of energy levels so that it includes all of the bands of carbon monoxide.

We employed hot cathode discharge tubes and measured the excitation potentials of the several systems by a photographic method. A part of the third positive bands appear at 10·2 volts in agreement with the energy level assigned to them by Johnson, but another set appears at 11·1 volts or at a 0·9 volt higher level. These bands were shown to have the same final states as the set which appears first, and when so analysed, indicate that they originate in a single state 8258 cm.$^{-1}$ above the first set. This difference in levels corresponds to 1·02 volts, in agreement with the difference in their measured excitation potentials. As this difference is rather large to be ascribed to a vibrational shift, we have concluded that the second set constitutes a different system, having final states identical with those of the third positive system but originating in an electronic level 1·02 volts higher than the zero vibrational level of the third positive bands. We shall refer to these bands as the 3A system. Their structure is quite different from the others, whereas they would be expected to be similar if they all belonged to the same system. The following bands constitute the 3A system: λ2295·2, 2389·0, 2489·9, 2597·1, 2711·35A.

Having now separated one set of bands from the third positive system, it is possible to arrange the remaining bands into two series having the same final states and having initial states differing by 2210 cm.$^{-1}$, which difference can be ascribed to a vibrational shift. Thus there are two initial vibrational levels for the third positive system and only one for the 3A system. When the molecule is in such highly excited states it cannot suffer very large nuclear displacements The same thing is illustrated by the few initial states of the Ångström system.

The third positive bands have usually been ascribed to carbon dioxide, instead of to carbon monoxide, because it was believed that they are of too complex structure to belong to a simple diatomic molecule. However, their relation to the Cameron bands points strongly to carbon monoxide as their origin, as suggested by Johnson. Further evidence that carbon monoxide, and not carbon dioxide, is the origin of these bands has been obtained by the writers in collaboration with Prof. E. F Barker of this laboratory. Carefully prepared and purified carbon dioxide was excited by electron impacts in a three electrode discharge tube through which the gas was caused to flow at a constant rate (Barker and Duffendack, *Phys. Rev.*, 26, 339, 1925) The gas passed through the region of excitation before it could come into contact with the filament, and oxide coated platinum filaments were used in order to reduce the amount of thermal dissociation, and so the amount of dissociation products that could find their way into the region of excitation was negligible.

With this apparatus, the bands of the third positive system were not observed unless a considerable voltage was applied to the electrodes. When they did appear (and they were always of feeble intensity) they were invariably accompanied by the Ångström bands Their presence under these conditions can be accounted for by the dissociation that occurs in the discharge at high voltages. When, however, the flow of gas was stopped and the stagnant gas excited in the tube, these bands and the Ångström bands appeared strongly in the discharge at much lower voltages. At the same time the pressure in the tube increased, indicating that the carbon dioxide was being dissociated by thermal action at the filament. It is concluded from these experiments that the third positive bands, like the Ångström bands, belong to the neutral molecule of carbon monoxide.

In possessing the two parallel sets of electronic energy levels, carbon monoxide is, so far as the writers are aware, unique It probably means that the molecule has two distinct types of spectral terms corresponding to different types of electronic orbits. It may be worth while to consider, as an hypothesis, that one set of levels is made up of triplet terms and the other of singlet terms in analogy with the term scheme for the 'corresponding atom.'

In pursuance of this idea, it would be concluded that the complex structure of the third positive bands may be due to the overlapping of bands from the several levels of the triplet terms. Separations of the order of magnitude as occur in the triplet terms of Mg would result in a superposition of the bands from the several levels and cause an apparent complexity of fine structure. The diminution in the triplet separations in the higher terms would result in a simplification of the structure of the bands originating at these levels, and this may account for the simpler nature of the bands of the 3A system. On the other hand, the singlet levels would produce bands of greater simplicity like those of the Ångstrom and fourth positive systems.

O. S. DUFFENDACK.
GERALD W. FOX.

University of Michigan,
May 30.

Hydrogen as Anion.

NOT every one can entertain the wild and woolly west—it is some feat! Still, I should be better pleased, if, instead of entertaining Prof. Lewis, I had led him to be serious and consider the depth of crime he is guilty of in aspersing the character of hydrogen as he has done. Being subversive of all that chemists have taught, the doctrine he preaches, that it is the analogue of fluorine and can act as an *anion* and as bigamist, is not one to be put forward in the light and airy manner he adopts—without considering the consequences. If its effect were confined to the Pacific coast, we here might regard such speculation with complacency—following the example of the Professor's countryman, who, during the civil war, expressed his readiness, rather than that it should come to an end to his disadvantage, to see every drop of blood shed from every vein of every one of his wife's relations. When, however, the morals of Cambridge and Oxford suffer, especially when one whom I long sought to train in the ways of righteousness, whose hand and eye work I have always greatly admired, preaches it as gospel in the tabernacles of Belgian, British and French chemists, I feel bound to protest. Men of his type, with an ever waxing clerical diathesis, are dangerous to society, when they begin to imagine and preach heresy—their acolytes tend to take them seriously, not realising that they are but acting the Huck Finn to some distant Tom Sawyer.

Let us admit that to-day chemistry is mainly a Huck Finn-Tom Sawyer business: any one who was present at the recent Faraday Society discussion on explosions and has listened to talks on tautomerism and polarity at the Chemical Society must see that such is now our condition. We just "let-on": the laboratory is fast passing into insignificance, the close study of *materia chimica* is a practice of the past, the judicial spirit is gone, engulphed in the Scandinavian wave, jesuitry prevails instead.

Prof. Lewis merely "lets on": he has no solid ground of evidence. His contention involves the assumption that calcium hydride is an electrolyte. Hittorf's early definition: "Electrolyte sind Salze" still remains the one concise and consistent statement concerning the facts. No pure binary hydride has yet been shown by valid evidence to be an electrolyte, let alone a salt. Prof. Lewis very properly raps me over the knuckles on account of my reference to potassium—an obvious howler. Incidentally, let me say, nothing is more strange than the way in which blunders are unconsciously made in writing and, being made, remain undetected until after an interval—only recently, when filing my letter, did I suddenly realise what a fool I had made of myself.

Prof. Lewis might, however, have taken the hint I gave him. The Bardwell experiment was not made with the metallic hydride but with a solution of the hydride in an eutectic mixture of lithium and potassium chlorides—both electrolytes. Is it not rational to suppose that only the chloride was electrolysed and that hydrogen was but the product of a secondary change? In other words, that it was displaced by the 'nascent' chlorine—hence its appearance at the anode. Bardwell makes no reference to an evolution or appearance of chlorine but calmly assumes that the hydride acts as the electrolyte. Even Prof. Lewis, I imagine, will not contend that the chlorides are unaffected by the current.

Hydrogen, however, will take care of itself. What concerns me is the future of our science. All my life, an advocate of training in the use of scientific method, I find little or no evidence in our ranks of the complete intellectual probity the practice of the method involves. The young student goes to the university in full honesty of purpose, his parents expecting that he will be trained for his life-work. Instead of science he finds nescience. The consequences are already seen to be disastrous both to scientific and industrial progress. Men who are both rational and reasonable, with some breadth of knowledge and outlook, observant and reflective, fit to take charge of posts of importance and responsibility, are not to be found among young chemists to-day. The wrong type of man is being forced into the profession and, even when one of the right type comes forward, the superficial training that is given but unfits him for the service of the world.

HENRY E. ARMSTRONG.

The Sensitivity of Selenium Cells.

MR. THORNE BAKER's observations on the enhanced light sensitivity of selenium cells actuated by alternating, instead of direct, current (NATURE, June 19, p. 858), are possibly related to some phenomena investigated recently by Mr. J. W. Avery and myself. We have found that selenium cells of a particular type (those made to the design of Prof. H. Thirring) display, when used in the ordinary way with direct current, appreciable and persistent polarisation effects. Almost accidentally it was discovered that this polarisation disappeared as a consequence of prolonged exposure of the cell to the operation of a drying agent. By the same process the 'dark' conductance of the cell was reduced in the proportion of about 4 to 1, while the 'light' conductance was scarcely altered. The dried cell had thus become much more sensitive to light. We have attributed both the polarisation observed and a large part of the 'dark' conductance of the undried cell to the presence of a film of water in parallel with the selenium between the electrodes, and our observations agree quantitatively with this assumption.

We have also obtained some evidence of the existence of a much more transient polarisation in the desiccated cell, leading to a difference of conductance according to whether alternating or direct current is used, but this work is, for the present, incomplete. What has been established is that quite apart from the question of current alternation, the sensitivity of certain selenium cells, and probably of others, can be greatly increased by the simple process of thorough drying. The record of our work on this subject has been completed for publication and will, it is hoped, appear shortly.

A. O. RANKINE.

Imperial College of Science and Technology,
South Kensington, S.W.7, June 20.

Luminous Night Clouds.

DR. G. M. B. DOBSON, in his recent Halley lecture on "The Uppermost Regions of the Earth's Atmosphere," makes mention of the phenomenon of 'luminous clouds' (NATURE, May 15, 1926, vol. 117, p. 697).

These clouds, discovered in 1885 by Prof. Ceraski, Moscow, may be observed in northern latitudes, 50°-60°, during the summer period, between the middle of May and the middle of August; in the southern hemisphere they are observed from November to February.

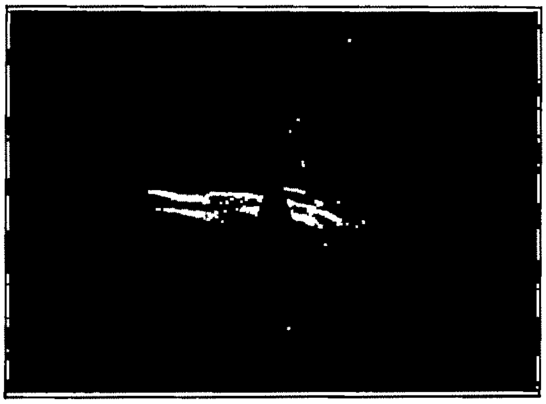


FIG. 1.—Luminous night clouds on August 8-9, 1925, 22 h. 47 m. U.T. Exposure 2 min.

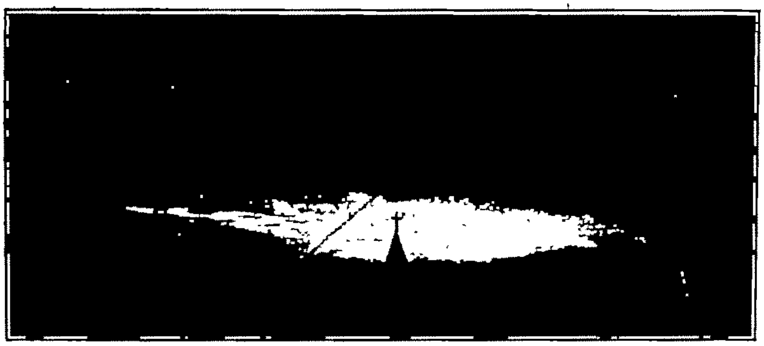


FIG. 2.—Luminous night clouds on August 8-9, 1925, 23 h. 29 5 m. U.T. Exposure 3 min.

The 'luminous' clouds are rather like the 'cirri' in appearance, but they seem to gleam on the background of the segment of the dawn, whereas the common 'cirri' appear dimmed and dark when seen against the sky at dawn. The characteristic feature of luminous clouds appears to be, as indicated by O. Jesse, their unchangeable altitude over the earth's surface; on the average about 82 km. It is interesting to note that the Heaviside layer, which plays such an important part in radio telegraphy, is at the same height of 80 km., moreover, according to Trowbridge (*Astrophys. Journal*, 1907), the tails of meteors are generally also observed at this same height (87 km.). These facts indicate peculiar properties for the layer lying at an altitude of 80-85 km. above the earth's surface; it seems possible that all phenomena observed at this height are closely connected with one another.

Our knowledge of luminous clouds is very incomplete and we have no satisfactory theory relating to their origin. The hypothesis of volcanic origin, maintained for some time after the first observations of luminous clouds in connexion with the eruption of Krakatao in 1883, had to be rejected, these clouds being observed almost every year, and independently of volcanic eruptions.

Lately (*Met. Zeitschrift*, Oct. 1925) a theory proposed by A. Wegener regards luminous clouds as being due to condensation of normal water vapour; this theory, however, has also met with many objections (*Met. Zeit.*, Mar. 1926.)

Luminous clouds, after being a vary rare phenomenon for a certain period of time, were again frequently observed during recent years. They were observed in Russia in 1916–19–20–22–23–24, and 1925; on the night of August 8-9, 1925, I succeeded in obtaining six photographs of these clouds from Leningrad at the Astronomical Observatory of the Russian Amateur Society for the Study of the Universe (Mirovédénié) and the Scientific Institute of P. F. Lesshaft (Figs. 1 and 2) The measurements of the photographs showed that the clouds, having started from a point 13° to the east from north, moved with the velocity of 230 metres a second to the south-south-west.

A detailed account of these observations will shortly appear in the Journal *Mirovédénié* (vol. 15, No. 2, 1926).

We consider observations of luminous clouds to be extremely valuable and should feel greatly obliged if any one would send to us duplicates of observations made either at the present time or relating to any other epoch. Photographs would be especially valuable.

Guidance as to methods of making these observations may be found in an article by W. Foerster and O. Jesse in *Astron. Nachrichten*, Bd. 130, 1892.

V. MALZEV.

Russian Society "Mirovédénié,"
25 Oulitza Petchatnikov,
Leningrad, U.S.S.R. (Russia),
June 14.

Magnetic Properties of Single Crystals of Iron.

REFERRING to the letter in NATURE for May 29, p. 753, by Messrs. Honda, Kaya and Masuyama, it will be noted that Fig. 1, showing the magnetisation curve for a large crystal of iron, indicates the occurrence of definite and distinct steps in the magnetisation curve, but no explanation is foreshadowed.

In the *Journal of the Institution of Electrical Engineers* for September 1920, vol. 58, p. 832, I suggested that such steps were likely to be found in the magnetisation of iron crystals on the probability that more than one configuration would be involved before saturation was reached. Any such steps would be hidden in commercial iron owing to the irregular arrangement of crystals and the resultant overlapping in their individual characteristics, but in an individual crystal with a wholly symmetrical arrangement one would expect a relatively sudden change of pattern falling into a different space-lattice.

It would be interesting now to have an X-ray examination made of the crystal to ascertain the configuration corresponding to each stage of the magnetisation curve.

E. B. WEDMORE,
Director and Secretary.

The British Electrical and Allied Industries
Research Association,
19 Tothill Street, Westminster,
London, S.W.1, June 22.

Climatic Changes during Geological Times.

By C. E. P. Brooks.

I. Glacial and Genial Periods.

After the primary discovery of geologists that the various strata of rocks exposed at the earth's surface could be arranged in chronological order, and that when so arranged they represented a sequence covering a very long period of time, the most striking result of their investigations has concerned the great variations of climate which all parts of the earth's surface have passed through. Coral reefs have extended into the British Isles and central Europe, and evergreens have flourished beyond the Arctic Circle. At the other extreme, large areas now enjoying a temperate or even tropical climate were covered by thick ice-sheets.

The evidence for all these changes is now so abundant that the general facts can no longer be questioned, though there are still differences in the interpretation of details. Thanks to this patient accumulation of evidence, we are now well acquainted with the climatic history of most parts of the earth's surface. Only the very oldest strata, the Archæan, composed of gneisses and similar rocks, are so altered that they give practically no information as to the climate prevailing when they were formed. At one time they were believed to be remnants of the earth's original crust, born in fire, but although the uranium-lead and thorium-lead ratios show that, according to the usual method of computation, some of these rocks are so much as 1600 million years old, the astronomical calculations summed up by Harold Jeffreys point to the age of the solar system as being very much greater still. Hence it is very improbable that any parts of the original crust of the earth still remain accessible.

The sedimentary rocks formed in the succeeding Proterozoic era are in many localities sufficiently unaltered to indicate the conditions under which they were laid down. During the greater part of this era the prevailing deposits were sandstones, such as the thick Torridonian Sandstone of Scotland, and limestones, but in many widely separated areas glacial deposits have been found—near Adelaide in Australia, in the Himalayas, South Africa, the United States, the head of the Yang-tse River in China, and perhaps also in Scotland and the Varangerfjord in Norway. The glacial phenomena at the latter site are very fine; they may be of any age from Proterozoic to Permian, but are most probably Lower or Middle Cambrian. The succession of events is best shown in Australia, where ancient boulder-clays or 'tillites' have been found on two horizons separated by 9000 feet of conformable strata. The later of these two tillites occurs probably just below the base of the lower Cambrian. Two glacial horizons, one probably just pre-Cambrian and the other much older, have also been recognised in South Africa, and possibly in the United States and India.

The Palæozoic was thus ushered in by an ice-age, but by the Middle Cambrian all traces of glaciation, with the possible exception of the Norwegian, seem to have disappeared, and by the Upper Cambrian at least mild climates had developed in all parts of the world. The temperature was not the same in all latitudes; for example, the Archæocyathinæ, which are fully developed in Australia, are dwarfed and crippled in the Antarctic, but the zonal differences were less than at present. The Ordovician period was one of prolonged warmth; in the Silurian this general warmth continued, and corals spread into all latitudes, though in the Arctic only isolated dwarfed forms occur. The Silurian also gives us some evidence of the development of desert climates, while in south-east Alaska, and possibly in Tasmania, there are traces of ice action. In the Lower Devonian the faunal zones became more accentuated, and there is evidence of ice action at Table Mountain in South Africa and probably also in the Falkland Islands. In the Upper Devonian, however, the general warmth appears to have returned, and in the Old Red Sandstone extending from England to the Baltic States we have evidence of a widespread arid region, which Walther compares with the interior of Australia or with the Trans-Caspian desert. The prevailing warmth continued into the Lower and Middle Carboniferous, when thick coral reefs were formed in middle latitudes and a cosmopolitan flora spread over the greater part of the land surfaces, but in the Upper Carboniferous the ice-sheets returned over very wide areas.

This ice-age is generally termed the 'Permo-Carboniferous,' because when its remains were first discovered they were believed to fall mainly at the junction of these two periods. It now appears that the ice reached its greatest development in the Upper Carboniferous, when the ice-covered area was probably greater than at any other time in the earth's history. The most remarkable feature of this glaciation is the distribution of the ice-sheets—a large part of Australia, South Africa, India, eastern South America from southern Brazil to the Falkland Islands. This immense area, much of which is now within the tropics, was covered, not by local valley glaciers, but by immense regional ice-sheets. The striæ indicate that the ice moved southwards in Africa, but northwards in India, *i.e.* away from the equator, but in Australia the centre of dispersal lay to the south-west of Tasmania. Farther north there are some rather doubtful glacial deposits in Europe—Germany, France and Holland—and a large amount of quite definite evidence of glaciation in North America, where the glaciers appear to have attained a considerable size and to have reached the sea. The most interesting glacial deposits in North America, the 'varve' clays associated with the Squantum tillites, will be referred to later. No Carboniferous glacial deposits have yet been discovered in the Antarctic.

Apparently contemporaneous with the ice-sheets was the rich flora of the Coal Measures in North America, Europe and Asia, which developed from the cosmopolitan flora of the Middle Carboniferous, but in Australia, India and South Africa a new flora of hardier appearance developed above the glacial deposits—the Glossopteris flora.

In the Upper Permian the climate again became generally warm and dry, and this initiated a long period of genial climate which persisted with only minor interruptions throughout the Mesozoic and the greater part of the Tertiary. There was floating ice in the English chalk seas and in Australia in the Cretaceous, and Alpine glaciation in the Antarctic and in the San Juan Mountains of Colorado in the Eocene, and perhaps in the Italian Alps in the Miocene, but the general impression given by the Jurassic coral reefs of Europe and the Upper Eocene Arctic flora is one of slight differences of temperature between different latitudes and warm ocean currents penetrating into the neighbourhood of the poles.

During the Pliocene the temperature began to fall rapidly, and it is probable that quite early in this period the Antarctic ice reached the sea, while a boreal fauna developed in the Arctic Ocean which spread out into the Atlantic, and early in the Quaternary penetrated into the Mediterranean. During the latter period glaciers formed on the mountain ranges in all parts of the world, developing into great ice-sheets in the north temperate zone, where there were four main advances of the ice—the well-known Gunz, Mindel, Riss and Wurm stages of Penck and Brückner's classification. Since the maximum of the Wurm there have been several minor oscillations, passing gradually into the present climate.

The outstanding features of this history are the alternation of glacial and genial periods and the association of glaciation with mountain-building, of warmth with periods of rest. The Lower Proterozoic glaciation was associated with great outpourings of lava, the Late Proterozoic-Early Cambrian glaciation coincided with a period of disturbance, the Upper Carboniferous glaciation followed the Hercynian folding, and the Quaternary glaciation followed the culmination of the Alpine folding. Minor periods of unrest, such as those of the Silurian or Cretaceous, were followed by minor deteriorations of climate. This orogenic-climatic cycle becomes more obvious when the dates are considered. The Quaternary glaciation was an affair of yesterday. The radio-active clock (according to the usual basis of calculation) gives the age of the Upper Carboniferous as 260 million years, and the base of the Cambrian as 500 million years. The interval between the two Proterozoic glaciations has not been defined exactly, but a reasonable estimate would be 200-300 million years. Thus each cycle of the geological seasons seems to have run its course in about 250 million years, giving a regular sequence which has been termed the "rhythm of geological time."

Before the causes of this grand climatic cycle can be discussed, however, the possibility has to be considered that the fluctuations were more apparent than real. In any region, such as Europe, the climatic sequence can be expressed in terms of variations of apparent latitude. This obvious fact has led to several theories of 'pole-wandering' and 'continental drift'—Simroth, Kreichgauer, and finally, the very complete and far-reaching theory of A. Wegener.[1] Wegener's work seems at first sight unassailable. The earth's surface is at present divided into a number of climatic belts—an equatorial rain-forest belt, two sub-tropical dry belts, two temperate rain belts, and finally two polar glacial caps. Now consider the climatic variations of western Europe. In the Upper Carboniferous there are the coal-measures—apparently the remains of an equatorial rain forest. In the Triassic there are desert sandstones—remains of the sub-tropical dry belt. During succeeding geological periods Europe passed successively through the warm temperate and the cold temperate belts until in the Quaternary it entered the polar glacial cap. Now go back to the Upper Carboniferous. If regions now in latitude 50° N. were on the equator, the south pole must have lain in some point now in 40° S. While Europe was much warmer than it is now, a large part of the southern hemisphere must have been much colder, and in fact a large part of the southern hemisphere now enjoying warm temperate or sub-tropical climates was then glaciated.

So long, however, as the continents remained in their present positions relative to each other, some parts of the southern glaciated region must fall in low latitudes no matter where the south pole is placed. Wegener gets over this difficulty in two ways. First, he considers that the relative positions of the continents have not remained the same. Continents are composed of masses of relatively light rock (sial), embedded in heavier rock (sima) which under long-continued pressure acts as a viscous fluid. Hence under the continuous action of any horizontally directed force the continents will drift through the sima. The east coast of America fits so neatly into the west coast of Europe and Africa that there is good warrant for believing that the two were formerly united and have recently drifted apart; there is some geological and biological evidence in support of this view. Similarly, though on less plausible grounds, Wegener effects a *rapprochement* of Africa, India, Australia and the Antarctic continent, the whole forming in Carboniferous times a compact continent or 'Pangæa,' centred near the south pole. But even this is not enough; parts of the glaciated area of Pangæa extended into temperate latitudes, and Wegener further supposes that the south pole described a wide curve through this primitive continent, so that different parts of the land area were glaciated at different times.

Wegener accounts for the long periods in which there is no evidence of ice action anywhere on the earth by supposing that during these periods the poles lay near the centres of extensive oceans, while during the glacial periods the poles lay near or over the land. In the Miocene the north pole is placed over Alaska, whence it moved eastwards across North America and Greenland to the neighbourhood of Spitsbergen. Thus the 'Quaternary' glaciation of America is older than that of Europe. The succession of glacial and interglacial periods is accounted for by Köppen[2] on astronomical grounds.

The whole work is wonderfully ingenious, and it has been accepted by many geologists. There are, however, a number of very serious objections to it. The forces which Wegener postulates to move the continents are twofold—a tidal force acting from east to west, which is indefinite but may be large, and a very small drift towards the equator which is common to all floating bodies. H. Jeffreys[3] considers that while the deeper layers of the sima are viscous, the surface layers are too rigid to allow these small forces to act. Joly's recent theory of the cyclic melting and solidifying of the sima[4] may provide an escape from this objection, and we may perhaps grant the possibility of east-west movement for which there is some geophysical evidence. But the "flight from the poles" is another matter, and in fact, according to Wegener's reconstructions, during a large part of geological time the main mass of land in the northern hemisphere was moving, not *from*, but *towards* the north pole. The evidence for these movements is entirely palæoclimatic, and needs to be very convincing to support such far-reaching deductions. Is it convincing? Leverett's comparative studies of European and North American glacial deposits do not bear out the assumption that the main part of the American glaciation is far older than the European. According to W. H. Dall the Miocene glaciation of Alaska is a myth, the main glaciation of that country having occurred in the Quaternary. The mild polar climates of the Upper Eocene cannot be accounted for by movements of the poles, since Berry has shown that a flora allied to the present temperate flora completely surrounded the north pole in high latitudes, forming a ring out of which it is impossible to bring the pole in any direction. The desert deposits of the Mesozoic are practically limited to the latitudes in which deserts are found at present. Wegener's reconstructions do not account at all for the climatic sequence in the Antarctic, as recently set out by Wright and Priestley.[5] There remains the Upper Carboniferous period.

---

[1] Wegener, Alfred, "The Origin of Continents and Oceans." Transl. by J. G. A. Skerl. London, 1924.

[2] Koppen, Wladimir, und Wegener, Alfred, "Die Klimate der geologischen Vorzeit." Berlin, 1924.

[3] Jeffreys, Harold, "The Earth; its Origin, History and Physical Constitution." Cambridge, 1924.

[4] Joly, John, "The Surface-history of the Earth." Oxford, 1925.

Most meteorologists would say that the development of extensive ice-sheets reaching sea-level within the tropics is inconceivable, and that for the Upper Carboniferous Wegener's theory offers the only possible solution. The succession of glaciations in different continents following a moving pole is not tenable in the light of recent geological work, which seems to demonstrate the approximate synchronism of the glacial maximum in all countries, but this scarcely affects the main problem. A more serious objection is the Upper Carboniferous glaciation of North America, which Wegener's reconstruction places on the equator. Evidence has been found that in Oklahoma, Arkansas, Massachusetts, Nova Scotia and perhaps in other regions also, powerful glaciers reached the sea, and icebergs or heavy shore ice transported large boulders fifty miles or more from their original source. The best development is seen in the Squantum beds near Boston, where, in addition to thick tillites, there are seasonally banded clays which are similar in all respects to the 'varve' clays formed during the retreat of the Quaternary ice-sheets in Sweden, Finland and North America. The glacial nature of these beds appears to be incontrovertible, and the well-marked seasonal banding appears to be incompatible with their formation on the equator. Whether Wegener's theory is adopted or not, the climatological problem presented by ice reaching sea-level within the tropics still remains to be solved.

(*To be continued.*)

---

[5] British (*Terra Nova*) Antarctic Expedition, 1910–1913, "Glaciology," by C. S. Wright and R. E. Priestley. London, 1922.

On the Rare Earths.

THE group of about sixteen elements the oxides of which are popularly known as 'rare earths' are characterised by an exceedingly close relationship in their chemical and physical properties—a relationship which, in its intimacy, is not paralleled by any other group of elements. In consequence of this fact, the task of isolating the individual members of the group has been one of quite exceptional difficulty. Until recent years, practically every reported discovery of a new element of the group was proved, by later searching investigation, to be not one element, but two or more. In addition to this difficulty has been that of distinguishing an alleged new element from some other previously discovered element, with the result that one and the same element was discovered over and over again, each discoverer giving it a separate name. Hence, the chemistry and the nomenclature of the rare earths were for many years in a state of almost hopeless confusion from which they have emerged only during the present century, and particularly in the last decade

The history of the discovery of the rare earths goes back to 1794 when Gadolin discovered the yttrium earths, out of which a considerable number of separate elements have since been identified. By the discovery of ytterbium and cassiopeium (or lutecium) by Auer von Welsbach in 1906, it was thought that the whole of the rare earths had been discovered, and it was not until the development of the atomic number rule by Moseley that it was found that a space in the series, corresponding to an element with an atomic number of 61, was vacant. There is now fairly conclusive evidence that, after a great amount of work by various investigators, including an exhaustive and negative examination of rare earth fractions by Prandtl and Grimm extending over a year, this element has been definitely identified by the use of the X-ray spectrum. There is also good reason for supposing that with the discovery of illinium, the name given to the supposed new element, the whole of the rare earth elements have been found and identified.

The term 'rare' as applied to these elements is relevant only in the case of a small minority of them. Cerium, believed to be the most abundant, is considered to be little, if any, scarcer than nickel, and many of the others are far from being scarce, even if concentrations of them are not common. On the other hand, a few of the elements appear to be among the rarest known, and this appears to be particularly true of erbium, and the element 61, which has so long eluded the searchers for it and even yet has not been found in measurable quantity.

The primary occurrences of the rare earth minerals in Nature are confined mainly to pegmatite dykes or pegmatitic rocks, considered to have been formed during the last phases of crystallisation and differentiation of an intrusive magma, that is to say, to the phase following acid rock formation. But rare earth minerals are usually not present in important concentrations in the primary rock formations, and it is only by the denudation of the containing rocks and the natural concentration of the relatively heavy minerals set free that accumulations representing any appreciable quantity of the material are formed.

The main source of the rare earths, so far, has been monazite sands found in considerable accumulations in Travancore in India, Bahia State in Brazil, as well as in Ceylon and a number of other places in the world. The composition of monazite sand is complex, but essentially it consists of the phosphates of cerium and lanthanum. But the economic value of the sands depends on the percentage content of thorium minerals which are now used so extensively in the manufacture of the incandescent gas mantle. The cerium content has some economic value, being also used in small proportion in the incandescent mantle industry, and also for the manufacture of ferro-cerium, well known in the form of the sparking type of lighter.

The following are partial analyses of two samples of monazite sand, one from Travancore and the other from Bahia:

	Travancore. Per cent.	Bahia Per cent
Thoria	9·43	6·50
Ceria earths	31·90	61·40
Lanthanum earths	28·00	
Yttria earths	0·46	0·70

The yttrium earths have been used in the manufacture of the incandescent parts of Nernst lamps, but for most of the other rare earths no industrial outlet has been found. In some quarters it has been suggested that certain of them may prove valuable as catalysts.

With reference to the close association of the rare earths in Nature, it is obvious that since the chemist finds so much difficulty in separating these by methods of great refinement, the crude large-scale metallurgical processes of Nature must tend to segregate them in groups rather than separately. The rare earth group is scarcely unique in this respect; the platinum group of metals is a more or less parallel example where the so-called native platinum may be, and often is, a complex alloy of platinum, iridium, osmium, palladium, ruthenium and other metals. All of these metals possess ~~closely related~~ physical and chemical properties which lead to their segregation in the basic and ultra-basic differentiations of an intrusive magma. The rare earth minerals, however, mainly associate themselves with silicious and aluminous magmas.

The conception of atomic numbers and the history of the discovery that X-ray spectra could be used in the identification of previously unknown elements have formed the subjects of numerous articles and communications in the scientific and philosophical press and need only be briefly mentioned here. The names associated with these discoveries include, among others, those of Laue~~, W. H.~~ and W. L. Bragg, and Moseley, to all of whom great credit is due for their respective parts. Moseley's work in connexion with the development of the atomic number rule has been especially valuable. In the field of the rare earths, the determination of the atomic numbers has revealed definitely the possible number of distinct chemical elements. Between barium with an atomic number of 56 and tantalum with an atomic number of 73 there is room for sixteen elements. Prior to 1923 it was possible to speak of only fourteen of these elements as definitely known, but with the discovery of hafnium with an atomic number of 72 by Coster and Hevesy by means of the X-ray spectra, and the later discovery by Prof. B. S. Hopkins and his associates of what seems to be element No. 61, the sequence from 56 to 73 is complete and justifies the claim that all the rare earths have been discovered. The X-ray method of investigation also leaves no room for assuming that the list of rare earth elements contains duplicated cases, and that the same element may be regarded as two distinct elements under different names. The indications obtained by that method are open to one interpretation only, and those characteristic of a given element are distinguished without difficulty and beyond reasonable doubt.

From its simplicity, ease and rapidity of the experimental examination, the determination of the X-ray spectrum is becoming of the greatest importance in the investigation of particular elements in a mixture, and in the control of separations; it will most probably, in a large degree, if not entirely, replace the much more complicated and troublesome examination of the light emission spectrum. Not only are elements identifiable by this method with a rapidity and certainty which far surpass those of other methods, but a comparison of the densities of the lines with that of the lines given by a known quantity of a foreign element will give approximate quantitative results.

The method of using the apparatus presents no difficulty. The apparatus is arranged in much the same way as an ordinary spectrometer, the incident light is replaced by the beam of X-rays from the material under examination, which forms the anti-cathode, in a vacuum tube. The diffraction grating is replaced by the crystal slice, and the telescope and eyepiece (or photographic plate) by an ionisation chamber by which the intensity of the reflected beam may be measured.

LITERATURE CONSULTED

Levy, S. I. The Rare Earths. 2nd ed. London, 1924.
Prandtl, W., and Grimm, A. *Zeitschr. für anorg. Chemie*, vol. 136, No. 61, p. 283.
Noddack, W., and Tacke, Ida. *Metall u. Erz*, vol. 16 (5/5/26), pp. 985-6.
Lindgren, W. Mineral Deposits. 2nd ed. New York, 1919.
Rastall, R. H. Geology of the Metalliferous Deposits. Camb., 1923.
Harris, A. J., Yntema, L. F., and Hopkins, B. S. NATURE, June 5.

Television.

THE possibility of 'seeing by telegraph' was fully recognised many years ago. The discovery that the electric resistance of selenium varied with the intensity of the light falling on it suggested to Professors Ayrton and Perry, amongst others, that the method was theoretically feasible. It was soon found out that selenium failed to respond quickly enough to the rapid changes in light intensity necessary for television, and it was not until the photo-electric cell had been perfected that inventors seriously attempted to solve the problem. The analogous problem of sending photographs and pictures by telephone wires or by radio waves, or by both these methods, we can consider as solved. It is now done commercially. Doubtless great improvements in the method will be introduced, and before very long every one will accept it as a commonplace operation and cease to regard it as wonderful.

The problem of television, however, is an immensely more complicated one, and even the most optimistic of scientific men had begun to think that it would be many years before the first glimmering of a practical method would be developed. We were therefore agreeably surprised on making a visit to Mr. J. L. Baird, at Motograph House in Upper St. Martin's Lane, London, W.C., to find that he had installed there a transmitter and a receiver which prove that he has made great progress in solving the problem. We saw the transmission by television of living human faces, the proper gradation of light and shade, and all movements of the head, of the lips and mouth and of a cigarette and its smoke were faithfully portrayed on a screen in the theatre, the transmitter being in a room in the top of the building. Naturally the results are far from perfect. The image cannot be compared with that produced by a good kinematograph film. The likeness, however, was unmistakable and all the motions are reproduced with absolute fidelity.

The general principle utilised by Mr. Baird is not difficult to understand. The image of the object to be transmitted is made to traverse a cell sensitive to light. This cell modulates an electric current. When the light on the cell is intense the current is large and when the cell is in shadow it is weak. At the receiving station the current controls a source of light which traverses a ground glass screen which moves in exact synchronism with the image at the transmitter. The spot of light is therefore bright when the light on the transmitter is intense and dark when it is in shadow. The light from the image moves over the screen about ten times a second. Hence, owing to the persistence of vision, a complete image is obtained.

Just as in the early kinematograph films, there is a constant flicker, but this will doubtless be got rid of in whole or in part in the new Baird 'televisor.' This is the first time we have seen real television, and, so far as we know, Mr. Baird is the first to have accomplished this marvellous feat. He had the first inkling of the method two years ago when he successfully transmitted shadows by electricity. We were told that a similar method of transmitting shadows has been independently devised in America. But his present method is as superior to the shadow method as a photograph is to a skiagraph.

It is natural that Mr. Baird and his partner, Capt. Hutchinson, should contemplate a great future for television. They are taking steps in the direction of having a broadcasting system of television for London. Every possessor of a 'televisor' will be in a position to see on his screen the performers in operas and plays as well as hearing them. They expect to make a start in this new system of broadcasting next year. The new discovery will in no way interfere with the ordinary British broadcasting. The Post Office officials, seeing the probable advent of a new British industry, regard the scheme with benevolent neutrality.

Those of us who remember the advent of the telephone in 1876, and remember also how little its importance was then realised, will hesitate to criticise this new invention. There is endless scope for improvement. Mr. Baird, who, like Graham Bell, is a Scotchman, has been so extraordinarily and so rapidly successful in the past that we have great hopes that he will soon perfect his invention to the commercial stage. We wish him every success.

A. R.

Solar Surveys.

Our Supplement this week will be read with great interest by specialists in solar research, and also by a considerable number of other readers to whom Dr. Hale's name is closely associated with the Mount Wilson Observatory and the progress of astrophysics. Since 1923 Dr. Hale has been engaged in perfecting an instrument for *visual* observation of the sun in monochromatic light; and the spectrohelioscope, as he calls it, is now permanently installed at his new solar laboratory at Pasadena. The recent increase of solar activity shown by sunspots, flocculi, and prominences has afforded him ample opportunity for testing the capabilities of the instrument. Its performance appears to have exceeded all expectations, and a rich harvest of results may be anticipated, especially with respect to observations of the sun's upper atmosphere and the hydrogen vortices registered in the light of $H\alpha$. These hydrogen vortices, which have been studied almost exclusively since their discovery in 1908 by Dr. Hale and his colleagues at Mount Wilson, are bound up with the problem of the nature of sunspots and their unexplained reversal of magnetic polarity at each spot minimum. The development of the spectrohelioscope, its uses as a powerful instrument of research, and a survey of results obtained to date are reviewed by him in this week's Supplement.

It is a matter for comment that the development of the spectrohelioscope was delayed by slight circumstances for more than fifty years. As Dr. Hale reminds us, the pioneers of solar spectroscopy, such as Jannsen, Lockyer, and Young, were fully aware of the principle involved; Young, indeed, constructed a spectrohelioscope for seeing the prominences at the sun's limb, but it was never applied for observing phenomena on the disc. The wide slit method for prominence work, introduced in the meantime by Zollner and Huggins, was so successful that a narrow oscillating slit—one of the essentials of the spectrohelioscope—was abandoned, and later experiments, then directed to *photographic* registration in monochromatic light, resulted in the spectroheliograph by Hale and the velocity spectrograph by Deslandres. Thus the need for a visual survey of the sun's atmosphere projected against the disc persisted until the construction of Dr. Hale's spectrohelioscope.

Of the many interesting observations, described and beautifully illustrated in Dr. Hale's characteristic manner, attention may be directed to those by which the observer views in rapid succession the ascending and descending portions of the same hydrogen flocculus and the sunspots which may happen to lie beneath. Dr. Hale's enthusiasm and inventive skill are now being directed to the making of a modified form of spectrohelioscope which he hopes may be within the reach of amateurs. If these hopes are realised, the chances of detecting the exact moments of critical outbursts on the sun will, as he says, be greatly multiplied, and such observations should prove most valuable in determining the true relationships between solar eruptions and terrestrial magnetic storms.

Obituary.

MR. J. J. FLETCHER.

BY the death on May 15, at the age of seventy-six years, of Mr. J. J. Fletcher, who for thirty-three years was secretary of the Linnean Society of New South Wales, Australia has lost one of the ablest and most sincere as well as one of the most beloved of her scientific workers. He was one of the first two Australians to take a science degree at the University of London, and during his visit to England he came under the influence of the late Prof. Francis Balfour at Cambridge, an experience that exercised a lasting influence upon his work and ideals. For the last forty years his life has been devoted to the Linnean Society of New South Wales, and its work bears the imprint of his fine character in the standard which has been maintained throughout all these years. He joined the Society in 1881, and at the time of his death was the second oldest member. During the course of his tenure of the secretaryship of the Linnean Society he also controlled the general management of the Society's affairs and edited the *Proceedings*. But this list of duties gives no adequate idea of the extent of his services to biology in Australia. He took his work as editor very seriously, and few of the contributors to its *Proceedings* failed to receive very material help from him in the lucid presentation of their results and in completing their bibliographical references. He was as modest and tactful as he was helpful.

Since 1881 Mr. Fletcher contributed about thirty-five important papers to the Linnean Society, including twenty-seven zoological papers, dealing largely with kangaroos, earth-worms, and frogs. He was one of the first to investigate closely the embryology of the marsupials, for which purpose he made many expeditions to collect material. His knowledge of the Australian amphibia was unsurpassed. During later years he contributed some botanical papers dealing with phases of eucalyptus and acacia seedlings. The account of his careful study of the families Loranthaceæ and Proteaceæ has unfortunately not been completed. Much of the valuable information he possessed concerning these plants has gone with him, for he was unable to find time to prepare for publication more than a very small percentage of his valuable knowledge.

On his retirement from the position of secretary of the Linnean Society of New South Wales Mr. Fletcher was made president, occupying the chair during the years 1919 and 1920, and his numerous friends presented his portrait to the Society, with a request that it be hung in the Society's hall in recognition of the great work he had so successfully carried out. He was president of the Biology Section at the Melbourne meeting of the Australasian Association for the Advancement of Science in 1900. In 1921 he was honoured by the Royal Society of New South Wales as the recipient of the Clarke Medal, "awarded from time to time for meritorious contributions to the geology, mineralogy, or natural history of Australia." At the time of his death he was a member of the council of the Linnean Society of New South Wales and a trustee of the Australian Museum.

PROF. C. J. LINTNER.

BIOCHEMISTRY of fermentation has sustained a loss by the death of Geheimer Hofrat Prof. C. J. Lintner, who died at the age of seventy years on April 8 after a long and severe illness. The deceased was the son of Dr. Carl (afterwards Hofrat) Lintner, director of what is now the Agricultural High School, Weihenstephan, who was also the founder of the Scientific Station for Brewing at Munich.

Lintner graduated at Munich in 1882 under Adolf v. Baeyer. After spending some years of work in connexion with agricultural chemistry, he became assistant at the Institut fur Garungsgewerbe, Berlin, after which he acted as assistant to Soxhlet at the Landwirtschaftliche Zentralversuchsstation, Munich. In 1888 he was appointed to a chair of technical chemistry at the Technical High School, Munich, becoming "ordentlicher" professor in 1896, his work dealing more particularly with fermentation chemistry.

As regards his researches, Lintner will be chiefly remembered by his work on enzymes, more especially the amylases, and on the transformation products of starch. In 1891 he claimed that one of the products obtained from starch paste when treated with malt amylase is an isomaltose. The existence of this alleged substance was denied by Brown and Morris in 1895, and doubt was thrown on its existence by Ling and Baker in the same year. In 1897, however, Ling and Baker obtained some positive evidence of the truth of Lintner's views, whilst in 1902 Syniewski confirmed the existence of isomaltose and re-named it dextrinose. The existence of the sugar was definitely established by Ling and Nanji in 1923.

Lintner was a man of extreme amiability, and his generous and modest character won for him the esteem of his colleagues and pupils. A. R. L.

PROF. FRANZ VON SOXHLET, emeritus professor of agricultural chemistry at the Technical High School in Munich, died early in May at the age of seventy-eight years. Soxhlet was a native of Brunn, and was appointed to Munich in 1879, where he became director of the central agricultural research station. He was well known for his work on the sterilisation of milk. He did not long survive his distinguished assistant Lintner, whose death was recorded in our issue of June 12 and is referred to again above.

WE regret to announce the following deaths:

Prof. F. N. Cole, professor of mathematics in Columbia University since 1895 and secretary for many years of the American Mathematical Society, distinguished for his work on the theory of groups and the theory of numbers, on May 26, aged sixty-four years.

Dr. Henry Skinner, president in 1909 of the American Entomological Society, who was known for his work on Lepidoptera, on May 30, aged sixty-five years.

Prof. Sidney Irving Smith, professor emeritus of comparative anatomy in the Sheffield Scientific School of Yale University and a member of the National Academy of Sciences since 1884, known for his work on invertebrates, notably crustaceans, on May 7, aged eighty-three years.

News and Views.

AN extraordinary general assembly of the International Research Council was held at Brussels on Tuesday, June 29. After agreeing unanimously, on the motion of the Executive Committee, to omit from the statutes words which have limited membership to allies and neutrals, the following motion proposed by the president of the Royal Society was passed unanimously. "That this meeting of the extraordinary general assembly of the International Research Council decides to invite Germany, Austria, Hungary and Bulgaria to join the International Research Council and the Unions attached to it and, in doing so, to indicate the institution which will act as adhering body."

THE second reading of the Public Health (Smoke Abatement) Bill was moved in the House of Commons last week by Mr Chamberlain. So far as it goes, the Bill is a step in the right direction. The provisions of the 1875 Act are amended to include other kinds of smoke besides black smoke, temporary exemption is to be allowed for certain processes for the present; the power of local authorities to regulate the emission of noxious smoke is to be extended. No provision is, however, made for reducing smoke from private dwelling-houses, which in many places are the greatest sinners. While the time may not be ripe for compulsory prevention of smoke from private houses, this does not appear sufficient reason for not making some provision to bring about improvement by encouragement instead of penalty, such as by empowering local authorities to make a rebate on the rates for users of smokeless methods only. In the debate, several speakers referred to the advantage of the open fire—a pleasant radiant heat and plenty of ventilation. If these can be combined with smokelessness it will be the best solution There is in the Bill no provision for standards of permissible smoke emission, and it is doubtful if much useful result will follow until such are set up As Mr. Chamberlain admits, it is rather on the administration that we shall have to rely for improvement of the conditions of the atmosphere, a reliance scarcely justified by our past experience. It would give more hope of improvement if the Bill empowered the Minister of Health to fix standards of industrial smoke emission from time to time; but the necessary preliminary must be the finding of a reasonably accurate method of measurement. The natural sequence would then be . (*a*) Find a suitable method of measuring smoke from chimneys; (*b*) fixed standards of emission based on (*a*); (*c*) enforce such standards legally.

THE Office d'Information scientifique et technique of Paris, the initiation of which was noted in our issue for June 12, has favoured us with copies of two recent news bulletins, which are interesting to compare with similar issues of the allied Science Service in Washington. The French material has been well selected, and is of real scientific interest; the language is plain and the treatment straightforward, but its somewhat educational tone raises a doubt as to whether the presentation is sufficiently attractive to appeal to editors and readers of the popular Press; it may be, however, that the intellectual standard in France is higher than elsewhere In the United States and England, it is the practice to attract the reader by one or more glaring headlines, to convey the gist of the information (which should contain news) in a short initial paragraph, and then to proceed with details and embellishment The French procedure, as displayed in these bulletins, is more logical: the headlines are distinctly sober and lacking in 'pep'; the article begins with an explanatory or historical preamble, and the news is reserved for a later stage Although this method will be preferred by the student, it is less effective in attracting the lay reader than the more sensational style of approach.

THE 'news' element of the bulletins is not strongly represented in the specimens before us, and in a few cases, for example, the articles on telegraphic reception and the nature of X-rays, the explanations given may convey little to the uninitiated. In about one-half of the items the information comes from the United States, and the remainder from France; when the Service gets better under way one may expect material from other countries to be included. The news appears to have been culled mainly from periodical literature—which must always constitute an important source—but it is to be hoped that first-hand news obtained from research workers and inventors will later become available; in this respect the American Service has been singularly successful. It is of happy augury that the French organisation is starting with high ideals: it will not try to serve both science and mammon; commercial profit is outside its scope and there will be no traffic with the advertiser; and it will preserve a rigid independence of all parties, groups and factions Its sole aim is the prompt diffusion of scientific and technical knowledge in a way that will neither 'mystify the crowd' nor promote sophistry and error by over-indulgence in 'purple patches.'

WE are glad to direct attention to the letter on p. 10 of this issue referring to the proposed widening of the activities of the Universities' Library for Central Europe. The original letter in NATURE of May 22 relating to the disposal of scientific journals brought responses from scientific institutions, research workers and others, from which it was evident, as we suspected, that although of no commercial value, back numbers of scientific journals and similar publications would be of very real use if they could be distributed in the right quarters Such a central distributing organisation already exists in the Universities' Library, and we trust that sufficient support will quickly be forthcoming to enable it to undertake the new function which it is now proposing to assume.

THE first number of the *British Journal of Psychical Research*, the editorial address of which is 16 Queens-

P 20658

berry Place, South Kensington, S.W. 7, merits mention in this column owing to the claim made in a foreword by the editor that one of its objects is "to deal with ascertained facts in a strictly scientific manner." It is a fine ideal to start out with, but one very difficult of attainment, apparently, in this particular subject. The account of the "Model Psychic Laboratory" on pp. 11-20, with photographic illustrations, is the best article in the number. The laboratory in question is the National Laboratory of Psychical Research at Queensberry Place, and the article is very helpful in giving a clear idea of the arrangements and apparatus in use there. We note that future numbers will contain accounts of experiments with a young psychic known as Miss Stella C, whose portrait forms the frontispiece of this number There is also a very full account of the first case of alleged mediumship which has come up for investigation before the officers of the Laboratory. This is dealt with by Mr Harry Price under the title of "Pseudopsychic Manifestations due to Self-induced Hysteria." The conclusion that the phenomena were all due to evident hysteria appears to cover quite fully all the facts noted. The same author, in a shorter article entitled "A Plea for Accuracy," makes some very caustic comments on an article by an American investigator, who, in dealing with the problem of so-called psychic photography, makes the remark (in italics) that "*the plates never left my hand until the negative was developed in the dark room*," but innocently publishes alongside this statement the resulting photograph, showing a "psychic extra" on a photograph of himself in which his hands are clearly visible, and therefore could not have been holding the plate! The editor having thus set a high standard, both of accuracy in his own articles and of very candid criticisms of inaccuracies in those of other journals, we may express the hope that future numbers will worthily uphold his ideals.

THE Australasian Association for the Advancement of Science will hold its eighteenth meeting in Perth, Western Australia, during the week commencing Monday, August 23 next. Owing chiefly to the long and costly journey from other parts of Australasia, no previous meeting of the Association has been held in Perth; consequently Western Australia is making special efforts to secure a good attendance of members from other States and from New Zealand. Private hospitality in Perth during the meeting is being offered to all visiting members. The State Government has granted 1200*l.* towards defraying the cost of printing and publishing, and is giving free transit to visiting members over the W.A. Government Railways, whilst the Australian Commonwealth Government has granted for the Perth meeting the sum of 750*l.*, out of which travelling allowances will be made to members coming by the Transcontinental Railway. As the various countries bordering on the Indian Ocean have many scientific problems in common, the Perth local committee has sent invitations to representative scientific men in those countries to attend the meeting, hoping thus to make it an informal Indian Ocean Science Congress, and thereby to inaugurate closer intellectual co-operation amongst the Indian Ocean peoples. To anthropologists, botanists, geologists and zoologists, Western Australia offers features which are unique, even for Australia; and a series of excursions has been arranged to enable visitors to study these as well as the economic resources of the State in mining, agriculture, fruit-growing, forestry, etc.

THE retiring president of the Association is Lieutenant-General Sir John Monash, whilst the president-elect is Prof. Edward H. Rennie, of the University of Adelaide, who has chosen as the title of his presidential address "The Chemical Exploitation, Past, Present and Future, of Australian Plants." The chairman of the local committee is the Hon. P. Collier, Premier of Western Australia. The presidents of sections and the titles of their addresses are as follow: *A* (*Astronomy, Mathematics, and Physics*), Prof. Kerr Grant, "Atomic Transformation"; *B* (*Chemistry*), Prof. James Kenner, "Some Aspects of the Problem of Molecular Structure"; *B* 2 (*Pharmacy*), Mr. A. T. S. Sissons, "The Indebtedness of Pharmacy to Organic Chemistry"; *C* (*Geology and Mineralogy*), Sir Douglas Mawson, "The Igneous Rocks of South Australia—a brief survey of present knowledge relating thereto"; *D* (*Zoology*), Prof. Launcelot Harrison, "The Composition and Origins of the Australian Fauna, with special reference to the Wegener Hypothesis"; *E* (*Geography and History*), Prof. Ernest Scott, "The Discoveries of the Western Australian Coast, with especial reference to Dampier and D'Entrecasteaux"; *F* (*Ethnology and Anthropology*), Prof. F. Wood Jones, "The Claims of the Australian Aboriginal"; *G* (*Social and Statistical Science*), Major L. F. Giblin, "Federation and Finance—an Examination of the Financial Relations of States to a Federal Commonwealth"; *H* (*Engineering and Architecture*), Sir John Sulman, "Town Planning"; *I* (*Sanitary Science and Hygiene*), Mr. F. S. Hone; *J* (*Mental Science and Education*), Mr. P. Board, "Social and Economic Values in Education"; *K* (*Agriculture and Forestry*), Mr. C. E. Lane Poole, "Forestry and Land Settlement"; *L* (*Veterinary Science*), Prof. J. Douglas Stewart, "The Relationship of Veterinary Science to the Prosperity of the State"; *M* (*Botany*), Prof. A. J. Ewart, "Past and Future Development of Botanical Science"; *N* (*Physiology and Experimental Biology*), Prof. W. A. Osborne, "The Study of the Reflex." The hon. local secretaries for Western Australia are Mr. A. Gibb Maitland, Geological Survey, Perth, and Prof. N. T. M. Wilsmore, University, Perth, W.A.

AT the invitation of the Gas, Light and Coke Company, a large and distinguished scientific audience assembled on June 24 in the Company's offices in Horseferry Road, Westminster, to hear Prof. W. A. Bone lecture on "New Experiments on the Combustion of Carbonic Oxide" The experiments described, and in many cases beautifully reproduced, form part of researches which Prof. Bone and his collaborators have been carrying out during the past three years at the Imperial College of Science, South Kensington, aided by fellowships given by the Gas, Light and Coke Co and Radiation, Ltd, and described in detail in recent numbers of the *Proceedings of the Royal Society* (*e.g* in the issue for April 1, pp 615-44, 1926 [A]). The outstanding result of this work is that, contrary to former belief, carbon monoxide will, under suitable conditions, combine with oxygen in the absence of moisture 'Mixed in the volumetric ratio of 2 : 1, at atmospheric pressure, these gases ignite with increasing difficulty as they are progressively purified from water vapour, but even after six months' drying over phosphoric oxide, they can be exploded by means of a sufficiently powerful condenser discharge The union is facilitated by increasing the original pressure of the gaseous mixture, although it appears to reach a limiting value of about 98 per cent

PROF. BONE stated that spectrograms obtained on exploding carbon monoxide with air, under 25 atmospheres pressure, showed the complete absence of 'steam lines,' thus proving that the presence of steam is not essential to the reaction, although under ordinary conditions it undoubtedly plays an intermediary rôle. High pressure increases the direct oxidation of carbon monoxide, whilst the presence of hydrogen, as in water gas, favours the indirect oxidation. All previous explanations of the mechanism of the combustion of carbon monoxide have assumed the continuous decomposition and regeneration of steam. Prof Bone's 'ugly' fact destroys this 'beautiful' hypothesis, and although he has no definite substitute to advance, he believes that precedent ionisation of the combining gases is the most probable explanation. A pleasing feature of an excellent lecture was the manner in which Prof. Bone gave credit to his collaborators, Messrs. F. R. Weston, R P. Fraser, and D. M Newitt.

AMONG the items which are to be dealt with at the forty-fifth annual meeting of the Society of Chemical Industry in London, a session of outstanding interest will be that on Tuesday, July 20, when a symposium will be held on "Corrosion." In view of the fact that this symposium is a joint meeting of the British Chemical Plant Manufacturers' Association, the Institute of Metals, the Institution of Chemical Engineers and the Chemical Engineering Group, it cannot fail to be of very general interest. British contributions will be described by a group of recognised authorities, including Mr. Ulick R. Evans, who will deal with "The Fundamental Principles of Corrosion," Mr P. Parrish, who will speak on "Corrosion and Erosion," and Dr. W. H. Hatfield and Messrs. T G. Elliott and G. B Willey, who will discuss "Chemically Resistant Steels." Possibly in no branch of metallurgy has there been such great advancement, both during and since the War, as in connexion with the production of resistant steels and acid-resisting irons. Novel methods of manufacture and the alloying of some of the less common metals with iron and steel have produced alloys of a chemical resistance quite unprecedented, and the steels which are to-day being produced to withstand corrosion are far in advance of the earlier forms of stainless steels, which are chiefly martensitic. The newer corrosion-resisting steels are austenitic, *i.e.* they are softened by quenching from a high temperature, as in the case of manganese steel, whilst the acid-resisting irons have been also greatly improved recently, both from the point of view of homogeneity and toughness, resultant upon careful methods of heat treatment Another joint meeting on the same date, of the London Section of the Society of Chemical Industry and the Biochemical Society, is on "The Scientific and Industrial Problems presented by the Hormones—the Natural Drugs of the Body," to be opened by Dr H H Dale.

IN his address to the Royal Geographical Society at the anniversary meeting on June 21, Dr. D. G. Hogarth pointed out how mistaken is the impression that no important work in geographical exploration remains to be done Apart from polar regions, southern Arabia, and central Australia, where large virgin tracts of territory exist, there still remains a great deal to do in many parts of the world in the regions intervening between known and charted routes. For intensive surveys in topography alone there is still a great field, and an even greater one for specialists in various sciences. Dr. Hogarth commented on the ever-present appetite for the sensational which tends to divert public interest and available funds from serious work to spectacular achievements. Each air dash to the Pole probably absorbs the interests, energies, and funds sufficient to furnish a dozen expeditions which would bring a hundred times more copious and valuable returns to geographical science As a subsidiary aid to land exploration, aircraft have proved valuable; and prolonged flights are no doubt of value in the development of aerial navigation, but they can add little of importance to geographical science. The work that is required to-day is not spectacular, but it is important and varied enough to absorb all the explorers and funds available.

THAT gold exists in sea-water is a well-known fact: that it can be profitably extracted is a belief that has enabled many a company promoter to batten upon a credulous public. This belief has now received another blow. At the annual general meeting of the Verein Deutscher Chemiker, held in Kiel on May 26-30 last, Prof. F. Haber communicated the results of a research which he and Dr J. Jaenicke have been prosecuting for several years. Whereas earlier investigators found the gold-content of sea-water to be 5-10 mgm per metric ton, their work on 5000 samples collected from many seas and from different depths has shown that the amount present is far smaller. Water from the South Atlantic contained less than 0 01 mgm per ton, water from the bay of San Francisco a little more, and samples from the Polar seas four or five times this quantity Melted ice from the Polar seas was often considerably richer in gold. The form in which the gold occurs in sea-water is not, as previously supposed, as dissolved aurichloride, but as a mineral slime or as a constituent of the plankton organisms. Its separation is effected quantitatively by adding a minute amount of alkali polysulphide and a trace of copper, and then filtering through fine sand charged with sulphur. This process, however, would not be practicable on an industrial scale. Although there may be localities comparatively rich in gold, the attempt to discover them would resemble the task of hunting for a hypothetical needle in a haystack.

Visitors to the Natural History Museum at South Kensington should find much to interest them in the greatly augmented series of enlarged models of disease-carrying insects and ticks, which has just been arranged for their benefit in the Central Hall of that institution, and of which a demonstration was given to representatives of the press on the afternoon of June 23. Initiated more than a quarter of a century ago by Sir Ray Lankester, with models of the then best known of the tsetse-flies, and of two typical mosquitos, and somewhat extended in more recent years, the series, with the latest additions, now embraces no fewer than eleven species of insects and three arachnids. The new models among the insects include representations of the internal anatomy of an infected malarial mosquito; the common household mosquito of the tropics, a carrier of the causal agent of Filariasis; the preliminary stages of the yellow fever mosquito; the tiny, midge-like transmitter of sand-fly fever, with its larva and pupa; a small West African horse-fly, which conveys the cause of Calabar swelling; the preliminary stages of one of the tsetse-fly carriers of sleeping sickness; the eggs and mouth-parts of the body-louse; and the preliminary stages and adult female of the tropical rat-flea, the most important carrier of plague. An addition to the models of ticks is a colossal representation of the transmitter of tropical African relapsing fever. Under the supervision of members of the Museum staff, the models have been executed with remarkable skill and attention to detail by Mrs. E. D. Blackman, Miss Grace Edwards, and Mr. A. J. Engel Terzi. Now that the importance of insect-borne disease to the British Empire and the world at large is receiving ever wider recognition on the part of administrators, it is well that the matter should be brought to the notice of the general public. To this end no better means than that afforded by this striking collection of models could possibly have been devised.

Eng.-Vice-Admiral Sir Robert B. Dixon, Engineer-in-Chief of the Fleet, has accepted the presidency of the Junior Institution of Engineers for the year 1926–1927 in succession to Mr. J. S. Highfield.

Major-General Sir Matthew H. G. Fell, K.C.B., C.M.G., has been appointed Director-General, Army Medical Services, in succession to the late Lieutenant-General Sir William B. Leishman, K.C.B., K.C.M.G.

Prof. Paul Sabatier, For. Mem. R.S., of the University of Toulouse, and Nobel Prizeman in 1912 for chemistry, has been awarded the Albert Medal for 1926 of the Royal Society of Arts, in recognition of his distinguished work in science and of the services to industry rendered by his researches in physics and chemistry, which laid the foundation of important industrial processes.

Mr. G. S. W. Marlow has been released by the Association of British Chemical Manufacturers to devote part of his time to the appointment of secretary and editor of the Faraday Society and secretary of the Institute of Physics, pending the completion of final arrangements for carrying on the official work of these bodies. Mr. Marlow was assistant secretary to the Institute of Chemistry from 1919 until 1925.

An earthquake of unusual violence and long duration occurred in the eastern Mediterranean at about 10 P.M. on June 26. Much damage to property was caused in Crete, and apparently, to a less extent, in Rhodes. The principal shock, as in so many of its predecessors in south-eastern Europe, was felt over a very wide area, from the Ionian Islands and Greece to Cairo and so far east as Jerusalem. The disturbed area cannot be less than 1200 miles long from north-west to south-west, and about 800 miles wide, the total area being about 750,000 square miles. The epicentre was probably near Crete and between that island and Rhodes.

In view of the enormous amount of scientific and other special information now available in periodicals and libraries, an association—The Association of Special Libraries and Information Bureaux—was formed to assist in making such information available to all who wish to use it. With the assistance of the Carnegie United Kingdom Trust the Association has undertaken, as one of its first activities, the compilation of a directory of sources of specialised information in Great Britain and Ireland. The general editorship of this work has been entrusted to Mr. G. F. Barwick, formerly Keeper of Printed Books at the British Museum.

Progress is being made towards uniformity in the issue of wireless time signals. We learn that the signal from the Cape is now to be brought into line with the modified Onogo system recommended at the meeting of the International Time Commission in July 1925 and issued from the French stations since the beginning of this year. This signal is emitted from the Slangkop Wireless Station and originates at the Royal Observatory, Cape of Good Hope. The change requires the introduction of a new transmitting apparatus, the cost of which is to be defrayed by the Union Government. Multiplicity in the form of time signals is nothing but a disadvantage, and the change will be a great satisfaction to users of the signal and especially to mariners. It is expected to come into operation early in 1927.

The Royal Sanitary Institute is celebrating its jubilee by holding an Imperial Congress at the Central Hall, Westminster, on July 5-10, under the presidency of the Minister of Health, the Right Hon. Neville Chamberlain. More than 1000 delegates have been appointed to attend by Government Departments, including the Ministries of Health of England, Scotland, and Northern Ireland, the Ministry of Agriculture, H.M. Office of Works, the Home Office, War Office, Board of Control, and the Air Ministry. Many foreign governments, and municipal authorities, learned societies, and universities throughout the United Kingdom will also be represented In connexion with the celebrations a handbook has been prepared recording the history and activities of the Institute, together with special articles dealing with sanitary progress during the fifty years 1876–1926, from the medical, engineering, architectural, parliamentary, legal, public administration, colonial, military, and naval aspects

The American Chemical Society, which was founded in 1876, celebrates its fiftieth anniversary in Philadelphia, Pennsylvania, U S.A., on September 6-11 next It is anticipated that some 3500 chemists from all parts of the world will be present. The Society will meet in eighteen divisional gatherings, dealing with various branches of pure and applied chemistry. Many of the divisions will hold special symposia of papers and addresses of importance from authorities in their respective fields. In addition, there will be two general meetings of the whole Society No direct invitations or requests for the appointment of special delegates are being sent out; all non-American chemists are invited to attend and take part in the meeting on the same basis and under the same conditions as members of the Society. Foreign chemists expecting to attend the meeting should, if possible, communicate with Charles L. Parsons, Secretary, Mills Building, Washington, D C, U.S A.

The latest catalogue of Messrs. Heffer and Sons, Ltd, Cambridge, (No. 269) is devoted to second-hand books on physiology, anatomy, medicine, zoology, biology, anthropology, and ethnology. Many of the works listed are from the libraries of the late Sir William Bayliss and Sir Francis Darwin. The publishers offer the catalogue free upon application.

Messrs. Watts and Co are about to reissue, in two volumes, Herbert Spencer's "Autobiography" which for some time has been out-of-print. They have also begun a new cheap series of volumes entitled "The Forum" Among future works will be "The Origin of Life," by Sir Edward Sharpey Schafer, and "The Goodness of Gods," by Dr. E. A. Westermarck.

Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W 1, have just issued another useful catalogue—No. 400—dealing with some 2000 second-hand works on botany, agriculture, early medicine and surgery, forestry, fruit-culture, gardens and gardening, herbals, modern medicine, and tobacco. It should certainly be seen by all readers interested in these branches of knowledge.

Our Astronomical Column.

The Atmosphere of Mars.—In August 1924 Mr. Wright obtained at the Lick Observatory photographs of Mars in ultra-violet, yellow and red light. The former showed a larger image than the others, but gave scarcely any detail on the planet's surface. B. Fessenkoff, of the Moscow Astrophysical Institution, makes some calculations on the subject in *Astr. Nachr.* No 5450 He concludes that the observed facts are best satisfied by supposing that the upper layers of the planet's atmosphere contain fine dust which is nearly opaque to ultra-violet light, but transparent to red and yellow light. As to the possibility of fine dust at great heights, reference may be made to the Krakatao eruption of 1883. The dust remained suspended in the upper air for more than a year, causing remarkable sunsets all over the world.

The Polar Compression of Uranus —An article by C Wirtz in *Astr Nach* No 5441 gives a new estimate of the oblateness of Uranus by comparison of its brightness at the Uranian equinoxes and solstices The inclination of the axis is so high that at the solstices, which occurred in 1861 and 1903, the terminator practically coincides with the planet's equator, and the outline appears almost circular; at the equinoxes, which occurred in 1882 and 1924, the poles are on the terminator, the oblateness reaches its maximum and the light a minimum. A discussion of all the available determinations gives the magnitudes as $5\ 46^{\mathrm{m}}$ at maximum, $5\ 67^{\mathrm{m}}$ at minimum. The light-range is concluded to be between $0\ 15^{\mathrm{m}}$ and $0\ 25^{\mathrm{m}}$, from which a compression in the neighbourhood of $\frac{1}{14}$ is deduced. The author concludes that long-continued photometric measures by modern methods would determine the compression more accurately than micrometrical measures of the disc The range in the values found by the latter method is considerable.

Cepheid Variability.—In an article on the δ-Cephei problem, published in the *Atti della Pontificia Accademia delle Scienze (Nuovi Lincei)*, the Rev. J G. Hagen, S.J, Director of the Vatican Observatory, deprecates the antagonism which has arisen between the two theories which have been advanced to explain the variability of the light emitted by stars of this type. In some papers, especially those in English, the pulsation theory is referred to as the generally accepted theory, while, in a recent publication of the Ottawa Observatory, it is asserted that the ordinary binary theory may almost certainly be definitely ruled out of court. Such statements are scarcely justified in view of the fact that no clear and precise answer has yet been given to the questions: (1) Where does the impulse for the pulsations come from? And, (2) how are the pulsations maintained uniform for centuries? A natural answer is furnished to both of these queries if a δ-Cephei star is regarded as a binary system; the pulsations would then be periodically excited by the approach of the satellite and would last only from one eruption or light maximum to the next. In this way the mathematical theory of pulsations receives the mechanical basis hitherto lacking, and, moreover, the undulations observed in the descending branches of the light curves find their most obvious explanation On the other hand, no invincible argument against the presence of a satellite has ever been brought forward. So far as analogy with other celestial phenomena is concerned, there is in the entire heavens no well-proven example of periodic changes due solely to the internal forces of a star, especially now that some long-period variables have revealed themselves as binary systems, whilst striking examples of light eruption are provided by comets approaching the sun.

Research Items.

THE PERUVIAN QUIPUS.—Baron Nordenskiold continues his study of the quipus, the systematically knotted cords found in Peruvian graves, in the second part of No. 6 of his "Comparative Ethnographical Studies" (Goteborg: Elanders Boktryckeri Aktiebolag). He here follows up his previous suggestion that the quipus have a calendrical significance by a detailed study of seven quipus on a numerical evaluation of the knots according to their position and the colour of the cords. As regards the ancient Peruvian calendar, the statements of early writers are ambiguous and contradictory as to the division of the year into months, the extent to which the distinction between the lunar and solar year was recognised, and the date on which the year began. It is possible that this confusion arose out of the fact that the more intimate and accurate knowledge of the calendar was confined to the priests, with whom the whites were less likely to come into contact, while the common people, from whom these writers obtained their information, used the lunar year; the solar year, divided up into months of thirty days with five intercalary days, being the property of the learned and not in general use everywhere. Certain results common to the quipus here examined are found to emerge from the numerical evaluation. It would appear that the Incas worked with solar years of 365 days and with months of either 29½ or 30 days, the classification of knots according to the colour of the strings producing both results on the same quipus. The number 7 has special significance. The Incas worked both with synodical months and with a division of the year into 12 months of 30 days plus 5 extra days. It is possible that they knew and reckoned with a synodical revolution of Jupiter calculated at 397 days. The results obtained support the statements of the old writers.

STONE IMPLEMENTS FROM NORTH-WEST PERU.—Relics of a remarkable lithic industry found in north-west Peru are figured and described by Mr. C. Barrington Brown in *Man* for June. Flakes apparently made by human agency were first observed in 1911 at Punta Picos, south-west of Tumbez, on the sandy surface of an ancient sea floor now sixty feet above sea-level. They were of the simplest type and of various materials, showing in every case one side as a single fracture. Later similar flakes, with a few showing secondary pressure flaking along an edge, were found at many different sites, on hilltops and slopes, river terraces and plains. In 1924, on the occasion of a second visit to that locality, not only large quantities of flakes, several reworked, were found, but also stone implements of a skilled manufacture, polished axes, mortars, bowls, etc. At the head of a canyon was found a piece of worked slate which may be a phallus. In three places flakes were found with modern Inca remains which may have been due to Inca occupation of ancient sites. So far, finished implements have been found in one locality only. In the majority of cases no pottery fragments, no bones, and no metal were found. The most interesting and important site is that of El Estero, a small pond 22 miles inland due east from Cabo Blanco on the highest point, at an elevation of 85 feet above sea-level, of a low pass through the Buitre hills. Most of the axe-heads and implements were lying on the surface a few yards from the trail. The area of habitation covers about 1000 square yards with an accumulated thickness of reddish-grey earth of about 4 feet. Here thirty-one axe-heads were found, all except one showing a feature unique in axe-heads, the sides and butt being filed down into a flat or slightly concave face. The butts are provided with protuberant ears of unusual shape. Two examples from Ecuador in the British Museum have the protuberant ears but not the typical flattened butt and sides. The absence of pottery suggests a pre-Inca industry.

BIRDS IN SOUTH AMERICA.—Comparatively little is known of the migration of birds in the southern hemisphere, and in order to some extent to repair this blank, A. Wetmore spent ten months in the southern States of South America, particularly to observe North American birds in their winter quarters, and of these more especially the waders. The results of this expedition, which lasted from June 1920 until April 1921, have recently been published (Smithsonian Institution, *United States National Museum Bulletin*, 133, "Observations on the Birds of Argentina, Paraguay, Uruguay, and Chile"). They comprise much more than the main object of the journey, for his travels in Argentina, Paraquay, Uruguay, and Chile brought the author in contact with many native birds, regarding which he has made comprehensive and excellent field notes. The descriptions of several racial forms new to science have already appeared in other scientific publications, but are here repeated. Many valuable notes on migration, a detailed itinerary, a good map, and many excellent photographs of the various types of bird country, add to the interest of this contribution to the knowledge of South American bird life.

THE SOURCE OF HYDROGEN SULPHIDE IN THE BLACK SEA WATERS.—It has long been known that the upper layers of the waters of the Black Sea only are free from hydrogen sulphide, which is present from the depth of 150 metres downwards, so that no life except bacteria is possible between 150 metres and the bottom (2188 m. in the deepest parts). Nothing was known, however, as to the origin of this hydrogen sulphide, and only recently Prof. B. L. Issatchenko has proved that it is produced from the sulphates dissolved in water by anaerobic bacteria similar to *Microspira æstuans*, known from the northern seas. The Black Sea organism is exceedingly active and can produce so much as 0·3 gm. of hydrogen sulphide per litre of water. Apart from this organism, there are in the bottom mud of the Black Sea some other bacteria able to produce hydrogen sulphide from albumins, but their productivity is far lower and the conditions for it in the depth of the sea are less favourable. Another problem investigated by Prof. Issatchenko was why the surface layers of water are free from hydrogen sulphide. This was formerly ascribed to the presence of an intermediate layer populated by bacteria which are able to oxidise hydrogen sulphide produced in the deeper waters. No such bacteria could be found by a systematic sampling of water, and it is concluded that the oxidation of hydrogen sulphide in the upper layers is due simply to the circulation of water (*Priroda*, 1925, Nos. 4-6).

DUSTING BY AEROPLANE AGAINST MOSQUITOES.—Circular 367 of the United States Department of Agriculture is devoted to an account of experiments carried out for testing the possibilities of employing aeroplanes in the control of the breeding of Anopheles mosquitoes. The authors, Messrs. W. V. King and G. H. Bradley, mention that Paris green was distributed from aeroplanes on the extensive marshes and swamps near Mound, Louisiana, in 1923 and

1924. As the Paris green is effective in very small quantities, it was diluted by mixing with an inert carrier, fine silicious earth being mostly used No special difficulty was experienced in distributing the insecticide over open water or rice fields: the most difficult conditions encountered were in heavily wooded areas where the water was protected by dense foliage. In the latter conditions a larger amount of the arsenical is required as compared with about half a pound per acre in open areas. The two final tests of 1924 gave particularly clear-cut results. In areas overgrown with aquatic vegetation, 88 per cent to nearly 100 per cent of the Anopheles larvæ were destroyed. Controls were made by the use of open porcelain pans of water containing ten larvæ each. These were placed at the different stations before the dust was applied by aeroplane, and were examined the following day for the percentage of larvæ killed.

GENETICS OF THE CABBAGE TRIBE —The cabbage tribe forms an interesting variation group. All the forms of cabbage, kale, kohl rabi, brussels sprouts, broccoli and cauliflower, are believed to have been derived from the wild *Brassica oleracea* found on various European coasts, for example, on the cliffs at Dover. The ancient Greeks recognised three varieties. The others have appeared since, but little is known as to how or when Mr. M. S Pease (*Journ Genetics*, vol. 16, No 3) is making a genetical study from crosses of savoy, kale, and kohl rabi Kale is found to have two independent factors, in the absence of which the cabbage heart develops, one factor giving an intermediate condition. Malinowski found three polymeric factors for heart in certain other cabbages. The heart factor also shows linkage with a number of others, and some of these linkages, as of curly leaf with heart, are of peculiar character, showing a strict association between degrees of hearting and degrees of smoothness. Although there is difficulty in classifying degrees of hearting, Pease obtained consistent results by growing the F_3 and F_4 and back-crossing A peculiar monstrosity (*Asparagodes*) in which leafy outgrowths occur on the midribs of the leaves, was first described in Gerarde's "Herbal," but is believed to be as old as the Greeks. It behaves as a simple dominant in crosses. Another independent factor gives the difference between the purple and green types Pease distinguishes in addition two linkage groups, one containing a factor (*a*) for heart, (*b*) for tallness, and (*c*) for curliness of leaves The other group contains the other hearting factor as well as factors for petioles, lyrate leaves, and broad leaves Thus four linkage groups have already been recognised, while the number of chromosome pairs is nine. Difficulties of observation arise from the fact that the multiple factors frequently give an apparently continuous series of variations, and self-sterility is also involved.

UNUSUAL FORMS OF FOSSIL CRINOIDS.—Among the unusual forms of crinoids described by F. Springer (*Proc U.S. National Museum*, vol. 67, art. 9, 1926) are those in which the stem loses its characteristic shape, becomes coiled, and the columnals (stem plates) are flattened or concave at the inner side and consequently crescentic or elliptical in cross-section; the cirri, instead of occurring in whorls around the stem, are borne only in two rows at the flattened or concave side In such crinoids there is a tendency for the crown to bend back upon the stem, and for the stem to coil around it in the opposite direction in such a way that the crown may be tightly enclosed within the coil and completely enveloped by the cirri. This character, which was evidently protective, originated independently in a number of unrelated genera ranging from the Silurian to the Carboniferous. Other crinoids are described with the arms in a recumbent position instead of being outstretched or folded together as is the case with existing forms, in these the arms were normally pendent, with the dorsal side pressing backward upon the calyx and stem.

THE DEPTH OF ORIGIN OF EARTHQUAKES —More than any other living man Mr. R. D Oldham has helped to bring the science of seismology to its present vigorous state, and his latest contribution to the subject is, like most of his work, of fundamental importance Dealing with *episeisms* (surface shocks) as opposed to *bathyseisms* (deep-seated shocks), Mr Oldham shows that the depth of origin can be calculated from an empirical formula based on the intensities at a point directly above the disturbance and at another distant point (*Q J Geol. Soc*, vol 82, 1926, p 67; and *The Observatory*, March 1926, p. 86). Loss of energy by absorption is allowed for from a study of earthquakes that have been worked out in great detail. Applying the formula to 5605 Italian shocks that occurred between the years 1897 and 1910, he finds that 90 per cent originated at depths of less than 8 km., and only 1 per cent. gave a depth greater than 30 km From the long-distance records of bathyseisms, Prof Turner has found that most of these disturbances originate at a depth of about 200 km, with smaller proportions at about 100 km and 500 km Fracturing of the rocks of the outer crust is by far the most probable cause of the surface shocks, but this explanation is out of the question for bathyseisms. Changes of state accompanied by changes of bulk might cause the long-distance earthquakes and at the same time fracture the surface rocks, thus leading to a nearly simultaneous episeism. The San Francisco earthquake was a compound phenomenon of this kind The local effects indicated a depth of 20 km., while the long-distance records gave 140 km Seismology thus becomes the study of two very different types of earthquakes.

GEOLOGICAL TIME —In the *Phil. Mag.* for May 1926, pp. 1055-74, Dr. Arthur Holmes gives a review of all the evidence in favour of the longer estimates of geological time which have been based on lead-ratios. The adverse criticisms by Prof. Joly are shown to be founded either on faulty data, or on speculations that are not necessarily true. The sodium method is rejected on grounds already reviewed in NATURE (April 24, p. 592). It is suggested that the discrepancies in thorium minerals are due to the fact that lead present as oxide or silicate would be more easily removed by percolating waters than the lead in uranium minerals, which is most probably present as a highly insoluble uranate. An analysis of atomic weight determinations on lead from thorium minerals supports this conclusion, and shows further that there can be very little actinium D in 'uranium lead' Thus the ages calculated from the lead-ratios of uranium minerals, if they are otherwise free from suspicion, cannot be more than a few per cent. too high. The variation in the radii of uranium haloes is shown to be explicable by other hypotheses besides that advocated by Joly, so that no evidence is valid along this line of attack until the isotopic constitution of 'uranium' has been revealed It is concluded that the time elapsed since the crystallisation of the middle pre-Cambrian pegmatite-minerals of Norway, Sweden, Texas, Ontario and Africa is of the order of 1000 million years No higher ages are yet well established, though the age of the oldest rocks must, of course, be considerably greater than these of the middle pre-Cambrian.

Rate of Aeration of Water.—W. E. Adeney has published a series of observations in which he has determined the rates of solution of oxygen, expressed in percentages of saturation, by films of de-aerated fresh, or salt waters, 0·05 cm. thick, when uniformly exposed to the air, and independent of evaporation and downward streaming ("On the Rate and Mechanism of the Aeration of Water under Open-air Conditions," *Sci. Proc. Roy. Dublin Soc.*, 18 (No. 20), 211-217, April, 1926). This has been followed by determinations of the rate of solution by quiescent columns of water. Owing to the cooling produced by evaporation, minute streamlets sink towards the bottom In the case of salt water, density changes also assist the mixing. Movements occurring at the surface facilitate the saturation of the water with gas. Quantitative results are given for certain limiting cases, and suggestions made as to the probable values under various intermediate conditions

Spectra of Exploded Metals —In the *Scientific Papers of the Institute of Physical and Chemical Research*, Tokyo, vol. 4, No. 48, T. Hori describes some interesting experiments on the spectra of exploded metals by the method of Anderson. A thread of mercury contained in a fine capillary tube, when exploded in that way, gave a good continuous spectrum crossed by some absorption lines of mercury Other metals gave a less satisfactory continuous background, but when exploded in the form of fine tubes containing mercury, many absorption lines were seen on the continuous spectrum produced by the mercury Under reduced pressure the Swan spectrum appeared in absorption by this process, owing to the presence of oil in the explosion chamber. A satisfactory substitute for mercury as the source of the continuous background was found in incandescent carbon particles produced by placing asbestos fibre saturated with petroleum at the exploding centre. Several absorption spectra—including bands of compounds and series and non-series lines of elements—were produced by this device. In the same volume (No. 56) Messrs. Fukuda, Kuyama and Uchida record the appearance of several lines, forbidden by the spectroscopic selection rules, in the spectra of constricted arcs *in vacuo*, while Fukuda, in No. 55, records the production of similar lines in vacuum tubes carrying heavy discharges.

Carbon Tetrafluoride.—In the issue dated May 31 of the *C. R. Acad. Sci*, Paris, Messrs. P Lebeau and A. Damiens give an account of the preparation and properties of carbon tetrafluoride, CF_4, from which it would appear that the compounds previously described under that name were far from pure By the direct action of fluorine on various forms of carbon and passing the products of the reaction through a vessel cooled with liquid air, a colourless liquid is obtained which, from its varying boiling-point, is obviously a mixture. The most abundant constituent of this mixture was isolated by repeated fractional distillation and was found to boil at about − 150° C The gas is odourless and without action on water, is not attacked by aqueous or by alcoholic potash (differing from the gas hitherto described as carbon tetrafluoride by Moissan and by Chabrié), and is not even attacked by fused potash at 740° C Its composition was established by the reaction with sodium heated to 500° C., which is according to the equation $CF_4 + 4Na = C + 4NaF$. It also reacts with metallic calcium at about 700° C, giving calcium fluoride, calcium carbide, and carbon A repetition of the work of Chabrié has established that the substance described by him as carbon tetrafluoride was a mixture, the principal constituent of which was a fluochloride, CCl_2F_2.

Propagation of Radio Waves.—Radio engineers are making strenuous endeavours to understand the mechanism of radio transmission. The Radio Corporation of America and its associated companies are making systematic researches, both theoretical and experimental, to discover this mechanism. They admit that electric currents in wires, in a vacuum and in electrolytes, can be explained by means of the electron, but the structure of the electromagnetic field still remains a mystery Each new discovery in long-wave and short-wave propagation is eagerly studied with this end in view. This is shown in the paper read by E. F. W. Alexanderson on radio wave propagation to the Academy of Swedish Engineers in July of last year. After describing the various phenomena generally referred to as 'fading,' he divides the waves sent out from a radio station into the earth-bound wave, which is guided by the proximity of the conducting earth, and the space wave or high angle radiation, which is guided by refraction in an ionised layer in the upper atmosphere. Long-wave telegraphy depends mainly upon the earth wave. Short-wave long distance communication depends entirely upon the space wave Broadcast reception depends upon the earth-bound wave for near stations, and on the space wave for distant stations. It is stated that at a distance of about 100 miles from the station the intensities of the two waves are nearly equal. It has been found that at a distance of ten miles from a fifty-metre station the plane of polarisation of the space wave has been twisted by between 20° and 30°. It follows that at some distance between 60 and 90 miles the twist would be 180°. The earth-bound wave maintains its vertical plane of polarisation; the two waves, therefore, may cancel one another at a distance of about 100 miles. This explains 'blind' spots. As a model of radio transmission, he discusses the motion of a horizontal rubber sheet actuated by a vertical shaft making rotatory oscillations. Straight lines drawn on the rubber sheet will appear to have a wave motion. In order to reconcile the old and new points of view he thinks it necessary to prove that the electron is an entity with an aurora reaching from it into infinite space.

A New Reflex Camera —Reflex cameras possess many advantages, particularly in regard to instantaneous photography, over those of the ordinary type The 'Press' reflex camera recently placed on the market by Messrs J H. Dallmeyer, Ltd., 31 Mortimer Street, London, W.1, should help, in large measure, to meet the demand for an instrument of this type at a reasonable price. We have examined one of these cameras, and find it a serviceable and well-made instrument, easy to manipulate, and capable of giving excellent results It is fitted with a single wind, self-capping, focal-plane shutter, giving speeds from $\frac{1}{15}$th to $\frac{1}{1000}$th of a second and capable of adjustment for time exposures The shutter runs very close to the plate, and is smooth and easy in action The hood is detachable and can be fixed at right angles to its normal position The reversing back is fitted with a hooded focussing screen, which can be used when the camera is mounted on a stand and critical focussing is required Sufficient extension is provided to enable objects at a distance of about 18 in to be brought into focus. The camera can thus be employed for photographic work in the laboratory. The outstanding feature of the equipment is the Dallmeyer 6 in focus, f/3.5, anastigmatic lens, which gives excellent definition over the whole field Its large aperture makes it extremely useful for very short exposures, as in certain types of Nature photographs, or for indoor and other work under restricted lighting conditions.

Explosions in Gaseous Media.

A GENERAL discussion on different aspects of explosions in gaseous mixtures took place at a meeting of the Faraday Society held on June 14 at the Institution of Mechanical Engineers, Westminster. The afternoon session, presided over by Prof. H. B. Dixon, was devoted to the consideration of explosions viewed quite generally. In an introductory survey of the subject, Dr. Garner pointed out the large number of factors which have to be considered. The rate of travel of a flame in a gaseous mixture appears to be intimately connected with the amount of preheating—probably by radiation from the flame-front—and with the thermal conductivity of the mixture. It is probable that catalysis also plays an important part in the spread of flame, and a number of substances were mentioned which can be regarded as positive and negative catalysts respectively. Dr. Garner described a possible mechanism which he termed energo-thermal catalysis.

The ignition temperatures of gas mixtures are very important both from the academic and the practical points of view, Prof. Dixon described recent results which he in conjunction with Messrs. Harwood and Higgins had obtained. Using the concentric-tube method, the temperature to which the furnace must be heated before ignition of the gas mixture takes place is dependent upon the time the hot gases are allowed to remain in contact; the true ignition temperature is taken as being that at which the gases unite immediately after mixing. There appears to be a crucial pressure for each gas at which the ignition point is highest; above and below this pressure the ignition point falls. Using the method of adiabatic compression, comparisons were made between the results obtained with two different pieces of apparatus in which the rates of compression were not identical: the lag between the completion of the piston stroke and the recoil due to explosion is shortest when the compressions are highest.

Methods of measurement of the radiation emitted during explosions in closed vessels were described by Prof. David. The infra-red radiation in coal-gas air explosions is at a maximum during the explosion period and before the mean gas temperature attains its maximum value; it is assumed that the radiation is therefore mainly due to chemical activity and not simply to temperature. The introduction of infra-red radiation can speed up the combination in a closed vessel provided that (1) the radiation is of the kind which is absorbed by the combustible gas; (2) nitrogen is present as a constituent of the inflammable mixture; and (3) the mixture composition is such as to be favourable to the formation of oxides of nitrogen during combustion. In the discussion, Mr. Finlayson suggested that the shape of the explosion vessel might have an important effect upon the results obtained, and Dr. Ellis showed some interesting photographs of the mode of flame propagation in closed vessels of different shapes.

The subject of ionisation in gas explosions was introduced by Dr. Garner and Dr. Saunders. It was pointed out that the results obtained by different investigators are not in entire agreement, but the following tentative conclusions can be drawn: (1) The ionisation occurring in gas explosions is mainly thermal, although certain experiments seem to indicate that a small fraction is due to chemical change. (2) Ionisation plays no part in the ignition of gases. (3) It appears unlikely that the ionisation of the gas in front of the explosion is the cause of the propagation of the detonation wave. (4) The action of anti-knocks and knock inducers in the petrol engine cannot be explained on the theory that these substances change the ionisation in the explosion wave. Similar views were expressed in a communication from Dr Lind.

The importance and the applicability of rates of flame propagation were discussed by Dr. Payman in presenting the results of experiments by Prof. Wheeler and himself. The conditions of flame propagation under which the 'law of speeds' has been found to hold were considered, and it was pointed out that from this law it is possible to calculate the speed of uniform movement in any mixture with air of an industrial gas, the speed of uniform movement of the individual gases with air being known. In the discussion on this paper the point was raised whether the speed of uniform movement could truly be regarded as a physical constant. A short account of recent experiments in Prof. Bone's laboratory was given by Dr. Fraser, and photographs were exhibited showing the movement of the flame in carbon-monoxide-oxygen mixtures. Prof. Jorissen contributed to the discussion some remarks on the limits of inflammability of gases.

The rates of detonation of cyanogen-oxygen mixtures were dealt with in a paper by Dr. Campbell and Prof. Dixon. The detonation velocities in the rapid mixtures appear to be almost independent of the diameter of the containing tube. This is not the case with mixtures largely diluted with nitrogen, in the most highly diluted, the detonation wave is probably never established. From the velocities in the rapid mixtures the mean specific heats of mixtures of carbon monoxide and nitrogen at high temperatures have been calculated.

At the evening session, under the chairmanship of Sir Dugald Clerk, explosive reactions were considered in reference to internal combustion engines. In a brief introduction Sir Dugald Clerk reviewed the work on this branch of the subject carried out by himself and others during the last fifty years. Prof. David discussed the extent to which incomplete combustion of the charge is responsible for limiting the pressures developed in gas engines; about 10 per cent. of coal-gas remains unburnt at the moment of maximum pressure. Various factors which may affect the rate of combustion in gas engines were touched upon. The greater the degree of turbulence of the gaseous charge the more rapidly will inflammation spread; the temperature of the gas engine charge appears to have only a slight effect on the rate of inflammation, but it seems possible that the radiation from the cylinder walls may exert an appreciable influence

From his experiments with petrol engines Mr. Tizard advanced the view that the dissociation of carbon dioxide at the temperatures reached is sufficient to account for the important fact that maximum power first occurs with slightly 'rich' mixtures and remains practically constant over a considerable range in strength of mixture. In regard to the possibility of detonation of a 'pure' fuel, this appears to depend upon whether a certain temperature, characteristic of the substance, can be exceeded. Anything which lowers the maximum temperature reached during the explosion will tend to stop detonation. The view was put forward by Messrs. Sims and Mardles that metallic anti-knock compounds suffer thermal decomposition, and that the colloidal metal so produced brings about a decrease in volume of the unburnt charge ahead of the flame. Easily oxidisable metals like lead, nickel and iron give positive results as anti-knock compounds, whilst silver and gold are not effectual. Prof. Dixon, Prof. Marks, Messrs. Finlayson, Kay, Sutton, Whatmough and others, contributed to the discussion.

C. C.

The Eastman Universal Colorimeter.

THE Eastman Kodak Company, of Rochester, N.Y., U.S.A., has placed on the market a very useful colorimeter (Fig. 1) which has a greater range of utility than many other instruments of this kind. Originally designed by L. A. Jones (*Journal of Optical Soc. America*, 4, 420, 1920) for use in connexion with war-time problems of visibility and the measurement of the colours of sea and sky, it has been adapted, by the addition of various accessories, for the majority of laboratory and industrial requirements.

The fundamental basis of its action is the phenomenon of the so-called "subtractive colour mixture." To illustrate this we may imagine three colour filters for which, in turn, the main absorption is in the red, green, and blue parts of the spectrum; thus the filters will appear blue-green, magenta, and yellow, respectively. It will easily be understood that by using these in pairs, the primary colours red, green, and blue may be produced in the transmitted light.

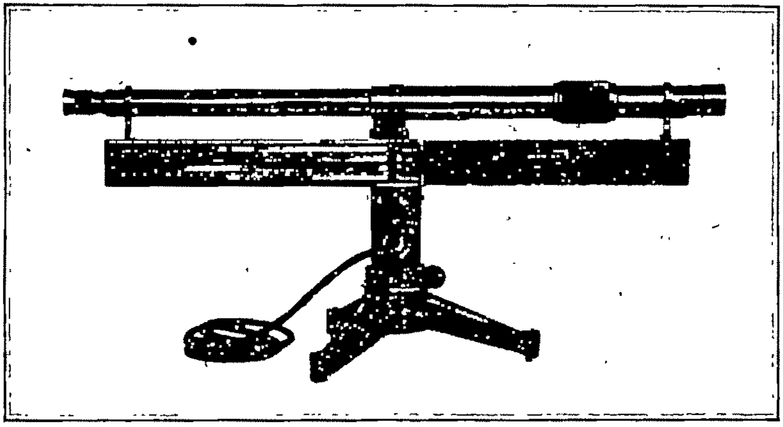


FIG. 1.—The Eastman colorimeter.

For the purposes of the colorimeter these subtractive primaries (blue-green, magenta, and yellow colour filters) are used in the form of long and thin wedges of dyed gelatine, suitably mounted so that various thicknesses of the absorbing medium can be introduced into the light beam by sliding the wedge parallel to its own length. By this means it is possible, for example, to 'mix' varying amounts of yellow with blue-green in order to obtain a series of greens varying from blue green to yellow green, and so on; the use of all three wedges in considerable thicknesses will produce the darker colours. A neutral wedge and supplementary colour filters are added to increase the colour range, which includes all hues and saturations up to high values. Only some of the most highly saturated colours cannot be matched, such as, for example, a very strong emerald green.

The colorimeter is so built that light derived from a standard electric lamp and passing through the wedges illuminates one half of the field of view, while the other half is illuminated by light from the object under test. Thus the colours of objects may be measured *in situ*, or samples may be specially mounted and illuminated for examination in the fittings which are provided; these include one designed for opaque objects, another for colour filters, and another which is designed to intensify the hue component in colours of low saturation by the use of multiple reflections from the coloured surface.

The colour scale is necessarily arbitrary, but it is claimed that an adequate permanency of the wedges has been secured, so that the instrument as it stands should be of utility for such industrial purposes as the standardisation of paints in manufacture and the like, but it is not easy to judge how far the scales of separate instruments of this kind would agree.

In order to convert the readings of the instrument into the usual colorimetric terms of 'hue, saturation, and brightness,' a special calibration of the wedges would be necessary; the accurate transformation would always be a somewhat cumbersome process, though time could be saved by suitable tables and graphical methods.

The instrument is well made and finished, and is very simple in operation. Provided that the difficulty of dealing with highly saturated colours is borne in mind, it should meet the needs of many who have to make colorimetric measurements. L. C. M.

The World's Forestry Congress.

THE World's Forestry Congress was held at Rome on April 29-May 5. The meeting was preceded by a visit on April 27 to the Milan Exhibition, at which a certain number of delegates inspected the forestry exhibit and a section dealing with wood-utilising machinery. Fifty-eight countries were represented at the Congress, most having from two to five Government delegates and a varying number of others who represented their countries but were not specially deputed to do so. Most of the European countries had strong deputations, as also had the United States of America. The heads of the delegations representing Great Britain and the Government of India respectively were Lord Lovat and Prof. E. P. Stebbing.

At a preliminary meeting of the Technical and Scientific Committee on April 28, the honorary presidents, president, and vice-president of the Congress were elected, and afterwards the presidents and vice-presidents of the five sections into which the Congress was divided for working purposes. The presidents of the Congress were Italians. The vice-presidents were from Germany, United States, Great Britain, Dutch East Indies, Japan, and Norway, and the presidents of sections from Sweden, Czechoslovakia, Spain, France, and Brazil.

The opening meeting of the Congress was held on April 29, H.M. the King of Italy and M. Mussolini being present. This was followed by a general meeting, and later by a meeting of heads of delegations at which the work to be carried out was finally sanctioned. Two days, May 31 and June 1, were devoted to a visit to the Forest School at Florence, and to an excursion to the forest of Vallombrosa. Three days were allowed for the work of the sections, each section having three meetings of three hours each. Sections I. and III. met at the same hours, and sections II., IV. A and IV. B. It was not therefore possible for any one delegate to attend all the meetings of each section. Since many Governments were well represented this would have been immaterial had the agenda of each section been confined to well-defined branches of forestry Unfortunately, however, there was a certain amount of overlapping, and this proved somewhat of a hardship. Some transfers of subjects were made between sections, at the request of presidents and vice-presidents. It became inevitable, but proved rather confusing for the rank and file of the delegations.

Briefly, Section I confined itself to questions dealing with forestry statistics, policy, economics, legislation and instruction in sylviculture; Section II., trade and industry in timber, and in forest products in general; Section III., technical problems relating to sylviculture and forest management; Section IV, A, control of torrents, reafforestation of mountain areas, plant diseases and wind damage, forestry propaganda and improvement of game and fisheries; Section IV, B, tropical forestry resources, sylviculture, protection and management and research in tropical forests, uses and export of tropical timbers Resolutions on these matters were passed by each section and were accepted at the final general meeting of the Congress on May 5.

Linguistic difficulties were of course a great trouble, and resulted in an enormous waste of time. The languages declared for use were French, English, German, Italian and Spanish The last two were given up at the outset. French was the language used from the chair at all meetings, and was the language (with English) used in the daily reports of agenda, etc., issued during the meeting. But translations into English or German had constantly to be made during the meetings. It is obvious that a certain responsibility rests on Governments in this matter, and that however eminent a man may be in his own branch of study, he loses the greater part of his utility to his Government, and wastes the time of an International Congress, if he can only speak his own language.

Some 247 papers were presented to the Congress, a proportion only being read in précis form. That the Rome Congress was a success is beyond doubt. A careful study of the proceedings will show that work of a very valuable character was accomplished, which should prove of use to the Governments of the various countries which have forest areas of importance to conserve.

University and Educational Intelligence.

CAMBRIDGE.—Mrs Pilcher, sister of the late Prof Lewis, has offered her brother's house, 2 Fitzwilliam Road, to the University in accordance with his wishes. The rent is to be devoted to the Mineralogical Museum, particularly to the purchase of specimens and books.

Mr A. J. Dorward, Trinity College, has been appointed University lecturer in moral science Dr. Cobbett, Trinity College, has been re-appointed University lecturer in pathology. Mr. A Hutchinson, Pembroke College, has been elected professor of mineralogy in succession to Prof. Lewis, who died on April 16 last.

The Council of Trinity College is inviting applications from Bachelors of Arts, or those admitted to the title of a degree, for a Rouse Ball travelling studentship in mathematics, the purpose of which is to enable the student to study mathematics or the application of mathematics in a foreign university or school.

The Master and Fellows of Pembroke College announce that they will shortly make an election to a Stokes Studentship for research in physics or subjects cognate thereto The value of the studentship is between 400*l*. and 450*l* a year, and the tenure will be for three years with the possibility of renewal for a further period not exceeding five years. Candidates may be of either sex and must be between 23 and 30 years of age. They must have shown capacity for research in mathematical or experimental physics or in subjects cognate thereto, such as physical chemistry or the study of physical laws in relation to living matter. Preference will be given to graduates of the University of Cambridge.

The Henry P. Davison scholarships have been awarded to F. P. R. Howard, Trinity College, A. Macdonald, St. John's College, and G. D G. Nicholson, Jesus College. The scholars will proceed to Harvard, Yale, and Princeton Universities respectively.

GLASGOW.—At the graduation ceremony on Wednesday, June 23, busts of the late Sir William Macewen were presented to the University and to Lady Macewen.

The following were presented for the degree of Doctor of Science (D.Sc): Mr. R. V. Hansford, for a thesis entitled "A Description of a High Frequency Generator utilising Thermionic Valves and forming part of a Modern High-Power Radio-Transmitting Station," with additional papers; Mr. J. P. M'Hutchison, for a thesis entitled "Researches in Radioactivity with the Radio-Elements Radium D and Radium E."

LONDON.—Mr. Justice Tomlin (chairman), Sir Amherst Selby-Bigge, Sir Cyril Cobb, Sir Josiah Stamp, Sir Cooper Perry, Mr. A. D. Lindsay, Miss Bertha S Philpotts, and Prof. T. P. Nunn are, according to the University of London Bill recently introduced in the House of Lords by Lord Balfour, to be the first Commissioners of the University of London.

Sir William Beveridge, Director of the London School of Economics, has been elected Vice-Chancellor for 1926–27 in succession to Prof. E. A. Gardner.

Mr. W. C. Clinton has been appointed as from August 1 to the University chair of electrical engineering tenable at University College. Mr. Clinton was educated at the Central Foundation School, the Technical College, Finsbury, and the City and Guilds College In 1894 he was appointed assistant in the Electrical Engineering Department at University College. and since 1907 has been assistant professor of electrical engineering. His published work includes "Electric Wiring," "The Science of Illumination" (translated and modified from the German of Dr. L. Bloch); and numerous articles in the *Proc. Phys. Soc.*, *Phil. Mag*, and other scientific and technical papers.

Mr. P. A. Buxton has been appointed as from August 1 to the University readership in medical entomology tenable at the London School of Hygiene and Tropical Medicine. Mr. Buxton was a fellow of Trinity College for the period 1916-21. In 1921-24 he was medical entomologist to the Palestine Government, and in 1924-25 leader of the expedition from the School of Tropical Medicine to the South Pacific. Since March last he has been Director of the Department of Medical Entomology at the London School of Hygiene and Tropical Medicine. He has published a book entitled "Animal Life in Deserts" (London, 1923), and numerous articles in scientific journals

The title of reader in pharmacognosy in the University has been conferred on Mr. T. E. Wallis, in respect of the post held by him at the School of Pharmacy. Mr Wallis was educated at Owen's School, Islington (1885-1892), and Birkbeck and King's Colleges (1899-1900). His published work includes "Analytical Microscopy, its Aims and Methods," "Bo Outline of Classification" and "Practical

Prof. A. J Clark, who occupied the University chair of pharmacology at University College, has resigned on his appointment to the chair of materia medica in the University of Edinburgh; Dr. G. V. Anrep has resigned from the University readership in physiology tenable at the same College, on his appointment as lecturer in physiology in the University of Cambridge.

Mr Major Greenwood has been appointed as from August 1 to the University chair of epidemiology and vital statistics tenable at the London School of Hygiene and Tropical Medicine. The title of reader in medical statistics was conferred on Mr Greenwood in January 1915 in respect of the post held by him at the Lister Institute of Preventive Medicine. He was Milroy lecturer at the Royal College of Physicians in 1922, and is honorary secretary of the Royal Statistical Society and of the Section of Epidemiology of the Royal Society of Medicine He has published a number of papers on medical statistics and industrial medicine

Prof. W. W. C. Topley has been appointed as from August 1 to the University chair of bacteriology and immunology tenable at the London School of Hygiene and Tropical Medicine. Prof Topley was educated at St Thomas's Hospital and the University of Cambridge He was director of the Institute of Pathology at Charing Cross Hospital (1911–22), and since 1922 he has been professor of bacteriology in the University of Manchester and director of the Public Health Laboratories In 1919 he was Goulstonian lecturer to the Royal College of Physicians, and in March last he delivered the Milroy lectures in experimental epidemiology there. He has published numerous papers dealing with bacteriology, epidemiology, and immunology

The degree of *D.Sc* in botany has been conferred on Miss M H Carré, the Imperial College (Royal College of Science) and Bedford College, for a thesis entitled "Chemical Studies in the Physiology of Apples."

ST ANDREWS.—The University Court has appointed Mr. A. D Peacock, senior lecturer in zoology at Armstrong College, Newcastle-on-Tyne, in the University of Durham, to the vacant chair of natural history in University College, Dundee Mr. Peacock's experience in the teaching of zoology and in research work, chiefly in entomology, extends from 1909 to the present time, that period being broken by service as an entomologist in the Government Agricultural Department of Southern Nigeria and by military service from 1914 until 1919, when his entomological knowledge was made use of for research and instruction in the Medical and Sanitary Services under the War Office In this department of investigation he has published many valuable scientific papers Miss Edith Philip Smith has been appointed to the lectureship in botany in University College, Dundee Miss Smith, who studied botany at Edinburgh, Oxford, and Harvard, was a lecturer in botany in King's College, London, and has for the past four years been demonstrator in botany in the University of Edinburgh. Her publications include a number of papers embodying the results of research, chiefly in plant physiology. Mr A. O Adamson having vacated the post of assistant in natural history in the United College, St Andrews, on his having been awarded a Commonwealth Research Scholarship, Miss Christina H Sutherland has been appointed to succeed him.

DR H. H. HODGSON has been appointed head of the combined departments of colour chemistry and general chemistry at the Huddersfield Technical College.

Contemporary Birthdays.

July 2, 1862.	Sir William H Bragg, K B E, F R.S.
July 4, 1848.	Lord Sydenham, G B E, F R S
July 5, 1862.	Prof G H F Nuttall, F.R S
July 6, 1857.	Sir Hercules Read, F.S A.
July 6, 1865.	Sir Hugh K. Anderson, F R S
July 6, 1873.	Mr. Sidney George Brown, F.R.S.
July 8, 1861.	Prof. J. Arthur Thomson

Sir WILLIAM BRAGG, who succeeded the late Sir James Dewar as Fullerian professor of chemistry in the Royal Institution, was born at Westward, Cumberland. Educated at Market Harborough Grammar School, and King William's College, Isle of Man, he graduated at Trinity College, Cambridge, in 1884 as third wrangler. His mathematical studies had been pursued under the guidance of Dr E J Routh Elected in 1885 to the chair of mathematics and physics in the University of Adelaide, he returned to England in 1908 to take up the professorship of physics in the University of Leeds, transferring, in 1915, to a similar chair in University College, London In that year Sir William was allotted the Nobel prize for physics, jointly with his son, Prof W L Bragg, for their services in promoting the investigation of crystal structure by means of X-rays. The Royal Society awarded its Rumford medal in 1916 to Sir William, on the ground of his researches in X-ray radiation.

Lord SYDENHAM, Governor of Victoria from 1901 until 1904, is of Lincolnshire extraction, and he was educated at Haileybury and the Royal Military Academy Entering the Royal Engineers branch in 1868, he participated in the 'eighties in much active service Lord Sydenham was president of the British Science Guild in 1917–20

Prof NUTTALL was born in San Francisco. Since 1906 he has been Quick professor of biology in the University of Cambridge He has written many memoirs concerning bacteriology, entomology, parasitology, and hygiene.

Sir HERCULES READ engaged early in the service of the British Museum, under the inspiring influence of Sir Augustus Franks He became keeper of British and medieval antiquities and ethnography in 1896, retiring in 1921. Sir Hercules has been twice president of the Society of Antiquaries, namely, for the period 1908–14, and again 1919–24. He is Hon. LL.D. Edin.

Sir HUGH ANDERSON was born at Hampstead. Educated at Harrow, Cambridge, and, for his medical studies, at St Bartholomew's Hospital, he has been, since 1912, Master of Gonville and Caius College, Cambridge.

Mr. SIDNEY BROWN, electrical engineer, was born at Chicago, but he is of English parentage. He was educated at Harrogate College, and University College, London. Mr Brown is responsible for many very ingenious inventions applicable to submarine cables, telephones, airships, aeroplanes, and radio, and also of a gyroscopic compass. He is the author of a number of original contributions to science.

Prof J. ARTHUR THOMSON was born in East Lothian, and he was educated at the Universities of Edinburgh, Jena, and Berlin Since 1899 he has been Regius professor of natural history in the University of Aberdeen He was Terry lecturer at Yale in 1924 Prof Thomson has written many books on natural history subjects, which have a wide vogue. He is Hon. LL.D. Edin.

Societies and Academies.

LONDON.

Royal Society, June 24.—J. C. **McLennan** and A. B. **McLay** On the structure of the arc spectrum of gold.—Nearly all the wave-lengths known to belong to the gold arc-spectrum have been classified. The most important wave-lengths not yet classified are six that were found to be absorbed by the vapour in the under-water spark of gold. These wave-lengths undoubtedly involve the metastable term $1D_2^1$. Zeeman-effect experiments will probably furnish the best means of definitely settling any features of the arc-spectrum of gold not yet clear.

J. C. **McLennan** and H. G. **Smith**: On the series spectra of palladium.—The regular arc-spectrum of palladium, involving disturbances of a single electron outside a core of nine 4_3 electrons, includes very nearly all the strong lines of the arc, and most of the faint lines of wave-length longer than 3400 Å.U. In the region of shorter wave-lengths there is also a large number of faint lines, apparently belonging to the arc-spectrum, for which no place can be found in the regular series system. These faint lines can probably be ascribed to a secondary-series system The analysis of the spark-spectrum has shown that $(4_3)^8\ 5_1$ and $(4_3)^9$ are of almost equal stability, and consequently terms of this type should occur with considerable prominence in the arc-spectrum, but might not combine readily with the regular terms. An attempt to find a clue to this part of the spectrum by means of the inter-combinations has been unsuccessful. Similar configurations are also likely to be prominent in the spark-spectrum.

A. M. **Tyndall** and L. R. **Phillips**: The mobility of ions in air (Part iii.)—Measurements of the mobilities in air containing organic vapours over a range of concentration extending up to saturation show in every case a reduction in mobility by the addition of vapour, though the amount depends upon the constitution of the vapour and the sign of the ion. The gradient of the mobility vapour pressure curve for the negative ion is in general steep at low concentrations, but falls off later. In the case of the homologous series of normal aliphatic alcohols the steepness increases as one ascends the series. Similar effects have been observed for the positive ion, but the initial drop in mobility is much less marked. The relative effects of the various vapours seem to depend upon (1) a 'clustering coefficient' determined by the combined effect of any permanent electric moment and an induced electric moment in the neutral molecule, (2) the effective diameter of the cluster.

L. C. **Jackson**: Investigations on paramagnetism at low temperatures (Part ii.).—Orientated sections of the crystal are suspended in a non-homogeneous magnetic field and the forces exerted on them are measured by means of a Pettersson quartz microbalance sensitive to 10^{-4} mgm. The magnetic field is produced by a large accurately constructed coil and its value is determined from the current strength and the coil dimensions. Data for the three principal susceptibilities of cobalt potassium sulphate are given for temperatures down to $-100°$ C. The principal susceptibility parallel to the symmetry axis of the crystal is also given for nickel ammonium sulphate and manganese ammonium sulphate. The principal susceptibilities all obey the law $\chi(T+\Delta) = \text{constant}$ over the range of temperature investigated.

Sybil **Cooper** and D. **Denny-Brown**: Responses to rhythmical stimulation of the cerebral cortex.—Electrical and myographic records have been made of movement produced by rhythmical stimulation of the cerebral motor cortex. Rates of 18 to 68 per second were used In the electromyograms the primary waves follow the rate of stimulation, and secondary waves are at present giving an average total frequency of 120 per sec. The mechanical records show rhythmic tremor corresponding in frequency with rates of electrical stimuli applied to cerebral cortex, even at 68 per sec. This confirms, and extends to higher frequencies, the original observations of François-Franck and Pitres

Karl **Pearson**: Researches on the mode of distribution of the constants of samples taken at random from a bivariate normal population.—This paper deals with the distribution in samples, regardless of their size, taken from a large normal population of some of their 'compound' constants By compound constants is meant not simple constants like means, standard deviations, or coefficients of correlation, but functions of these constants. The actual curves of distribution of the standard deviations of arrays, and of the regression coefficient are obtained Also the distribution of the means of arrays as determined by the regression line of the sample is studied, and all the moments of this distribution are determined, but it has not been possible to determine its curve of distribution. Even when sampling from a normal population, the curves of distribution of compound constants (like those of the majority of simple constants) are not themselves normal, nor are the relations between them linear. It follows accordingly that the so-called 'probable errors' of these constants are of relatively small significance in exactness, especially in the case of *small* samples, where their values are usually given by physicists and astronomers, as measures of accuracy of observation.

Lord **Rayleigh**: Further spectroscopic studies on the luminous vapour distilled from metallic arcs.—The appearance of high series members in the luminous vapour is due to their narrowness In the arc these lines are so broad as to overlap; as the vapour emerges and expands, they become narrow and can be resolved. Enhanced lines occur in the distilled vapour, though in diminished intensity relative to the arc lines In some cases, *e.g.* magnesium, they fade out very rapidly compared with the arc lines The resonance line of mercury $1_1S' - 1p_2$ gains intensity relative to all other lines as the vapour matures The same is true of calcium; but the corresponding line of magnesium behaves in the opposite manner A luminous jet of one metallic vapour is able in many cases to excite the vapour of another metal injected into it, but generally only if the ionisation potential of the first metal exceeds the excitation potential of the spectrum line in question.

Sir William **Hardy**: A microscopic study of the freezing of gel (Part i. and Part ii.).

Sir William **Hardy** and Millicent **Nottage**. Studies in adhesion (i.).

T. **Moran**. The freezing of gelatin gels

W. **Jevons**: The more refrangible band system of cyanogen as developed in active nitrogen.—Modification of the λ3590 $(n''-n'=-1)$ group and of some of the 'tail' bands is discussed. As regards the λ4216 and λ3883 groups, the afterglow develops especially lines of low m values and bands of high n' values. As n' increases the intensities of the bands in each group tend to show an alternation as well as a general increase Bands with $n'=1$ are the weakest. The λ3590 group (like the above) is shortened in the low wave-length direction, but (unlike the above) it is prolonged in the high wave-length direction in the afterglow as compared with the arc, and also consists of headless bands. On the assumption that these bands have $n'' - n' = -1$, the absence of heads follows from the non-development of high m lines, and the high wave-length extension is in accordance with the enhancement of high-n' bands.

J. A. V. **Butler**: The equilibrium of heterogeneous systems including electrolytes (Part I.).

(The late) **Mrs. Hertha Ayrton**: Primary and secondary vortices in oscillating fluids: their connexion with skin friction.—Mrs. Ayrton demonstrated the existence of pressure differences on the lee side of obstacles in oscillating water and showed that vortices were formed in the liquid. These vortices were called 'primary' vortices when their full strengths were attained in one oscillation, and 'residual' vortices when more than one oscillation was required for their full development. The word 'secondary' is now substituted for 'residual.' Instantaneous photographs show that primary vortices occur near the ends of a tank in which water is oscillating and also near the nodes of stationary waves in such a tank, whilst secondary vortices spread throughout the remainder of the water.

T. T. H. **Verschoyle**: Isotherms of hydrogen, of nitrogen and of hydrogen-nitrogen mixtures at 0° and 20° C. up to a pressure of 200 atmospheres.—Experimental determination of isotherms of binary mixtures has been limited almost exclusively to mixtures of oxygen and nitrogen. It appears to be tacitly assumed that, for mixtures of the permanent gases, pv-values at normal temperatures are linear functions of composition. Isotherms of three mixtures of hydrogen and nitrogen have been measured at 0° and 20° C., and the results prove that the pv-values for the mixtures are far from being linear functions of the composition. Actually, a small admixture of nitrogen with hydrogen has relatively little influence on the pv-values, whereas a small addition of hydrogen to nitrogen has a comparatively great effect.

E. W. **Marchant** and J. L. **Miller**: The loss of energy in metal plates of finite thickness, due to eddy currents produced by alternating magnetic fields.—The energy lost due to eddy currents, produced by an alternating magnetic field, due to a flat circular coil, when placed near metal plates of different thicknesses, reaches a maximum for a certain thickness of plate. With a frequency of 50 cycles the loss is a maximum with copper plates about 0·4 cm. thick. A similar effect has been observed with zinc plates, though the maximum is not so definite. The mathematical theory worked out by Prof. Proudman is consistent with these results. The shape of the curve of the magnetic field is assumed to approximate to a Bessel function of zero order; a new integral is given for determining magnetic fields due to a coil of wire in terms of Bessel functions.

W. **Sucksmith** and H. H. **Potter**: On the specific heat of ferro-magnetic substances.

L. B. **Pfeil**: The effect of occluded hydrogen on the tensile strength of iron.—Tensile tests during electrolytic pickling of carbon-free iron are discussed. With iron in the ordinary finely crystalline condition, occluded hydrogen may result in a 10 per cent. reduction in tensile strength and an 80 per cent. reduction in elongation: the fracture, instead of passing *through* the crystals, as is normally the case, may pass only *between* the crystals. With single crystals, occluded hydrogen does not appreciably affect movement on the slip planes, but it materially decreases the cohesion across the cubic cleavage planes, the cohesion in certain cases being reduced to 5 tons per square inch. When the parallel portion of a test piece is made up of two large crystals, the weakest point is, in general, the intercrystalline boundary; the strength here is only about half that of the boundary between small crystals. The difference is due to the irregular path of the intercrystalline fracture in finely crystalline iron.

T. E. **Allibone**: The infra-red secondary spectrum of hydrogen.

D. C. **Rose**: The scattering of alpha particles through small angles.—The single scattering of alpha particles through angles from 1°·2 to more than 8° has been measured. A nearly parallel beam of alpha particles was projected perpendicularly on a thin gold foil and the number of particles emergent at the different angles was counted. The relative number of particles scattered at the different angles show that the nuclear field obeys the inverse-square law of force fairly closely, for distances between $0·4 \times 10^{-10}$ cm. and $1·7 \times 10^{-10}$ cm. from the nucleus. This region includes the K shell of electrons (radius, $0·69 \times 10^{-10}$ cm. for gold) calculated from Bohr's model of the atom. Other experimenters have shown that the nuclear field obeys the inverse-square law of force for distances between $0·5 \times 10^{-10}$ cm. and $3·2 \times 10^{-12}$ cm. from the nucleus. The absolute number of particles scattered show that over the same range the field corresponds to a nuclear charge within 5 per cent. of the atomic number times the elementary electronic charge. The results are not accurate enough to detect the shielding effect due to the K shell of electrons. The curves indicate that the K shell is not ionised to any appreciable extent. Wentzel's criterion for single scattering has been extended.

V. H. **Stott**, D. **Turner** and H. A. **Sloman**: Effects of thermal treatment on glass as shown by precise viscometry.—A new viscometer for molten glass has been designed; prolonged measurements can be made on the same specimen subjected to various heat treatments. The determination depends on the thickness of glass which adheres to a thin iridio-platinum wire withdrawn from the glass at a known velocity. The apparatus is capable of a precision of the order of ± 3 per cent. of the viscosity, which is equivalent to a temperature error of about 3°. At sufficiently high temperatures the viscosity of a particular glass is a function of temperature only. Below 1200° the glass is generally in a heterogeneous form yielding discordant viscosity values; the heterogeneity is not directly connected with devitrification, which takes place at approximately 950°. The glass, in its high-temperature state, may be cooled to room temperatures and reheated an indefinite number of times without change of state if the cooling and heating be not too slow.

J. E. **Lennard-Jones** and **Miss B. M. Dent**: The forces between atoms and ions (ii.).—Earlier results are extended to provide a complete table of forces between the monovalent and divalent ions of the inert gas type.

J. **Topping** and A. E. **Ludlam**: Tables of log K_0 (x) over the range $x=2$ to $x=12$ at intervals of 0·001.

B. **Lambert** and K. T. **Hartley**. An investigation of the effects of variations in the radiation factor on the efficiency of Dewar vessels.—The rates of evaporation of liquid oxygen and cooling of hot water have been determined in special Dewar vessels, with one or both of their vacuum-adjacent surfaces silvered, and with polished deposits of silver, gold, platinum, and copper on the vacuum-adjacent surface of the inner vessel, the outer vessel being plain glass. The result obtained by silvering the inner vessel only is almost as good as that obtained by silvering both surfaces. Silvering on the outer vessel only reduces the efficiency by about a half. With different metal surfaces on their inner vessels, the order of efficiencies of the vessels should be that of the emissivities of these metals. This is the case for all the vessels with respect to hot water—the order being, silver, gold, copper, and platinum—but for liquid oxygen the copper-coated vessel is the least efficient. The dominant wave-length at the temperature of liquid oxygen approaches that corresponding to the 'characteristic frequency' of copper. For energy in this region of wave-lengths the emissivity of copper will therefore be high, so that copper vessels will necessarily be inefficient as containers for liquid oxygen.

J. E **Lennard-Jones** and W. R. **Cook**. The molecular fields of hydrogen, nitrogen and neon

H. **Florey**. Observations on the resolution of stasis in the finer blood-vessels.

T S P. **Strangeways** and Honor B. **Fell**: Experimental studies on the differentiation of embryonic tissues growing *in vivo* and *in vitro* (ii.). The development of the isolated early embryonic eye of the fowl when cultivated *in vitro*

Nesta **Ferguson**: The Aloinæ—a cytological study, with especial reference to the form and size of the chromosomes.

Optical Society, June 10.—L. C. **Martin**: The distribution of light in elementary optical images A series of calculations have been made on the distribution of light near the 'star focus' of a centred lens system in the following cases: (*a*) Freedom from aberration, (*b*) primary spherical aberration, (*c*) zonal spherical aberration In the two latter cases the condition chosen is that when the least residual phase differences amount to $\pi/2$ The characteristic extra-focal effects are determined, and the effect of primary spherical aberration is discussed. In the case of zonal aberration the greatest axial intensity is not found at the focus giving least phase residuals. In both cases of aberration a concentration closely resembling in some respects the 'Airy' disc characteristic of zero aberration is found.—T. **Smith**: (1) The stationary value of axially symmetric functions. The formula for the stationary value of a function is put into a form which shortens the calculations involved in applying it to functions which possess special kinds of symmetry, such as that corresponding to symmetry about an axis. (2) Note on the criterion for the best position of focus. The position in which the amount of energy within the first dark ring of the diffraction image of a point is a maximum is suggested as not unlikely to correspond with the best focus found by visual observation in the presence of moderate amounts of aberration.

PARIS.

Academy of Sciences, May 25.—L. **Lecornu** The rotating millstone—P. A **Dangeard**: Researches on the cellular formations contained in the cytoplasm of the Peronosporæ—Alfred **Rosenblatt**: Algebraical varieties of three dimensions of which the types satisfy the inequality $P_g \leqq 3(p_g - p_a - 3)$.—Pierre **Humbert**: The *q*-harmonic functions in hyperspace.—R **Gosse**: On a note of M Lainé—**Goursat**: Remarks on the preceding communication—Georges **Valiron**: Meromorph functions without asymptotic values.—A **Toussaint** and E. **Carafoli**: Contribution to the study of the plane flow of fluids. A new mode of applying the coloured thread method possessing certain advantages over that previously used (Marey, Hele-Shaw). The paths can be followed by the kinematograph.—Albert **Nodon**: A colloid condenser. This condenser is composed of two sheets of aluminium separated from each other by a material such as canvas, the pores of which are filled up with a thick paste of colloidal ferric oxide and glycerol. This arrangement fulfils the functions of an electrostatic condenser of great capacity, when submitted to an alternating current.—R. **Forrer**: The structure of the atomic magnet. Demonstration of the existence of a doublet in nickel—H. **Mineur**: The theory of the partial entanglement of the ether.—W **Kopaczewski** and W. **Szukiewicz**: The periodicity of colloidal reactions.—Jean **Barbaudy**: The miscibility, densities, and refractive indices of mixtures of methyl alcohol, benzene, and water.—P. **Chevenard**: The dilatometric anomaly of the paramagnetic nickel-chromium alloys; an alloy suitable for an expansion pyrometer. The nickel-chromium alloy suggested in an earlier communication as suitable for use in a pyrometer shows an anomaly at the temperature of 550° C. To remove this anomaly it is sufficient to increase the amount of manganese, to incorporate a small percentage of iron, and to replace a part of the chromium by tungsten. The new alloy (commercial name Pyros), besides nickel, contains 7 per cent. chromium, 5 per cent. tungsten, 3 per cent manganese, 3 per cent. iron.—Raymond **Quelet**: The synthesis of derivatives of para-bromoallylbenzene.—A. **Kastler**: Contribution to the study of pollucite. The pollucite examined proved to be non-radioactive and contained 30·5 per cent. of cæsium— —**Legrand**. A relation between the amplitudes of the annual rise of the Nile, the Niger and the Mekong.—J. **Lacoste**: Earthquakes observed in central France in 1925. Seven earthquakes were noted, the more important being on September 26, December 3 and 9. Details are given of the three mentioned.—Armand **Renier**: The existence of coal balls in the coal basin of Asturia.—J. **Giaja** and X. **Chahovitch**: The inefficacity of pilocarpine to affect the energy metabolism in the absence of the suprarenal capsules.—A. Vedel **Tåning**, The position of the cephalic disc in the Echeneideæ in the course of ontogenesis.—Ph. **Joyet-Lavergne**: The vital colorations of the gregarines and the characters of sexualisation of the cytoplasm.—Y. **Manouélian** and J. **Viala**: The enhancement of the virus of rabies and the Negri bodies

ROME.

Royal National Academy of the Lincei, April 18.—Leonida **Tonelli**: Quadrature of surfaces.—A. **Angeli**: Anomalies of certain reactions A number of cases are quoted in which a reaction of one substituent group in an organic compound may be retarded or even prevented by the introduction into the compound of another substituent—Federico **Sacco**: The tunnel at Drink (Valle d'Aosta)—Achille **Russo**: The ex-conjugants derived from the first accessory conjugation between impure gametes in *Cryptochilum Echini* produce pure gametogens and pure gametes, which renew the principal cycle.—Alessandro **Weinstein**: The speed of propagation of the solitary wave.—Giorgio **Vranceanu**: Dirichlet's theorem—Arnaldo **Masotti**: An extension of Blasius's formula.—Eligio **Perucca**: The cause of 'flying shadows.' If the phenomenon of flying shadows is one of diffraction, it must be more complicated and more indirect than is indicated by Armellini's theory. The absence of chromatism and the velocity with which these shadows are propagated suggest that the cause should be sought in the earth's atmosphere.—Enrico **Fermi**. The intensity of prohibited lines in intense magnetic fields.—Franco **Rasetti**. The polarisation of the light emitted by electronic shock.—Giorgio **Piccardi**: Ionisation potential of silver. By means of the flame method of Rolla and Piccardi, values ranging from 7·37 to

7·67 volts are obtained for the ionisation potential of silver, the mean being 7·46 volts. In view of the inaccuracy introduced by the impossibility of avoiding slight sparkling of the fused metal, this result agrees satisfactorily with the value, 7·54 volts, derived from the limits of the spectral series.—**Carmela Ruiz**: New investigations on barytes from Racalmuto, Sicily. Measurements of two specimens of barytes, occurring together with calcite and sulphur at Racalmuto, gave the axial ratios, $a:b:c = 0{\cdot}81558:1.1{\cdot}31467$, and the density 4·42-4·43 at 18°-19°.—**Gustavo Cumin**: Geological observations on the island of Asinello and on neighbouring rocks (Carnaro). The island of Asinello and the neighbouring rocks are mostly Cretaceous, Eocene measures appearing only on the principal island. Their coast morphology is the result of an aerial erosive action, on to which the marine action has been superposed.—**F. Stella Starrabba**: Monthly distribution of the eruptions of Japanese volcanoes.—**Giulio Cotronei**: Dark and light fibres in the insular organ of *Petromyzon marinus*.—**B. Monterosso**: The structure of the body of *Perodema cylindricum* Heller, in relation to the cellular theory.

VIENNA.

Academy of Sciences, May 14.—**V. Oberguggenberger**: Determination of altitude of the pole at the Innsbruck Observatory with the help of Oppolzer's zenith telescope.—**V. Pietschmann**: A new deep-sea fish of the order Pediculati.—**E. Keller**: Curved perspectives.—**M. Kohn** and **A. Zandmann**: Communication on bromo-phenols, xxi. Display of new halogen-phenols from *m*-chloro-phenol.

Official Publications Received.

Department of the Interior: U.S. Geological Survey. Bulletin 781B: Geology of the Baxter Basin Gas Field, Sweetwater County, Wyoming. By Julian D. Sears. (Contributions to Economic Geology, 1925, Part 2.) Pp. ii+13-29+plates 2-6. Water-Supply Paper 542: Surface Water Supply of the United States, 1922. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. iv+74+2 plates. 10 cents. Water-Supply Paper 546: Surface Water Supply of the United States, 1922. Part 6: Missouri River Basin. Pp. vii+349+2 plates. 35 cents. Water-Supply Paper 552: Surface Water Supply of the United States, 1922. Part 12: North Pacific Slope Drainage Basins. A: Pacific Basins in Washington and Upper Columbia River Basin. Pp. v+203+2 plates. 25 cents. Professional Paper 138: Mining in Colorado; a History of Discovery, Development and Production. By Charles W. Henderson. Pp. iv+263+1 plate. 1 dollar. Professional Paper 140A: Geology of the Latah Formation in relation to the Lavas of the Columbia Plateau near Spokane, Washington, by J. T. Pardee and Kirk Bryan; Flora of the Latah Formation of Spokane, Washington, and Coeur d'Alene, Idaho, by F. H. Knowlton. (Shorter Contributions to General Geology, 1925.) Pp. iv+81+31 plates. Professional Paper 140B: Fossil Proboscidea and Edentata of the San Pedro Valley, Arizona. By James Williams Gidley. (Shorter Contributions to General Geology, 1925.) Pp. ii+83-95+plates 32-44. Professional Paper 140C: Pleistocene Plants from North Carolina. By Edward Wilber Berry. (Shorter Contributions to General Geology, 1925.) Pp. ii+97-119+plates 45-57. Professional Paper 140D: Shore Phases of the Green River formation in Northern Sweetwater County, Wyoming. By Wilmot H. Bradley. (Shorter Contributions to General Geology, 1925.) Pp. ii+121-131+plates 58-62. (Washington, D.C.: Government Printing Office.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 77, 1925. Pp. iii+388+11 plates. (Philadelphia, Pa.)

Fortieth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1918–1919; with accompanying Papers—The Mythical Origin of the White Buffalo Dance of the Fox Indians, by Truman Michelson; The Autobiography of a Fox Indian Woman, by Truman Michelson; Notes on Fox Mortuary Customs and Beliefs, by Truman Michelson; Notes on the Fox Society known as 'Those who Worship the Little Spotted Buffalo,' by Truman Michelson; The Traditional Origin of the Fox Society known as 'The Singing Around Rite,' by Truman Michelson. Pp. viii+664. (Washington, D.C.: Government Printing Office.) 2·75 dollars.

Journal of the Manchester Egyptian and Oriental Society. No. 12. Pp. 59. (Manchester: University Press; London: Longmans, Green and Co., Ltd.) 7s. 6d. net.

Proceedings of the Imperial Academy. Vol. 2, No. 3, March. Pp. v-vi+93-147. (Ueno Park, Tokyo.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 15: The Resistance of the Airship Models measured in the Wind Tunnels of Japan. By the Wind Tunnel Committee specially appointed by the Aeronautical Council of Japan. Pp. 84. (Tôkyô: Maruzen Kabushiki-Kaisha.) 2 yen.

Annual Report of the Zoological Society of Scotland for the year ending 31st March 1926. Pp. 59+6 plates. (Edinburgh.)

Observatoire de Zi-ka-wei. Notes de sismologie, No. 7: Mouvements sismiques des magnétomètres à Zi-ka-wei et à Lu-kia-pang (1877–1924). Principaux sismogrammes, 1925. Par le Rev. P. E. Gherzi. Pp. 33+7 planches. (Zi-ka-wei, Chang-hai.)

Proceedings of the Royal Society of Edinburgh, Session 1925–1926. Vol. 46, Part 2, No. 19: The Wheatstone Bridge as the Means of Measuring Linear and Angular Dimensions at a Distance, and its Application to Borehole Surveying. By Prof. Henry Briggs. Pp. 218–229. 1s. Vol. 46, Part 2, No. 20: On Fertility in the Domestic Fowl. By Dr. F. A. E. Crew. Pp. 230–253. 9d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation to be submitted at the Fourth Annual General Meeting on June 9th, 1926. Pp. 32. (London: Millbank House, Millbank, S.W.1.)

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk). Čís. 64: Oblastní odtoková mapa Moravy (Carte géographique du débit d'eau relatif de la Moravie). Napsal Dr. Fr. Koláček. Pp. 18+1 tab. Čís. 65: "Tanytarsus connectens." Par Dr. Jan Zavřel. Pp. 47+1 tab. Čís. 66: Morfologický vývoj Hlučínska (The Morphological Development of Hlučín). Napsal Dr. Fr. Vitásek. Pp. 38+1 tab. Čís. 67: Terasy dolní Svitavy a dolní Svratky (Les terrasses de la Svitava inférieure et de la Svratka inférieure.) Napsal Fr. Říkovský. Pp. 17+3 tab. Čís. 68: O absorpci chlorovodíku a kysličníku siřičitého v kyselině sírové a v kyselině octové [Pokračování] (On the Absorption of Hydrogen Chloride and Sulphur Dioxide in Sulphuric Acid and Acetic Acid [Continuation].) Napsal Václav Čupr. Čís. 69: O W-kongruencích s fokálními plochami přímkovými (Sur les congruences W dont les surfaces focales sont réglées). Napsal J. Klapka. Pp. 31. (Brno: A. Píša.)

Sborník Vysoké Školy Zemědělské v Brně (Bulletin de l'École supérieure d'Agronomie, Brno). Sign. C1: Oxydimetrické studie o antimonu (Oxydimetric Studies on Antimony). Napsal Prof. Dr. J. Knop. Pp. 22. Sign. C2: O gravimetrickém poměru mezi antimonem a antimontetroxydem (Observations on Gravimetric Proportion between Antimony and Antimony-Tetroxide). Napsal Prof. Dr. J. Knop. Pp. 10. Sign. C3: Implantace volných fragmentů kostních pomocí omenta u psů (Implantation des fragments osseux libres à l'aide de l'omentum chez les chiens). Napsal Prof. Dr. Theodor Dohnal. Pp. 18+5 tab. Sign. C4: Studie o změnách, zvláště analytických konstant tuku máselného, vlivem paprsků ultrafialových (A Study of the Changes, particularly of Analytical Constants of Butter Fat, under the Influence of Ultraviolet Rays). Napsal Dr. Josef Spinka. Pp. 38. Sign. C5: Příspěvek k poznání nutritivního významu látek ve vodě rozpuštěných pro vodní zvířata (A Contribution to the Knowledge of the Nutritive Importance of the Substances dissolved in Water for Water-Animals). Napsal Dr. Jan Podhradský. Pp. 58+8 tab. Sign. C6: Stimulování vzrůstu zvířat vitaminovými preparáty z obilních klíčků (Stimulation de la croissance des animaux par les préparations des vitamines des germes du blé). Napsal Dr. Jaroslav Křížeňecký a Dr. Jan. Podhradský. Pp. 60+16 tab. Sign. D1: Rok hladu u Abies Nordmanniana Lk. 1 Část: Varianty jehlic (A Year of Hunger at Abies Nordmanniana Lk. 1 Part: The Variants of Spines). Napsal Prof. Dr. Otakar Vodrážka. Pp. 18+1 tab. Sign. D2: Synthesa škrobu u různých rostlin za přítomnosti solí vápníku a sodíku: Fysiologicko-oekologické výzkumy (The Synthesis of Starch in different Plants under Presence of Salts of Calcium and Sodium: Physiologic-oecological Researches). Napsal Prof. Vasil Sergějevič Iljin. Pp. 27. Sign. D3: Nové rody Lycorid (s bezkřídlými samičkami) z lesní půdy (Genres nouveaux des Lycorides (avec des femelles aptères) du sol de forêts). Napsal Antonín Vimmer. Pp. 16+1 tab. (Brno: A. Píša.)

Diary of Societies.

MONDAY, JULY 5.

ROYAL INSTITUTION, at 5.—General Meeting.

CONFERENCES.

MONDAY, JULY 5.

ROYAL SANITARY INSTITUTE (at Guildhall), at 3.—Right Hon. Neville Chamberlain: Inaugural Address.

TUESDAY, JULY 6.

ROYAL SANITARY INSTITUTE (at Mansion House, Central Hall, and Institution of Civil Engineers), at 10.—Sections A (Sanitary Science and Preventive Medicine), C (School Hygiene). Discussions: Sanitary Authorities; Engineers and Surveyors; Sanitary Inspectors.

WEDNESDAY, JULY 7.

ROYAL SANITARY INSTITUTE (at Caxton Hall, Central Hall, and Guildhall), at 10.—Sections A (Sanitary Science and Preventive Medicine), E (Hygiene of Food), F (Hygiene in Industry). Joint Session with Maternity and Child Welfare Conference. At the Royal Sanitary Institute, at 3.—Prof. C. E. A. Winslow: Appraisement of Health Administration.

THURSDAY, JULY 8.

ROYAL SANITARY INSTITUTE (at Central Hall and Institution of Civil Engineers), at 10.—Sections B (Engineering and Architecture), D (Personal and Domestic Hygiene). Discussions: Port Sanitary Authorities; Veterinary Inspectors.

FRIDAY, JULY 9.

ROYAL SANITARY INSTITUTE (at Central Hall and the Institution of Civil Engineers), at 10.—Section B (Engineering and Architecture). Discussions: Medical Officers of Health; Veterinary Inspectors; Health Visitors.

NATURE

SATURDAY, JULY 10, 1926.

CONTENTS.

PAGE
Reconstitution of the University of London. By T. Ll. Humberstone 37
Eugenic Reform By E. W. M 39
Modern Physics in Chemistry. By J. R. P. . . 42
The Biology of Lepidoptera. By Dr. A. D. Imms . 43
Our Bookshelf 44
Letters to the Editor:
Muscular Action.—A. Mallock, F.R.S. . . . 46
Collisions of the Second Kind with Excited Mercury Atoms in the $2P$ State.—J. G Winans . . . 46
Activated Fluorescence and Doppler Effect —Franco Rasetti 47
High Frequency or Ironless Induction Furnaces.—N. Ryland Davis and C. R. Burch; Frank Adcock 47
The Drop-weight Method of Measuring Surface Tension —T. Iredale 48
Cirrus at a Lower Level than Alto-cumulus.—Antonio Giao 49
The Zoological Names *Simia*, *S. satyrus*, and *Pithecus*, and their Possible Suppression.—Dr. C. W. Stiles 49
Names for Companion Stars. — Prof. Frank Schlesinger 49
Energy Levels of the Carbon Monoxide Molecule.—Dr. R. C. Johnson 50
The Physical Basis of Insect Drift.—C. J. P. Cave 50
Abnormal Venous Circulation in a Frog —F. W. Flattely 50
Oxidation, Passivity, and Corrosion. By Ulick R. Evans 51
Climatic Changes during Geological Times. By C. E. P. Brooks 53
Recent Developments in the University of Sheffield . 55
News and Views 57
Our Astronomical Column 61
Research Items 62
The Chemical Constitution of Thyroxine . . . 65
Annual Visitation of the National Physical Laboratory, Teddington. By L. J. C. 66
University and Educational Intelligence . . . 68
Contemporary Birthdays 69
Societies and Academies 69
Official Publications Received 72
Diary of Societies and Conferences 72

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Reconstitution of the University of Lon

THE Government has redeemed its pledge to introduce legislation "to make further provision for the University of London." The University of London Bill, which, on the motion of the Earl of Balfour, was accorded its second reading in the House of Lords on June 29, proposes to appoint eight commissioners with plenary powers to draft statutes for the University "in general accordance" with the recommendations contained in the Report of the Departmental Committee of the Board of Education appointed by Mr. Trevelyan in 1924, subject to any modifications which may appear to them to be expedient. Thus the procedure is assimilated to that adopted in the recent reconstitution of the Universities of Oxford and Cambridge. There are, however, important differences between the two cases. Whereas the reconstitution of the ancient universities was based on the recommendations of a Royal Commission of great authority, presided over by Mr. Asquith (now Lord Oxford) — recommendations which were unanimous save for some relatively unimportant reservations by individual members—the proposed reconstitution of the University of London is to be based, not on the recommendations of the Royal Commission, generally known as the Haldane Commission, which reported in 1913, but on the recommendations of a Departmental Committee of the Board of Education. Conditions, it is true, have changed since the Haldane Commission reported. The reception accorded to the Departmental Committee's report has been comparatively friendly, but it cannot be overlooked that the constitution proposed by the Committee differs essentially from that suggested by the Royal Commission.

Another difference relates to the historical development of the universities in question. Broadly speaking, Oxford and Cambridge have retained their traditional constitutions, based on the University of Paris. They remain corporations governed by their graduate members. Certain internal reforms, such as the abolition of the celibacy of college fellows, have been effected by the pressure of public opinion. But external control in any form has always been resisted, notwithstanding acceptance of generous financial aid from the Government. The presence of outside representatives on the Council, the Royal Commission reported in 1922, "would hamper the Council in its work without securing as a rule any compensating advantage"; and the objection to representatives nominated by the Government appeared to the Commission "particularly strong."

The University of London was established by Royal Charter in 1836 with a Senate nominated by the Government to administer its educational affairs, the Government retaining full financial control. It was not until

1858 that the graduates secured a share in the administration of the University, when the privilege of nominating for a limited number of seats on the Senate was conceded to Convocation under a new charter. Forty years later the teachers of the colleges and medical schools in London were accorded a similar privilege, the Act of 1898 reconstituting the University as a teaching university. The reconstitution now under discussion in Parliament derives its motive force from the demand of the Government, voiced by the University Grants Committee, for an improved financial and executive control.

The schedule of the University of London Act of 1898 gave to the Commissioners named in the Act detailed directions for the constitution of the Senate. It enforced the 'advisory' character of its chief councils, provided safeguards for religious and sex equality, prescribed the radius for the recognition by the University of public educational constitutions, insisted that the internal and external degrees of the University should represent "as far as possible the same standard of knowledge and attainment," and gave instructions on several other matters. These provisions were fully discussed by Parliament. If the present Bill passes, Parliament will abrogate its right to discuss the details of academic organisation, reserving only the right to reject statutes. Government of a university by statutes without rigid and permanent directions from Parliament offers certain obvious advantages, provided fundamentals are safeguarded. Statutes can be amended to meet changing conditions without cumbersome Parliamentary procedure. Under the present Bill, statutes for the University can be altered or supplemented by the University, except statutes, if any, that the Commissioners may consider ought not to be altered by the University. The Bill directs the Commissioners, before adopting statutes, to receive representations "by or on behalf of the Senate or Convocation or any fifty graduates of the University, or by or on behalf of any other bodies or persons appearing to the Commissioners to be directly affected by the proposed statute"; and there are the usual provisions for the approval of statutes by the Privy Council. Thus the arrangements for publicity and for preliminary discussion by those specially qualified are adequate.

This is not the occasion for a detailed discussion of the recommendations of the Departmental Committee, either at large or in relation to the promotion of scientific education and research. Controversy has so far centred—as was to be expected—round the status and powers of the proposed Council which is to be given financial and executive control. This reform is fundamental; but the question of the relation of the Council to the Senate, the body responsible for educational policy, will have to be closely examined by the Commissioners. Presumably all the proposed Commissioners are already in agreement as to the creation of the Council. On other matters, the Commissioners can adopt modifications of the Departmental Committee's recommendations, and no doubt many suggestions will be forthcoming in due course in regard to such matters as the number and mode of election of heads of colleges as members of the Senate, the devising of some method more dignified than co-option of appointing a number of members of the Senate as independent experts or on grounds of services rendered to the University—the elder statesmen or aldermen of the University—and the appointment of the Principal as a member of Senate and Council *ex officio*. Statutes should also authorise the payment of fees to members of the Council, thus emphasising the serious nature of their duties and the demands on their time and energy.

The important question of the relation of the University to its affiliated colleges is a matter which will be within the competence of the Commissioners, who may make statutes for the colleges, subject to the consent of the respective governing bodies. Their powers appear to extend to the incorporation or disincorporation of colleges in the University, a subject of acute controversy within the University. Under the present statutes, colleges were affiliated to the University without any clearly defined privileges and obligations, and it will be of great advantage both to the University and to its colleges if their relations are placed on a firmer basis.

The personnel of the Commissioners has been selected with care and judgment. The chairman, Mr. Justice Tomlin, will ensure judicial treatment of the questions to be considered. Two graduates of the University, Sir Josiah Stamp and Prof. T. P. Nunn, and the present Principal Officer, Sir Cooper Perry, who will retire from his University office shortly, may be deemed to represent the University. The point of view of the Board of Education and the London County Council will be represented by Sir Amherst Selby-Bigge, the late Secretary of the Board, and Sir Cyril Cobb respectively. Oxford contributes a representative in the Master of Balliol (Dr. A. D. Lindsay), and the special interests of women will find a natural protector in Miss Philpotts.

Past history has shown that the University of London through its graduates can exercise powerful political influence. Will that influence be used on the present occasion against the Bill? Convocation, at a sparsely attended meeting held during the strike, adopted three resolutions declaring that the creation of a Council to control the finances of the University would have "prejudicial effects upon the University"; that the reconstitution of the Senate in accordance with the recommendation of the Departmental Commission would be "a grave error"; and, finally, strongly deprecated the setting up of a Statutory Commission. The Senate has adopted a resolution declaring its opinion that as regards the relative positions of the Council and the Senate, the scheme proposed by the Majority Report of the Departmental Committee should be rejected on the ground that it will be found to be unworkable in practice, that it will deprive the truly representative body (the Senate) of all effective control, that it will not clear the body charged with control of finance from any possible imputation of partiality; and finally, that it will complicate further the already too complicated machinery of the University. The Senate further offered to submit a scheme of agreed reforms. The inference to be drawn from this resolution is that the Senate would prefer that the Council, if created, should have the status of a statutory finance committee.

One final suggestion. Would it not be well for the Government to make some announcement as regards increased financial aid for the work of the University, if and when reconstituted? The great developments in university education, which London, as the capital of the Empire, urgently needs, cannot be accomplished, however perfect a constitution may be provided by the authority of the Government, unless the money is forthcoming. The University may reasonably expect the Government, which has shown so much solicitude for its spiritual welfare, to contribute generously to its material needs. T. LL. HUMBERSTONE.

Eugenic Reform.

The Need for Eugenic Reform. By Leonard Darwin. Pp. xvii + 529. (London: John Murray, 1926.) 12*s.* net.

THIS is in every respect a notable book by a most distinguished author. Major Darwin has now for fifteen years occupied the presidential chair in the Eugenics Education Society, and comparatively few realise the services which he has rendered towards making clear the social implications of the results of the scientific study of heredity. The word 'Eugenics' signifying 'the study of the agencies under human control by which the human stock can be improved' was coined by Galton, as most people know. Most are also aware that it was associated in the public mind with a number of fantastic projects for the compulsory mating of specially selected specimens of opposite sexes in order to improve the race. For this conception of the subject Galton is directly responsible; it has led to eugenists being regarded as a collection of faddists, and has drawn on to the whole subject the sharpest shafts of ridicule and sarcasm. G. K. Chesterton has said of eugenic reform that it could be imposed only on slaves and cowards, and it is, no doubt, of 'Galtonian' reforms that he was thinking when he made this statement.

The present reviewer is forced to confess that he formerly shared the common attitude towards the subject, an attitude which, as he must regretfully admit, is still maintained by some of his most admired scientific friends. It was in 1913, when he had the good fortune to listen for the first time to a presidential address by Major Darwin, that the reviewer first saw that a wholly different interpretation could be given to eugenic reform, an interpretation calculated to appeal strongly to the common sense of all who take the trouble to give their attention to the subject. This interpretation, which, though theoretically admitted, was not regarded as of practical importance in comfortable Edwardian days, is now forcing itself on the attention of every one who has to deal with social affairs. Major Darwin pointed out that, if we went on fostering the unrestricted multiplication of the least competent members of the nation by continually increasing doles extracted from the pockets of the more competent and therefore well-to-do, we should inevitably lower the quality of the race. It is a sinister portent that the large families which were reared in our rectories and in the manses of Scotland in Victorian days, from which we gathered so many distinguished and able men, have disappeared, whilst there is no serious diminution in the offspring of our dock labourers and unskilled workers. Major Darwin's conception of eugenics was essentially the extension of his father's doctrine of natural selection to human affairs.

The book which we are considering opens with a biological introduction which deals with the Mendelian theory of heredity and discusses the inheritance of acquired qualities and the Lamarckian theory of evolution. This part is by far the weakest section of the book, for Major Darwin labours under the disadvantage of not being a biologist, and this disadvantage is increased by the fact that, as he admits in the preface, he has relied for assistance and advice mainly on Mr. R. A. Fisher and Mr. C. B. S. Hodson. Of these the first is a mathematician, and the second name is obviously a slip for Mrs. Hodson, the respected assistant secretary of the Eugenics Education Society, who undoubtedly has had some training in biology, but is scarcely fitted to give serious criticism in this subject.

Major Darwin accepts the extreme Mendelian view, namely, that the whole force of heredity in any individual is capable of being analysed into a series of units or 'genes,' and that a chance assortment of 'genes' is handed on by the parent to his children. This view, which has been rejected by many biologists with a really wide outlook on the science, including systematists, embryologists, and palæontologists, leads, if logically pressed, to impossible and absurd conclusions. The innate common sense of Major Darwin leads him to see this: he plaintively confesses that if genes are unalterable he cannot see how evolution can ever have taken place, for all the genes which make up human heredity must have been present in the original amœba. It may be added that the 'factorial analysis' of heredity adds nothing to our knowledge of the subject: the 'genes' or 'factors' are purely imaginary units, and the number is continually added to as Nature shows herself unwilling to be compressed within mathematical formulæ. As the author naïvely confesses, it is impossible to devise means of analysing human capacities into genes, and eugenic reform cannot wait whilst the attempt is made; therefore Mendelism is of service to eugenics chiefly by fostering belief that heredity is not a haphazard thing but follows fixed rules. But this belief is far older than Mendelism; no farmer, nor even any common-sense observer of human affairs, needed Mendel to teach him this; it is expressed in unequivocal language by the Founder of Christianity himself: "neither can a corrupt tree bring forth good fruit."

Major Darwin is no happier in his criticisms of Lamarckism. He points out that there are certain qualities which he does not think could have been 'acquired' in this sense by animals; as, for example, the protective resemblance shown by the plumage of a bird. How, he asks, could the bird know when its plumage assimilated with its surroundings? Well, we do not know how a bird would react to changed surroundings, but we do know that many reptiles, amphibia, and fishes can and do control their colour so as to make it match their environment, and that this control is exercised through the eye. If Major Darwin will keep a common frog in a dark tank he will find that it soon assumes a very dark brown tint. If it is now removed to a white porcelain dish it will in half an hour assume a light straw-coloured tint. If, however, the optic nerves of the dark frog are severed, it will remain dark on the whitest porcelain. What goes on in the mind of the frog, what it feels or thinks, neither Major Darwin nor any one else knows.

Then Major Darwin says that whilst doubtless a muscle increases in size with use, Lamarckians have never explained how this power was 'acquired.' On this subject it is necessary to speak firmly and decisively. Neither Lamarck nor any other competent biologist has ever advanced a theory to explain how living beings could develop out of dead matter. The fundamental properties of life are as clearly manifested in amœba as in man; every faculty shown in the higher forms of life is present in the simplest form in germ—*ex nihilo nihil fit*. These properties are the presupposition of every valid theory of evolution. This was clearly seen and expressed by no less a person than Alfred Russel Wallace. The author's third objection that Lamarckian change, if it really occurs (and his father admitted that it did), is extremely slow in its action and can therefore be left out of account in considering eugenic measures, has a considerable measure of truth in it; yet even here a *caveat* must be entered. It is not the case that "millions of years" are needed to effect any noticeable change. It is not "millions of years" since palæanthropic man ranged over Europe, and yet since that time we have acquired straight backs and thighs. The Lamarckian view is that evolution is due to changes of habits (in Lamarck's phrase, the effort to satisfy new needs awakened by new surroundings), and that these habits induce changes in structure which are passed on to the next generation. The first stage in this transmission consists merely in a quickened response to the same stimulus which induced the corresponding change in the parent. It is only after a long time that the change becomes so engrained in the constitution that it appears without the stimulus at all. Baron Nopcsa, in a recent brilliant address to the London Zoological Society, pointed out that in the adaptations which fit the human leg to maintain the upright position both stages can be found. The thickened pad on the sole of the foot appears whilst the embryo is in the womb, but the change in the ankle-joint only appears after walking has begun, and fails utterly to appear if the foot for any reason is not used. It is quite probable that good education—the development of the brain by mental exercise, not the cramming of it with facts—does leave in the progeny of the educated an increased capacity to learn.

Besides Lamarckian adaptation, however, which being an epitome of the past history of the species, accounts for the racial differences which divide mankind, there is another kind of variation prominent amongst our domestic animals which also occurs largely amongst civilised city-dwellers, who, like the denizens of the farmyard, are domesticated. This is a weakening of developmental energy caused by bad conditions surrounding the germ in its earliest period of growth. This weakening produces a disharmony in growth which results in weird structural aberrations, and once produced it is handed on to subsequent generations and produces the same result in the progeny as in the parents. To this cause not only the 'fancy' character of our domestic breeds but such pathological aberrants as epileptics and mental defectives owe their origin. Nevertheless, if such individuals are transferred to healthy natural surroundings *and left to support themselves by their own efforts*, this plasma-weakness gradually passes off and the natural structure is regained. A beautiful example of this reversion can be seen every day in London; and it is one which seems to have been going only for forty or fifty years, since it is never mentioned in the works of Charles Darwin, and it would have greatly interested him had he seen it. As all know, pigeons originally escaped from dove-cotes have multiplied all over London and maintain themselves in our squares, no doubt in the innocence of their hearts mistaking our tall London houses for their ancestral cliffs. A large proportion of these pigeons are assuming the plumage and shape of the wild rock pigeon, yet this is certainly not due to crossing, for the wild progenitor is now an exceedingly rare bird and is in fact almost extinct. So the emigration of a city-stunted population to Australia, if they were not coddled but left to their own efforts, might in time give rise to a population of respectable physique.

The author, as in filial duty bound, attaches great importance to natural selection—and so do we. If advance is the result of energy and vigorous striving, a race will progress only as the weak and lazy are eliminated or, at any rate, prevented from procreating progeny—and in this lies the central core of all Major Darwin's proposals. He points out the disastrous effects of public assistance; the class assisted does not increase in its efforts at self-maintenance, but depends more and more on doles; and it increases in fertility whilst the class from whom assistance is drawn diminishes in numbers He then considers how the elimination of the less worthy class might be promoted. He considers, and rightly so, that parenthood should be prevented in the case of all certifiable as mentally defective. This could be accomplished if lifelong segregation were instituted with the acceptance of voluntary sterilisation and freedom as an alternative. He thinks that parenthood should be prohibited even in cases where the mental defect is held to be due to 'environmental factors,' since even if such parents would not hand on the defect to their children—and we consider it very probable that they would do so—they are quite unfit to give parental care and good upbringing. Major Darwin discusses the objections to sterilisation which are both futile and sentimental. It is objected that sterilised individuals would feel free to adopt an immoral life. This, we might rejoin, is not our business: they are in no way forced to do so, and even if they did, this would be a very much lesser evil than the contamination of the next generation by them. After all, people who now desire an immoral life are deterred not by the fear of illegitimate offspring, but the dread of venereal disease; yet that is no argument against stamping out that disease if we can. The author would further sterilise or segregate the habitual criminal, and when hard necessity has made us shed some of our sentimentalism we shall agree with him. As he remarks, 120,000 new recruits join the ranks of labour every year, and yet it seems probable that our trade will never rise to its pre-War level, so that some regulation of population is an absolute necessity.

This necessity, it seems to us, can only be met by birth-control; that is, limitation of size of family. Here, however, the author shows himself fussy: he is afraid that contraceptive measures in certain circumstances might do harm. The answer to this is that since contraceptive practices are widespread amongst the more intelligent members of the community, to extend the knowledge of them amongst the class that is multiplying too quickly can do no harm. Of course, as Major Darwin sees, this would leave the utterly reckless class uninfluenced. So the right of any one to have children whom he cannot support must be challenged sooner or later, and the ultimate remedy for that is the threat of sterilisation if the family is added to. It seems to us that another remedy not envisaged by the author would be to treat all public assistance as a loan which must be repaid before the beneficiary is allowed to vote.

Major Darwin then goes on to discuss mate-selection, divorce, and kindred matters. On the question of divorce he is stern and conservative. Like all eugenists, he considers marriage as an institution mainly for the purpose of the next generation and family life as indispensable, and this life would inevitably be destroyed by easy divorce. As to mate-selection, no doubt prudence should be exercised in selecting a wife, both with regard to health and character, but as the author truly remarks, love laughs at locksmiths, and once passion is aroused, prudence is apt to be thrown to the winds. Hence, where care ought to be exercised is in the quality of the opposite sex with which our children are familiarised during their young and formative years, for this quality will create the ideals which will arouse passion later on.

The conclusion of the volume is naïve and surprising. The author having come to the conclusion that 'science,' as he conceives it, leads to a mechanical conception of the universe and causes him to regard his fellow-being as an automaton, and as therefore having no individual rights as compared with the welfare of the race, yet finds, when he looks within, that he is a being with a free-will; and so he rejects the conclusions to which 'science' leads him. This he regards as an antinomy which he is powerless to resolve. It might perhaps have induced him to inquire whether the postulates of his 'science' were not doubtful; whether, in fact, we really can begin with 'matter' and its laws, when matter, as Huxley admitted, is inconceivable except as presented to a conscious mind; and whether therefore Lamarckian evolution, which assumes that in animals, as in us, there is something that feels, strives, learns, and remembers and transmits its memories in part to its offspring, is not preferable to the view that animals owe their origin to a series of 'chance' variations that have accidentally come to pass. We think that the author would get some light on his difficulties if he were to study the "Psychological Principles" of Ward and "L'Évolution créatrice" of Bergson. E. W. M.

Modern Physics in Chemistry.

Fundamentals of Physical Chemistry: for Students of Chemistry and related Sciences. By Prof. Arnold Eucken. Translated and adapted from the second German edition by Dr. Eric R. Jette and Prof. Victor K. Lamer. (International Chemical Series.) Pp. xxiii+699. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 27*s.* 6*d.* net.

THE translators of Prof. Eucken's text-book observe that there appeared to be room for a book in which kinetic theory, thermodynamics and quantum theory, each discussed on the basis of experimental facts, are considered of equal importance for the development of the subject. Kinetic theory and thermodynamics have long formed part of the studies of chemical students, and there can be little doubt that a really practical working knowledge of physical chemistry must include them, but the quantum theory is relatively new and has not yet in all cases received adequate treatment from the point of view of the student of chemistry. In its mathematical aspects it has formed the subject matter of several important treatises, but these are for the most part addressed to students of physics and have a very limited appeal to chemists. It must therefore be admitted that a treatment in which these three components of modern physical chemistry are considered in a connected manner, and especially in close relation to experiment, is very desirable, and an examination of Prof. Eucken's book shows that he has been very successful in presenting the material in a form suitable for students of chemistry.

It is clear at the outset that in such a presentation an adequate knowledge of mathematics is essential, and as the author remarks in his preface, a practical acquaintance with the subject is only possible on a mathematical foundation. For this reason, whilst the book will be stimulating and valuable to those students who are equipped with the small amount of higher mathematics necessary (the outlines of which are given in the first part of the book), it will be of very limited use to those not so equipped. Students who merely wish to attain to a smattering of the subject, based on vague and often unsuitable analogies, are not considered, and indeed in these days need scarcely be considered by any author of a book which attempts to go beyond the very elements of the subject. At the same time, it must be admitted that an attempt to make the whole treatment logical has resulted in some cases in a rather more difficult style of mathematical deduction than is necessary. For example, the theory of concentration cells and of ionic transport in electrolysis may be treated without first making use of the general equations for transport, based on the theory of diffusion; and there can be no doubt that students coming to the subject for the first time would obtain much clearer ideas and would feel much less difficulty than can be the case when the general method is put into application forthwith. The same remark applies to many other parts of the book, and on the whole it may perhaps be considered more suitable for students who have already an elementary knowledge of most of the subjects dealt with.

The book is divided into two main sections, the first called "Thermodynamics" (divided into physical thermodynamics and chemical thermodynamics), and the second "The Structure of Matter." In the first part, however, is included the classical kinetic theory, and the abundant use made of kinetic ideas and equations is one of the best features of the treatment. One might perhaps criticise the way in which the fundamental equation of the Second Law of Thermodynamics is first introduced on p. 50 in an equation (No. 49), which is made to appear as if it followed in some way from the preceding argument, whereas it is not really deduced until much later, and then on the basis of the properties of ideal gases. In this section the common error of deducing the equation for the adiabatic expansion of gases without pointing out that the specific heat is tacitly assumed to be constant is made (p. 83), in spite of the fact that the variation of specific heats with temperature is fully considered in another place.

The section on the theory of solution has been completely rewritten by the translators in the light of the conception of activity, and it forms a useful and brief summary of this method of treatment. The new theory of Debye and Hückel is also included, and a praiseworthy attempt is made to exhibit the fundamental assumptions and the method of calculation without reproducing the rather long and difficult details of the actual calculations. It is shown that the theory in its simplest form, *i.e.* when the ions are assumed to be point charges, fails to account for the experimental facts, but the further very valuable result emerges that, even when the correction for the sizes of the ions is fully applied, the theory still fails to reproduce the facts. A further correction term, depending on the actual structure of the ions and the deformability of the external electronic orbits, can at present be applied only in a semi-quantitative form, and it is clear that the problem, as in the case of all those in which the structure of molecules appears, becomes extremely complex. It is further shown that the theory is at present unable to distinguish between complex ion formation (as is commonly assumed in the case of cyanides and silver, for example) and the specific interaction of ions. Thus, the effect of a cyanide on the solubility of silver cyanide is treated in the same way as the effect of hydrochloric acid on the solubility of sodium chloride. It is clear that, although progress has been made in this perplexing region, there are still formidable difficulties to be overcome.

The section on the structure of matter follows the usual lines. The proof that the experiments which seemed to point to the existence of sub-electrons are vitiated by incorrect assumptions as to the structure of the particles, as was supposed by Millikan, probably came too late for inclusion in the book, but the fact that Aston's whole number rule is not always true, and cannot be regarded as a law of Nature, might have been mentioned. The Bohr atom is made the basis of the whole discussion, although static models are used in the consideration of Born's calculations of heats of formation, etc. The quantum theory of the atom is given in more detail than is usual in books intended for chemical students, but the calculations are omitted in difficult cases and the results only stated. It is quite clear from the whole of this section that, apart from the spectroscopy of some simple atoms, the theory is still too complicated to yield information of much real value to chemists, since in the case of more complex atoms the results are still more or less qualitative. The theory of spectra, however, is of direct interest to chemists, and if the considerations put forward in this section do no more than indicate that the theoretical basis of much speculation on absorption spectra is fallacious, they will serve their part. The real significance of the quantum orbits, as distinguished from the old idea of vibrating electrons, is quite satisfactorily explained.

The translation leaves much to be desired. In many cases the exact opposite of the German meaning has emerged, in some cases owing to the translation of "noch" as "not"; in other cases lack of knowledge of facts has led to such errors as the translation of "Kohlenoxydknallgas" as "an absolutely dry mixture of the gases CO, H_2 and O_2," which, it is stated, will not explode! The technical meanings of many German words are apparently unknown to the translators, who have rendered "Energieverteilungsgesetz," for example, as "the equilibrium law" (p. 73); they usually translate "darf" as "dare," and so on. As an example of the faulty translation, the following, selected from numerous cases, may serve. On p. 112, in discussing the quantum theory of specific heats, they say: "The failure of the classical theory obviously dates from the day when heat energy was added to a system consisting of a diamond crystal at 20° abs. in an atmosphere of hydrogen or helium, and it was found that this energy was absorbed only by the gas molecules." The German text (p. 92), however, reads: "Das Versagen der klassischen Theorie tritt handgreiflich zu Tage, wenn man sich bei etwa 20° abs. einen Diamantkristall in einer Wasserstoff- oder Heliumatmosphäre vorstellt: Führt man dem System Wärmenergie zu, so wird diesselbe nur von den Gasmolekeln aufgenommen." Incorrect translations in very many cases make the text completely obscure if not even incorrect, and it is difficult to understand how the translators could have failed to perceive that in many cases their rendering is meaningless. A list of errors has been forwarded to the translators.

J. R. P.

The Biology of Lepidoptera.

Biologie der Schmetterlinge. Von Dr. Martin Hering. (Biologische Studienbücher, 3.) Pp. vi+480+13 Tafeln. (Berlin: Julius Springer, 1926.) 18 gold marks.

NO scientific book has appeared hitherto that deals adequately with the many biological problems that are exemplified in Lepidoptera. These insects have so long proved a convenient source of material for fundamental research that a comprehensive work, bringing together accumulated knowledge in an accessible form, should appeal to a wide circle of zoologists. This want has now been met to a large extent by the admirable volume by Dr. Martin Hering, of the museum of zoology of the University of Berlin, which is now before us. His treatise surveys a breadth of field unexcelled by previous writers on these insects and is a storehouse of information relative to most phases of their biology. Throughout the book he discusses the principles underlying the phenomena described and, although his theoretical conclusions may not always seem to be sufficiently supported by facts, his original viewpoint is particularly stimulating.

In his general introduction, Dr. Hering divides the order into two main groups depending largely upon the presence or absence of the anal vein (Cu_2 in the most recent interpretation), and in this scheme, it may be added, the Hesperiidæ are relegated to a position intermediate between the higher and lower families of the order. The first main section of the book is devoted to ontogeny, or individual development, from fertilisation of the egg to the eclosion of the imago. With regard to oviposition certain remarkable facts are alluded to. It appears that *Polyommatus rutilus* consistently lays its eggs in pairs, one egg of the pair producing a male and the other a female. There appears, furthermore, to be an alternation of male- and female-producing eggs in the ovarioles. With regard to *Papilio memnon*, some of the eggs are laid in pairs and others singly; the eggs in pairs produce male insects, while the isolated eggs give rise to females. In discussing parthenogenesis, the Psychid moth *Solenobia triquetrella* F. is mentioned as reproducing by this method in northern Germany, while in the southern form of this species fertilisation is the invariable rule.

The second section is concerned with the life of the imago. A very full account is given of the significance and distribution of the various types of scent scales and tufts that are so frequent among Lepidoptera. Some reference is also made to the presumed chemical nature of the odours produced. Senses and tropisms are likewise discussed at length, and there is a useful summary of what is known concerning the tympanal organ, mainly through the work of Eggers.

The third section, which extends to more than 240 pages, will commend itself to the general biologist. Here the author elaborates his views on geographical distribution, dimorphism, coloration, mimicry, etc. Certain of the conclusions that are arrived at are not convincing, such as the following. Large-sized species are more generalised than small-sized; the spring generation of seasonally dimorphic forms is more primitive than the summer brood; the lengthier the feeding period of larvæ and the shorter the pupal instar is an indication of primitiveness. With reference to the significance of colour patterns the classification of Heikertinger is followed, and we note in the discussion on mimicry there appears to be no mention of the name of Poulton.

The long chapter on leaf- and other miners is particularly good, and the author adopts a convenient terminology indicative of the different kinds of mines produced. The relations of Lepidoptera to ants and termites likewise form the subject of a separate chapter, and in this connexion the absence of any reference to the remarkable Lycænid *Liphyra brassolis* is unexpected. Further on in the book coloration is dealt with, both from its environmental and experimental aspects, while hermaphroditism, intersexuality, hybridism, all come in for discussion, along with other subjects too numerous for separate mention.

The bibliography at the end of the volume is intentionally restricted but it is too short to be an adequate guide to the literature. We miss reference to a number of leading authorities through the book, while many authors are quoted with no indication other than the date as to where their work is published. In whatever features one may disagree, however, they are insufficient to obscure the outstanding merit of the book.

A. D. Imms.

Our Bookshelf.

Practical Hints to Scientific Travellers. Edited by Prof. H. A. Brouwer. Vol. 1. Second, revised edition. Pp. v+122+9 plates. Vol. 2. Second, revised edition. Pp. v + 150 + 7 plates. Vol. 3. Pp. v + 185 + 6 plates. (The Hague: Martinus Nijhoff, 1925.) 5 guilders (8*s*. 6*d*.) per volume.

The object of this work is explained by its title. It consists of a series of independent articles, each dealing with a more or less remote portion of the earth, and written by a man with years of field experience in that particular region. The contributors include representatives of several nations; most of them are well-known geologists, whose names are sufficient guarantee that full reliance can be placed on the advice that they give. All except two of the articles are in English; those two, on Indo-China and Morocco, being in French.

Of the three volumes now to hand (the first two of which are in their second edition), vol. 1 deals with the East Indies and South and East Africa; vol. 2 with various Arctic countries, and with Turkestan; and vol. 3 with Mexico, Indo-China, India, New Zealand, New Guinea, and Morocco. In some of the articles the treatment is much more detailed than in others, but from most of them information on the following subjects is obtainable: preliminary studies and arrangements, climate, means of transport, appropriate equipment, native servants, food-supply, and medical care. Various hints are given concerning the etiquette and idiosyncrasies of the native inhabitants, upon whose attitude the smooth running of expeditions in many lands will largely depend.

Any one about to visit one of the regions here dealt with on a survey or other scientific expedition can be recommended in all confidence both to study this work as a preliminary and to take it with him. He will not fail to derive many useful hints from a perusal, not only of the article relating to the particular country he is visiting, but also of those dealing with other comparable lands.

A Synopsis of the Families and Genera of Nematoda. By Dr. H. A. Baylis and R. Daubney. Pp. xxxvi+277. (London: The British Museum, 1926.) 10*s*. 6*d*.

The Nematoda as a zoological division contains free-living as well as parasitic forms, and the number of the former is probably as great as, if not greater than, that of the latter. Yet the study of the parasitic forms, owing to their growing interest in relation to disease, has become more and more divorced from that of the free-living. The authors regard this growing separation as indefensible and they have incorporated both groups in one system of classification. However sound this may be in theory, the result as shown in this volume is somewhat incongruous. The Nematoda are assembled into five orders in all, and the whole of the vast and varied assortment of free-living worms is included with Ascaris and Oxyuris in the single order Ascaroidea.

Apart from questions of classification, however, upon which there is much present-day difference of opinion, the work will prove a trustworthy and succinct guide to the various genera of roundworms together with the habitat usually taken up by the species of each genus and the name of its typical species or genotype. Under each genus is listed the papers most useful for reference. The general arrangement of the volume is admirable and should form a boon to the specialist; as, however, it does not list species, its use to the general reader is unfortunately limited. The year 1923 has been chosen as the closing date for the admission of new genera to the volume, and although a few names made since that date have been included, these are limited to synonyms of earlier genera or to new names to replace those already preoccupied.

The Fauna of British India, including Ceylon and Burma. Edited by Sir Arthur E. Shipley. (Published under the Authority of the Secretary of State for India in Council.) Birds. Vol. 3. Second edition. By E. C. Stuart Baker. Pp. xx + 489 + 7 plates. (London: Taylor and Francis, 1926.) 30*s.* net.

WITH the publication of this volume, which, like its two predecessors, deals solely with the Passeres, the author has brought to a conclusion his work on that great order of birds. In the three volumes issued up to date, 1336 species and subspecies have been recognised. In the first edition of the Avifauna, the Passeres were dealt with in two volumes, and the number of species then acknowledged was 936. The advance of ornithology has therefore given Mr. Stuart Baker much more ground to cover, largely owing to the necessity for his dealing with the numerous racial forms which have of late years been described.

The high standard set in the first two volumes has been fully maintained in the present one, which, in addition to numerous woodcuts, contains seven coloured plates by the author, that of the Zosterops being particularly pleasing.

The map of India which accompanies the volume would have been more instructive had the topographical features of the country been more clearly shown. The account of the birds of British India will probably be completed in three additional volumes.

The Statesman's Year Book: Statistical and Historical Annual of the States of the World for the Year 1926. Edited by Sir John Scott Keltie and Dr. M. Epstein. Sixty-third Annual Publication, revised after Official Returns. Pp. xxxvi + 1496. (London: Macmillan and Co., Ltd., 1926.) 20*s.* net.

EACH issue of this work of reference adds new features without sacrificing the old. The arrangement of countries remains the same, except that the kingdom of Hejaz has lost its place among the independent states. It is in regard to India that the principal changes occur. That section of the book has been expanded from forty-four to sixty pages, the increased space being devoted to the provinces of British India and the independent states over which the Indian Government exercises certain control. Each of these entities is now treated in the same way as the provinces of other parts of the Empire. Among the introductory matter, which includes a section on the League of Nations, new features are sections on the International Institute of Agriculture, a list of European and North African air routes, and tables showing taxation, national debt charges, and paper currency of various countries. The coloured maps are two, showing the distribution of republics and other political divisions in the Soviet areas in Europe and Asia. In spite of additions the bulk of the volume is not increased.

A Report on the Sugar Cane Mosaic Situation in February, 1924, at Soledad, Cuba. By Prof. Edward M. East and Prof. William H. Weston, Jr. (Contributions from the Harvard Institute for Tropical Biology and Medicine, 1.) Pp. vi + 52 + 9 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1925.) 8*s.* 6*d.* net.

IN this, the first of a new series of publications from Harvard University devoted to tropical biology and medicine, an account is given of the mosaic disease of sugar-cane as seen by the authors on the Soledad estate, Cuba. The disease is thought to be of long standing in Cuba (unlike most of the British West Indies), but, at Soledad, it is not appreciably reducing the yield and quality of the Crystalina cane ordinarily grown in the island. The extensive bibliography, and the plates (some in colour) showing mosaic and certain other types of chlorosis in sugar-cane and maize, are useful features of the book.

Geography in School. By James Fairgrieve. Pp. x + 364. (London: University of London Press, Ltd., 1926.) 7*s.* 6*d.* net.

THERE is little that is new in this book, but there is nothing that is not said in an interesting way. Every thoughtful teacher of geography has faced the problems which the author discusses in the light of his long experience of school work, and no teacher could fail to derive something of value from what Mr. Fairgrieve has to say. Especially valuable is his insistence on reality in geography and his warnings of misunderstandings that are liable to be caused by the necessarily small scale of so many maps and the lack of personal knowledge of the world of most teachers. The book has a useful bibliography and full index.

Pression de la lumière. Par Pierre Lebedef. Traduit du russe par T. Kousmine. (Collection de monographies scientifiques étrangères, No. 9) Pp. 71. (Paris: Albert Blanchard, 1926) 7·50 francs.

PIERRE LEBEDEF devoted twelve years of his life to the study of the pressure of light, and this little monograph gives us, in a convenient form, a description of his experiments. The work practically consists of two papers, one on the pressure exerted by light on solids, and the other on the pressure on gases, the latter being important because of its application to the tails of comets. Some bibliographical notes are appended.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Muscular Action.

A NUMBER of papers by various writers have recently appeared on this subject, mostly dealing not with the action of the muscle itself but with the material consumed by its action and the products formed by their consumption. Taking the somewhat parallel case of an engine, the papers alluded to aim at describing what is put into the fire-box, what falls into the ash-pan, and what goes up the chimney. Nothing of any value, however, is said as to the nature of the engine, its efficiency, or how and why it performs its work. The function of a muscle is to exert a pull, and the pull depends on the shortening, or tendency to shorten, of the cells of which the muscular fibres are composed, when something is transmitted to them by the nerves.

One would like to know—What is it that the nerves transmit? And what is the origin and nature of the force which deforms or tends to deform and shorten the cells?

A nerve can be made to act on a muscle in many ways; by electric currents, for example, or by chemical or mechanical irritation, but this does not indicate the character of the natural stimulus any more than the fact that a pipe can convey power to an engine by carrying water or gas indicates the real nature of its contents.

Nervous stimulus involves the expenditure of work independently of the work done by the muscle in which it induces contraction. What is the proportion between these two expenditures? Again, as regards efficiency. Efficiency may be specified either as the over-all efficiency, by comparing the potential work in the fuel with that realised by the engine, or, what is more important as regards muscular action, by the work expended in the muscle compared with the realised external work.

When a muscle is in tension, work is expended whether the muscle remains stationary or contracts; but it is only during contraction that useful work is done, and the work consumed in keeping a muscle taut but stationary amounts to a leakage of power.

Does this leakage continue at the same rate for the same tension while the contraction is going on?

This might well form the subject of experiment, and were it determined it would be possible, for any particular case, to state the most efficient speed of contraction.

So far as is known, all the work done by the muscles in accelerating themselves and their attachments is wasted. In walking on a resilient level surface, for example, the whole of the muscular work is spent in this way, for the walker might perform the same journey in a frictionless carriage by merely starting it with a push the energy of which could be recovered at the journey's end.

It must not be assumed, however, that the whole of the acceleration of the leg in walking is supplied by muscular effort. The legs, like pendulums, have natural periods, and the muscular acceleration is that required to convert the natural period of the leg to the forced period of the step.

Letters touching on these questions have already been published in NATURE of April 15, 1920; June 3, 1922; and January 31, 1925. A. MALLOCK.

9 Baring Crescent, Exeter, June 19.

Collisions of the Second Kind with Excited Mercury Atoms in the 2*P* State.

A NUMBER of experiments have recently been performed by various experimenters in which a mixture of gases containing mercury vapour as one constituent has been illuminated by light from a water-cooled quartz mercury arc. In interpreting the results of these experiments it has generally been assumed that the following process takes place. Mercury atoms first absorb radiation λ2536, an electron thereby being raised to the $2p_2$ state. Having reached this excited state the mercury atom may collide with one of the other atoms or molecules present and transfer its potential energy over to the other atom or molecule. The energy thus transferred may do one of several things. It may cause a molecule to dissociate, it may excite the colliding molecule or atom; it may all be changed into thermal kinetic energy of the two colliding bodies; or it may do combinations of the above.

In the interpretation of their results most of the experimenters have considered only the effect of mercury atoms in the $2p_2$ state. Recent experiments performed by the writer have shown that mercury atoms in the 2*P* state are also effective in the above process.

The apparatus and method were the same as used by Loria (*Phys. Rev*, **26**, 573-584, Nov. 1925) with his sealed-off tubes. A mixture of zinc and mercury vapours was illuminated by the light from a water-cooled quartz mercury arc, and the following zinc lines were observed.

Wave-length (Å U.).	Intensity.	Notation.	Energy necessary to excite (volts).	Remarks
4810 4722 4680	8	$2p_{1,2,3} - 1s$	6·63	Sharp triplet
3345? 3302 3282	2	$2p_{1,2,3} - 3d$	8·48	Diffuse triplet
3075	5	$1S - 2p$	4·01	Resonance line
2138	2	$1S - 2P$	5·77	" "

λ3345 is hidden by the mercury line λ3341. λ2138 was only obtained with long exposures.

When the exciting light was filtered through weak acetic acid (concentration 1 in 180) the zinc sharp triplet was reduced to an intensity of 2. λ2138 did not appear, but the exposure was not long enough to show definitely anything about this line. The intensities of the other lines remained very nearly the same. This weak acetic acid was found to absorb completely all wave-lengths shorter than λ2000 and to transmit λ2536 with nearly full intensity.

When this mixture of zinc and mercury vapours was illuminated by the uncooled or hot mercury arc, the sharp triplet and a very faint trace of λ2138 appeared. The zinc diffuse triplet and the resonance line λ3075, if they appeared at all, did not have sufficient intensity to be seen on the plate. When the exciting light was filtered through weak acetic acid no zinc lines appeared.

These results may be interpreted as follows. When the mixture of zinc and mercury atoms is illuminated by light from the water-cooled mercury arc, some normal mercury atoms are raised to excited states by absorbing light. Some of them absorb λ2536, an electron thereby being sent to the $2p_2$ level. In this state the atom has a potential energy of 4·86 volts. Other mercury atoms absorb λ1849, an electron going to the $2P$ level, giving these atoms a potential energy of 6·67 volts. Now, excited mercury atoms of either kind may collide with normal zinc atoms and transfer their potential energy to the zinc atoms, which are thereby raised to excited states. If an excited mercury atom has more energy than is necessary to excite a zinc atom, the energy remaining changes into thermal kinetic energy of the two colliding atoms. The excited zinc atoms returning to the normal state give out the zinc spectrum lines observed.

The energies necessary to excite these observed zinc lines are given in the table above. The only zinc line which a $2p_2$ mercury atom with its 4·86 volts energy could excite is λ3075, requiring 4·01 volts. A $2P$ mercury atom having an energy of 6·67 volts might excite either the sharp triplet requiring 6·63 volts or λ2138 requiring 5·77 volts. When we filter the exciting light through acetic acid, λ1849 is absorbed but λ2536 is transmitted. This means that no mercury atoms can now be raised to the $2P$ state, but about the same number can absorb λ2536 and reach the $2p_2$ state. As a result the intensity of the sharp triplet is much reduced, showing that it owed most of its existence to $2P$ mercury atoms. The zinc line λ3075 kept nearly the same intensity, showing that it depended principally on $2p_2$ mercury atoms.

When we illuminate by the hot arc, in which λ2536 is reversed, no mercury atoms will absorb λ2536 and be changed to the $2p_2$ state. However, we have some mercury atoms in the $2P$ state which have absorbed λ1849, and these collide with zinc atoms, causing them to emit the sharp triplet and λ2138. Now if we filter the light from the hot arc through acetic acid, λ1849 is absorbed and we have no excited mercury atoms present. Consequently no zinc lines appear.

There is some evidence that the zinc diffuse triplet requiring 8·48 volts is caused by mercury atoms in the $3d$ state. The discussion of this triplet will be reserved for the full report of this work.

It might be said that the zinc atoms could absorb λ1849 directly without the necessity of the intermediate $2P$ state of mercury. Powers (*Phys. Rev.*, 26, 761-765, 1925) and Kapuscinski (Nature, 116, 170 and 863, 1925) have found such a possible absorption for cadmium. In order to test this possibility, these experiments were repeated with a tube containing pure zinc and practically no mercury vapour. No zinc lines were obtained in any case.

These experiments show, then, that the effect of mercury atoms in the $2P$ state must be considered in the interpretation of the results obtained when any mixture of gases including mercury vapour is illuminated by a quartz mercury arc.

J. G. Winans.

University of Wisconsin,
Madison, Wis., U.S.A., May 24.

Activated Fluorescence and Doppler Effect.

Klein and Rosseland deduced from thermodynamical considerations that an excited atom can, in consequence of a collision, fall into the normal state without emission of radiation (impact of the second kind). A part of the energy that becomes free can be spent in exciting the other atom, giving rise to the phenomenon of the "activated fluorescence" which was found to occur in mixtures of metallic vapours by Franck and his school.

For example, if mercury atoms which are brought into the $2p_2$ state by absorption of the 2537 line (corresponding to a potential of 4·9 volts) collide with atoms of another element possessing a lower resonance potential, the lines of this element are found to be emitted. The excess of energy must be distributed between the two atoms as kinetic energy.

As no direct proof of this latter point, so far as I know, has been given, I have tried to observe the speed acquired by the atoms as a Doppler effect, and I give here a preliminary account of the results, which agree also quantitatively with the theory.

I used a mixture of mercury and sodium vapours, contained in a bulb of fused silica, which was continuously evacuated by a diffusion pump. The mercury was put into a side tube, heated to 120°, so that the pressure of its vapour in the bulb was of the order of 0·5 mm. The bulb contained some sodium, and was heated to 300°-350°. On illuminating with the light of a water-cooled mercury lamp, a visible glow of D light appeared. The D lines were observed with a 40-plate echelon grating, and their breadth was measured with an ocular micrometer. It was found to be, as a mean value of six observations on D_1 and D_2, 0·16 Å.U. The lines were strongly reversed, the central part being absorbed by the sodium vapour before escaping from the bulb.

The breadth to be expected is easy to calculate. The kinetic energy must correspond to the difference $V_2 - V_1$ of the excitation potentials of mercury and sodium, *i.e.* to 4·9 − 2·1 = 2·8 volts; hence, and from the law of the conservation of momentum, we get the equations—

$$m_1v_1 = m_2v_2\,; \quad \frac{m_1v_1^2 + m_2v_2^2}{2} = e(V_2 - V_1),$$

where m_1, v_1 and m_2, v_2 are the respective masses and velocities of the two atoms. The velocity of the sodium atom (which owing to its smaller mass absorbs nearly all the energy) is thus found to be $4{\cdot}3 \times 10^5$. The distribution of the velocities of the excited sodium atoms is uniform as regards the direction in space, but is not a Maxwellian distribution, because the molecules have all the same velocity. Hence it follows that the distribution of the intensity in the broadened line is quite different from that due to the ordinary Doppler effect of thermal agitation; and it is easy to see that our distribution must be a uniform one, with a breadth of the lines $\Delta\lambda = 2\lambda v/c$. Introducing for v the value given above, we obtain $\Delta\lambda = 0{\cdot}17$ Å.U., which agrees with the observed results within the limits of experimental error.

Also the distribution of intensity, so far as could be determined by eye observations, agreed completely with that predicted by the theory. To be sure that the broadening of the lines was due to the expected effect, I observed with the echelon spectroscope the D lines obtained by resonance in a bulb at the same temperature as in the previous research, illuminated with the light of a sodium vacuum lamp; the lines were found to be very narrow.

Franco Rasetti.

Firenze, Istituto Fisico dell' Università,
June 2.

High Frequency or Ironless Induction Furnaces.

In an unsigned article in Nature for May 29, entitled "High Frequency or Ironless Induction Furnaces," the writer suggests that his experiments on the heating of copper cylinders under certain conditions are at variance with the conclusions reached in our paper on this subject.

The statement in question was, ". . . consider the frequency which gives maximal (misquoted as "maximum") heating in several cases." Maximal in respect to what? Constant voltage applied to the inductor (!) or constant inductor current? (as the writer seems to imply). He should have appreciated that neither condition was assumed.

We were considering maximal charge heating under constant power input to the inductor, and it was expressly stated that only inductors satisfying certain conditions were contemplated. The writer's experiments have no relation to the statement in question. Let us examine his experiments more closely.

We believe that the Ajax-Northrup inductor has 1·6 turns/cm., then with 200 amp at 50 cycles, a long cylinder of copper 5 cm. in diameter would absorb approximately 3 watts per cm. length. An elementary calculation indicates that this power would result in a temperature rise of 13° C. in 5 minutes—a temperature rise which might well escape the notice of hand-thermometry.

On the other hand, at 25,000 cycles, the power input would be 67 watts per cm length into cold copper, and this, when account is taken of the large temperature coefficient of resistivity of copper, would in 8 minutes result in a temperature approaching 700° C.

It is important to remember that the resistivity of copper at its melting point is nearly six times its value at room temperature, so that the lowest frequency at which copper could be efficiently melted in 5 cm. diameter cylinders is about 220 cycles per second.

The fact that the charge has finite length will tend to increase the heating at the higher frequencies, and when it is borne in mind that the Ajax-Northrup converter produces damped waves ("containing all frequencies"), it will be realised that no very great precision can be claimed for these calculations. They are, however, more definite than the writer's statement of his inductor current—a statement more likely to satisfy the potential user than the physicist.

Again, regarding the exception which we have taken to Northrup's "fundamental statement" that at high frequency "the resistance of a charge is equal to its reactance," surely it is about time that this remark, which has appeared in technical papers for the last ten years, was laid to rest. Scientifically it is wrong; commercially it does not appear to serve any useful purpose, and even at the risk of being "noteworthy" we must continue to take exception to a "fundamental statement" by any authority when it is fundamentally incorrect. We must repeat that the ratio of resistance to reactance at high frequency is

$$\frac{1}{\sqrt{2\pi}.\mathrm{R}}\sqrt{\frac{\rho}{p}}.$$

N. Ryland Davis.
C. R. Burch.

Research Department,
Metropolitan-Vickers Electrical Co., Ltd.,
Trafford Park, Manchester, June 3

In reply to the communication of Messrs. Burch and Davis, I have to say that:

1. The anonymity of the article was not of my seeking. My name was omitted owing to a misunderstanding.

2. I regret misquoting maximal as maximum. The use of the English equivalent did not, however, alter the meaning of the quotation

3. The last paragraph of their letter evidently arises from some misinterpretation. In my article I pointed out quite legitimately that they took exception to a certain statement of Northrup's but made no comment, favourable or otherwise, concerning their attitude.

4. Implied criticisms concerning the accuracy of my measurements are out of place, since the experiments were intended to show, and did show clearly, that under practical conditions and at frequencies specified by the authors the heating effect on the copper charge was not merely less than some other value, but insignificant.

5. The authors state that only inductors satisfying certain conditions were specified. As it is impossible to construct inductors exactly complying with the theoretical conditions, their arguments are out of reach of rigid experimental verification. On the other hand, they arrive at certain general conclusions from which it can be deduced that an inductor current of, say, 25-50 cycles frequency would be suitable for heating a cold copper charge of 3 cm. radius. I endeavoured to check this conclusion experimentally at 50 cycles, and although a kilowatt was being dissipated in the inductor coil, no serious temperature rise of the charge took place in a period of 5 minutes. The inductor coil was designed for high frequency currents, and from this point of view the conditions were not favourable for the low frequency experiment.

The conclusions of Burch and Davis are so revolutionary, and if capable of practical application are so important, that I hope shortly to repeat the experiment, using an inductor specially designed for low frequencies. Such an experiment should determine if ironless inductive heating at these low frequencies is a practical proposition. Frank Adcock

---

The Drop-weight Method of Measuring Surface Tension.

The letter by Prof. Harkins on the above subject in Nature of May 15 seemed to me to be very interesting. As, however, he has severely criticised my own views on the subject, I have thought it best to make some reply, for it is possible that a misunderstanding has arisen.

The method I adopted for calculating surface tension from the weights of drops of liquid falling from circular tubes is given in the *Philosophical Magazine*, vol. 45, p. 1088, 1923. I would refer any one interested to this paper, as it is quite unnecessary to reproduce any of the details here. The method was based on certain postulates which might replace Tate's laws in the greater accuracy with which they expressed the experimental facts, and which also seemed to lend a certain clarifying expression to the hopeless rigmarole that has been written round the subject for so many years. The fundamental operation in my calculations is certainly *not* taken from Harkins's work. I used certain data of Harkins and Brown (*Jour. Amer. Chem. Soc.*, vol. 41, p. 512, 1919), because at the time they were the most accurate I could find, and I saw no reason for repeating the experimental work unless I could be reasonably sure of a greater accuracy.

Harkins refers to my method as "cumbersome," "indirect," "involved," etc. The calculations could easily be shortened by the compilation of certain tables, but I do not understand why the ordinary mathematical operations of addition and multiplication should be "cumbersome" in my case and not in Prof. Harkins's. I suppose my method may be considered indirect because I have not followed in the tradition of certain formulation from which to the more conventional-minded it would be wrong to depart.

In ignoring the difference in gravity for Chicago and London, I have incurred an error in my results of 1 in 1000. It will be seen from my paper that I have merely given the figures for the surface tension correct to about 1 in 450.

Harkins's ingenious attempt to show that a drop hanging from a circular tube must inevitably satisfy the equation $W = 2\pi r\gamma$ when the radius of the tube becomes extremely small, is not by any means conclusive, and does not seem to be supported by adequate experimental evidence. In any case, it could only be proved by extrapolation from a curve, and we should find ourselves involved in an argument as to whether the surface tension is the same for a thin mass as for the bulk of the liquid in all cases. The truth is that neither Harkins nor any one else has ever given a quite satisfactory solution of the dynamical problem of the drop detachment. His way out of the difficulty seemed to me to be somewhat vague and unsatisfactory; but that is only a point of view, and perhaps may not matter very much.

The main point at issue seems to be whether it is worth while checking any further propaganda on behalf of my method as opposed to Prof. Harkins's; and on this matter, of course, I have nothing to say. But I should be glad if Prof. Harkins would point out where my method is "erroneous," as at the moment I do not know what to make of his extremely general criticism, which occupies nearly two columns of this journal, and to which I can only make an equally indefinite reply. T. IREDALE.

Armstrong College, Newcastle-upon-Tyne.

Cirrus at a Lower Level than Alto-cumulus.

IN his letter to NATURE of February 6, 1926, p. 199, Mr. C. J. P. Cave has directed attention to the fact that well-defined cirrus clouds may occur at a much lower level than we generally assume to them, say, under a sheet of alto-cumulus. To support his view he describes a striking observation similar to that made by me on Sunday, June 13, at Strasbourg. During the morning and early afternoon of that day the weather was rainy and the sky covered with alto-stratus and nimbus. The nimbus ceased about 16.30 (G.M.T.) and the alto-stratus merged gradually into a sheet of fleecy alto-cumulus moving from west-south-west. It had a straight edge separating it from a beautiful clear sky.

At 17.30 I saw at an angular altitude of near 45° to the east-north-east a patch of well-defined white cirrus clouds under the alto-cumulus, and detached from them. As at the same moment many cirriform streaks were developing from alto-cumulus and acquiring the form of *cirrus-uncinus*, I believe the cirrus mentioned above may have been similar streaks afterwards separated from alto-cumulus.

Later, in the clear blue sky, some of these streaks were seen that had lost their *cirrus-uncinus* form. I am sure that if any one had observed the sky only at this moment he would undoubtedly have noted common cirrus, and there is no reason, I suppose, to say that they have not the same structure, as we know that in many cases high cirrus clouds are formed by snowflakes.

It is interesting to note that Mr. Cave's observation and my own were made exactly with the same sky aspect; namely, a sheet of alto-cumulus with a straight edge and cirrus seen under it, near the edge. We are thus led to ask. Is all the low cirrus derived from alto-cumulus, and is it always seen near the edge of the sheet? The cirrus derived from the anvils of cumulo-nimbus seems to be an exception. The general meteorological conditions of the days of the two observations as regards cloudiness were also similar, the clouds being placed at the transition of a "corps" to a "traîne" of a "cloud system," using the modern French nomenclature. On January 24 a low pressure area was above western Scandinavia and another to the south-west of Iceland. These were fast-moving depressions with well-defined warm sectors passing over the British Isles. On June 13 a low-pressure area was situated to the west of Ireland, and it commanded in Europe a circular stream of occlusions.

A revision is desirable of the altitudes assigned by the International Classification to the cloud forms, and also of the definitions of these forms, to take into account the new ideas of the structure and formation of clouds. ANTONIO GIAO.

Geophysical Institute,
38 Boulevard d'Anvers, Strasbourg (France),
June 14.

The Zoological Names *Simia*, *S. satyrus*, and *Pithecus*, and their Possible Suppression.

THE attention of the zoological profession is invited to the fact that the proposition is before the International Commission on Zoological Nomenclature to re-open the case of *Simia*. In its present form the proposition is for the Commission: (*a*) absolutely to suppress the generic names *Simia* and *Pithecus* and the specific name *Simia satyrus*, on the ground that retention of these names and the application of the rules to them will produce greater confusion than uniformity; (*b*) to insert into the Official List of Generic Names, *Chimpansee* Voigt, 1831, 76, for the chimpanzees *Pongo* Lacépède, 1799, type *pygmaeus* 1760, for the orang-utans, and *Macaca* Lacépède, 1799, type *sylvana* 1758, for the Barbary ape.

The argument before the Commission gives an extensive historical review of the subject; this will be published in Bulletin 145, Hygienic Laboratory.

Briefly summarised, the argument maintains: (1) that because of the importance of the Primates in connexion with investigations on infectious diseases, the nomenclature of certain genera has passed far beyond a status in which this subject is of importance only to zoologists in general and to mammalogists in particular; (2) that it is absolutely essential that unambiguous names be adopted internationally for experimental animals used for studies dealing with problems involving the life and death of human beings; (3) that the names *Simia*, *Simia satyrus*, and *Pithecus* are so confused in zoological literature as to preclude hope of reasonable uniformity in their use in zoological, bacteriological, serological, and public health work; (4) that the safest solution is to suppress these names entirely; (5) and that the International Commission should select thoroughly unambiguous and suitable substitutes which will preclude possibility of confusion in interpreting results as reported by bacteriologists and others in different countries—results which deal with human life.

The secretary will delay announcement of final vote until about September 1, 1927, in order to give to zoologists, bacteriologists, and others who may be interested, time to consult the premises formulated in Bulletin 145, and to express their views to the Commission. Application for copies of Bulletin 145, Hygienic Laboratory, should be addressed to the Surgeon-General, U.S. Public Health Service, Washington, D.C. C. W. STILES,
Secretary to Commission.

Hygienic Laboratory, Washington, D.C.

Names for Companion Stars.

I HAVE been expecting to see some comment in NATURE upon Sir Oliver Lodge's suggestion under the above title in the issue of March 13, 1926, but none seems to have appeared. It is not my purpose to dwell upon the propriety of naming so insignificant and dense an object as the companion to Sirius for one whose contributions to science have been so large and brilliant. It is the suggestion regarding the companion to Algol that needs comment. Vogel's contributions to the art of measuring radial velocities put him in the first rank, but they do not include the discovery of the first spectroscopic binary. As this is an error that has often been repeated it may be well to set down the facts.

In his third annual report on the Henry Draper Memorial, published early in 1889 (our copy reached New Haven on April 16), E. C. Pickering states: "One photograph of Zeta Ursæ Majoris shows the K line distinctly double, and others show it single." In the January, 1890, number of the *American Journal of Science*, Pickering has an article dated November 12, 1889, in which he states that the K line in this star occasionally appears double, and he goes on to give what we now know to be the correct explanation, namely, that we are dealing with a binary, both components of which are bright.

At the meeting of the Prussian Academy of Science held on November 28, 1889, Vogel communicated six observations of Algol which show it to be a spectroscopic binary. These observations were first printed in *Astronomische Nachrichten* 2947 (dated January 11, 1890), in an article by Vogel dated December, 1889. Vogel's first observation of this object is dated December 4, 1888, while the duplicity of the lines in the spectrum of Zeta Ursæ Majoris was noted on a plate secured at Harvard on March 29, 1887. We see, therefore, that no matter what criterion is used to fix the epoch of the discovery of the first spectroscopic binary, we must conclude that the first of these objects to be detected was Zeta Ursæ Majoris by Pickering.

The above illustrates a difficulty which will be constantly met if Sir Oliver's suggestion is followed out; we should often be involved in matters of priority if these names are assigned during the lifetimes of the investigators concerned or too soon after their deaths. FRANK SCHLESINGER.

Yale University Observatory,
June 4.

Energy Levels of the Carbon Monoxide Molecule.

IN their communication under this title in NATURE of July 3, p. 12, Messrs. Duffendack and Fox make a suggestion in connexion with the scheme of electronic energy levels of neutral carbon monoxide which I recorded in a recent letter. It is briefly, that there are two sets of levels involved corresponding to triplet and singlet terms in the corresponding atom. I would like to say that this and other suggestions were made to me by Prof. Birge and Dr. Mulliken in private communications some three months ago, but too late for publication in my letter. It is clear that the whole scheme of levels can be interpreted on Birge's views, which are outlined in his important letter on "The Structure of Molecules" (NATURE, Feb. 27, 1926). The common ground level is $1S$ The initial levels of the 4th positive and the Ångstrom bands are respectively $1P$ and $2S$. The initial level of the Cameron bands is the triplet $1p_{123}$, and of the third positive bands is $1s$, while the new level which Duffendack and Fox postulate is probably $2p_{123}$. All the above levels have their counterpart in the corresponding magnesium atom, and the inferences which may be drawn therefrom account for all the facts.

The $3A$ positive bands of Duffendack and Fox are clearly the bands which I interpreted as an $n' = 4$ sequence. The interpretation as arising from a $2p_{123}$ level is, however, preferable for two reasons: it avoids the anomalous intensity distribution in which the states $n' = 2$ and 3 are absent, and secondly, the existence only of the states $n' = 0$ and 1 is in harmony with recent work of Birge and Sponer on the heat of dissociation of the molecule. It may perhaps be added that not only are s to s transitions possible in band spectra but so also are p to p transitions (*e.g.* the $3A$ bands of carbon monoxide).

R. C. JOHNSON.

Department of Physics,
Queen's University of Belfast.

The Physical Basis of Insect Drift.

THE letter of Dr. E. P. Felt (NATURE, May 29, p. 755) illustrates how difficult it is in these days for the student of one science to keep in touch with developments in other sciences, developments which may have a considerable bearing on his own subject. We know all too little about the conditions in the upper air, but we know more than "the extremely few observations made by airmen in balloons, dirigibles, or aeroplanes." If Dr. Felt were to get in touch with the Weather Bureau at Washington, or with the Blue Hill Observatory, he would probably be able to obtain data which would be of great value in connexion with the question of insect drift. Observations of wind in the upper air are made as a matter of routine in many places in the northern hemisphere, and in some in the southern, so that there should be plenty of material to work on.

No doubt winds in the upper air have a great deal to do with the dispersal of insects, and convection currents occur at times up to much greater heights than those mentioned by Dr. Felt. At the same time there may be other factors besides wind; it is not easy to see how the extraordinary migrations of *Vanessa cardui* in Europe can be explained on purely meteorological lines unless other insects are similarly affected, which, so far as I know, is not the case. No doubt the appearance of *Colias edusa* in England from time to time might be explained by meteorological considerations, but if so a "clouded yellow year" should be a year when other continental forms appear here. There is evidently scope for a considerable amount of team work between meteorologists and entomologists. C. J. P. CAVE.

Stoner Hill, Petersfield,
June 17.

Abnormal Venous Circulation in a Frog.

ONE of our senior boys here, Alan Cadbury, when dissecting a frog, directed my attention to the fact that the right anterior vena cava appeared to be completely missing. Closer examination proved this to be actually the case. In order to return the blood from the right anterior region of the body to the heart, a commissural vessel had been established connecting the bases of the external jugular vein of the two sides, the venous blood from the entire anterior region of the body thus finding its way back to the sinus venosus through the left anterior vena cava. The specimen was a well-grown male.

In a communication to NATURE of April 25, 1925, Dr. N. B. Eales has directed attention to variations occurring in the distribution of the anterior abdominal vein of the frog and remarked on their evolutional significance. No such significance can be plausibly attached to the present case, but the anomaly seems rare enough to be worth recording. The anterior abdominal vein opened into the liver as usual.

F. W. FLATTELY.

Leighton Park School,
Reading, June 10.

Oxidation, Passivity, and Corrosion.[1]

By Ulick R. Evans.

When a clean surface of metal is heated gently in air, a fine series of colours is often produced, the sequence of tints being that which would be expected from optical principles. In the case of lead, four 'orders' of tints can be observed: red, for example, occurs four times in the sequence. The transparent oxide film which is responsible for the effect can be lifted from the lead, and it is found that for any given film the colour as seen by reflected light is complementary to that seen by transmitted light. On copper and iron the sequence is essentially the same as on lead, but the fourth-order tints (corresponding to fairly thick films) cannot be seen; indeed on iron—no doubt owing to the low transparency of the oxide—only the first-order colours are really bright, although, if the oxidation is carefully carried out, the sequence can easily be followed as far as the third-order red.

It is important to notice that absolutely no change in the appearance of the iron occurs until the first yellow 'temper tint' arrives; this appears quickly at high temperatures, more slowly at lower temperatures. At ordinary temperatures iron can be kept in dry air indefinitely without undergoing visible change. It is generally considered that an oxide film is produced; but that, since diffusion of oxygen through an oxide is very slow at low temperatures, the film becomes protective, and ceases to thicken further, before it reaches the thickness needed to give the first (yellow) temper colour.

This view is supported by some experiments on the changes produced by oxygen on the chemical behaviour of electrolytic iron. The iron was very kindly prepared for me by Dr. W. H. Hatfield; it was fused *in vacuo* in a magnesia crucible before being rolled into sheet. When freshly ground, the iron was found to be capable of precipitating copper from $N/10$ copper nitrate solution within a few seconds. But after exposure for 21 hours to dry air or oxygen (freed from carbon dioxide) it was found to lose its activity, and drops of the copper nitrate solution then produced no effect even after standing on the surface for many hours. In other experiments, strips of the iron, freshly ground, were subjected to a temperature gradient in air or oxygen, so as to give a film of gradually increasing thickness, ranging at one end from thicknesses too small to give temper colours, through intermediate thicknesses displaying the three orders of tints, up to considerable thicknesses at the other end, where the scale had the slaty-grey appearance characteristic of magnetite.

On testing the films with small drops of copper nitrate, it was found that only a limited range of thicknesses afforded protection; this range was situated in the invisible region, and extended almost—but not quite—to the place where the first yellow tint commenced. At points near to the unheated end of the specimen, where the film was too thin to give protection, general deposition of copper quickly occurred. Near the heated end where the film was visible the protection also failed, but in a different way. Deposition of copper commenced at certain isolated points or lines, and spread out from these places over the oxidised surface. This copper was certainly deposited on the *outside* of the oxide film, since when the copper was afterwards dissolved away with ammonia the oxide film reappeared. The points around which deposition occurred almost certainly represented pores or cracks in the oxide scale; indeed, in the thicker scale, the cracks were sometimes visible. At a crack, the exposed iron would act as the anode of a local cell and the oxide around as cathode, copper being deposited on the latter without destroying it.

The behaviour of the part of the strips showing temper colours is of some interest. A short immersion in copper nitrate solution causes the tints to become dull, owing to the deposition of metallic copper upon the film (the colour of this copper can be seen if the specimen is held at a suitable angle); at the same time, the tints shift in a direction which would seem to indicate a thickening of the film at each point. If, at this stage, the copper is dissolved away with ammonia, the colours re-emerge with practically undiminished brightness. If, on the other hand, the strip is kept in the copper nitrate solution until the colours are completely hidden by a thick deposit of pink copper, the colours, when the copper is dissolved away by ammonia, reappear distinctly weaker than before.

Analogous results are obtained when copper strips, covered with an oxide-film of varying thickness, are treated with dilute silver nitrate, although on copper the protective power of an oxide skin is much less permanent than in the case of iron. The maximum resistance is again situated in the invisible region, but the films thick enough to give first-order tints resist the reagent for almost as long a time. As in the case of iron, the thick films fail in quite a different manner from the very thin films; on the thick films tiny isolated crystals of shining silver appear, no doubt at the sites of pores, whilst where the film is very thin general deposition of darker silver occurs.

Both on iron and copper the behaviour of the oxide-film in protecting the metal varies *gradually* as the thickness is increased: there is no sharp change at the point where the first visible tint appears. This observation has a bearing on the cause of the 'passivity' displayed by iron which has been treated with oxidising agents. Some authorities have maintained that this cannot be due to a protective film, basing their argument on the facts (1) that no film is visible on passive iron, and (2) that iron covered with a visible film is not, as a rule, passive. These particular objections to the oxide film theory would seem to possess but little weight. The poor protection afforded by relatively thick visible films is almost certainly due to the increase in the probability of spontaneous cracking which accompanies an increase in thickness. Clearly, however, the conditions of formation of the film greatly affect the protective character; some oxidising agents, for example, seem to give more reliable films than oxygen itself. It is, of course, possible that other causes besides the presence of a film on the iron might give rise to the phenomenon known as passivity; but all the cases so far examined by the present writer appear to be due to protective films.

---

[1] Based on two lectures on the "Tinting, Tarnishing, and Corrosion of Metals," delivered at the Royal Institution on May 20 and 27.

It is well known that solutions of oxidising agents, such as chromates, render iron passive towards copper salts. In the case of electrolytic iron this passivity can also be brought about by dissolved oxygen, provided that it is present in sufficient quantity at all points on the surface. Since oxygen is not very soluble in water, some special arrangement is needed to ensure the oxygen supply to the point where the specimen is supported. This can be attained by using the "eccentric whirler" recently described by the writer[2]; the specimen, consisting of a metal disc pierced centrally with a circular hole, is slipped over a glass tube blown to bulb-form at the lower end, and attached eccentrically on a vertical spindle, which can be driven by a motor. When the spindle rotates, the whirling disc mounts the tube and the point of contact with the glass alters from one moment to the next; thus there is no fear of oxygen exhaustion at the point of support. If a disc of mild steel is thus 'whirled' in distilled water containing oxygen, it soon attains a yellow appearance, due to the formation of adherent ferric hydroxide over the surface generally;[3] if taken out after 100 minutes, dried and tested with copper nitrate, the iron is found to blacken within a few seconds. When, however, the experiment is repeated with electrolytic iron, quite different results are obtained. It is found that this material develops rust only in minute spots, between which the metal remains bright; the spots probably represents the sites of pores in the metal into which oxygen cannot rapidly penetrate; only a trace of iron passes into solution. If the specimen is taken out after 100 minutes 'whirling,' the iron is found to be quite passive towards copper nitrate. Some specimens of electrolytic iron have been found to remain free from rust altogether when whirled for many hours in water containing oxygen, probably because they were free from pores.

It should be understood that the comparatively non-rusting behaviour of electrolytic iron only refers to conditions of *uniform aeration*. If the same iron is exposed in the same water under conditions of *differential aeration*, rusting occurs readily. Thus if a strip of electrolytic iron be partly immersed in a nearly vertical position in the water, so that oxygen reaches the upper part more easily than the lower part, corrosion quickly commences; it is plainly visible after 30 minutes. Iron passes into solution at the points where the oxygen-concentration is lowest as the comparatively soluble ferrous hydroxide, and although this will ultimately be oxidised to the much less soluble ferric hydroxide (the main component of 'rust'), the ferric hydroxide, being formed as a secondary product at an appreciable distance from the seat of origin of the ferrous hydroxide, does not form a continuous film over the metal and has no protective character.

The setting up of corrosion by differential aeration is well shown by experiments on the behaviour of steel in contact with sodium chloride solution. When a drop of salt-water is placed on a sheet of mild steel, corrosion occurs in the centre of the drop; the peripheral portion of the drop—the part which oxygen can reach most readily—remains quite uncorroded. Similarly, if a strip of steel be partly immersed in sodium chloride solution, corrosion occurs over the portions well below the surface; just below the water-line there is a zone of quite uncorroded metal.

Experiments have shown that the corrosion is connected with electrical currents set up by the variation in oxygen concentration; the portion where the oxygen concentration is lowest functions as the anode, or corrodible portion. These currents only flow if oxygen is supplied continuously to the cathodic area, but they produce corrosion upon the part which is not directly reached by the oxygen. The mechanism would appear to be as follows. Oxygen reaches the portion next to the water-line and causes a kind of passivity. The potential is raised above that of the lower, relatively unaerated, portions, and this determines the flow of current; measurements by McAulay and Bowden[4] have shown that the potential over the aerated zone may become so much as 0·2 volt 'nobler' than that of the unaerated zone. The unaerated portion suffers anodic corrosion yielding ferrous chloride, whilst at the aerated portion the cathodic reaction produces sodium hydroxide; along the line where the ferrous chloride and sodium hydroxide meet, we get white ferrous hydroxide, rapidly oxidising through the green intermediate body, to brown ferric hydroxide, and thus a membrane of rust is produced at the junction of the anodic and cathodic regions. Thus the *direct* effect of oxygen is to produce a species of *passivity* at the points actually reached by it; but the *indirect* effect is to cause *corrosion* at the points not reached directly.

The corrosion set up by these differential aeration currents becomes most serious when the unaerated anodic area is much smaller than the aerated cathodic area, since then the whole effect is concentrated on a limited surface, and the rate of penetration downwards will be quite rapid. If a minute cavity exists in the metal and becomes filled with liquid, this will be relatively inaccessible to diffusing oxygen, and will therefore become anodic to the main portion of the surface; the attack will here quickly eat down into the metal, causing 'pitting.' The mouth of the pit will become covered with a loose hump or blister of rust, due to interaction of the anodic and cathodic products, but since this rust is not formed *in situ* at the anodic area, it will not protect the metal from corrosion; on the contrary, by shielding the interior of the pit from oxygen, it will, for a time, tend to promote the attack. Thus, when once pitting has commenced, it is difficult to stop it.

Differential aeration currents probably constitute the most serious practical cause of corrosion of zinc, iron, steel, lead, and aluminium articles. But electric currents set up in any other way will cause corrosion, provided that the immediate anodic and cathodic products are soluble bodies; where—as in the case of lead in a sulphate solution—the direct anodic product would be an insoluble compound, there is comparatively little attack.

Numerous other ways of generating these corrosion currents are known. In the case of copper, if water is moving rapidly over the surface at one place and is comparatively stagnant elsewhere, the copper ions will be carried away more quickly from the point of rapid motion than from the rest of the surface, and therefore a concentration cell is set up; the point of rapid motion is anodic and suffers corrosion. Where a material consists of two phases, a current may flow between these two phases, even when the composition of the liquid is the same everywhere. This is possibly the reason why—as mentioned above—a steel disc suffers alteration even under conditions of uniform aeration; for though—by whirling—we may diminish or even eliminate differential aeration currents, we can still get currents set up between the iron and carbide particles of the steel. Owing to the fact that under conditions of whirling the individual anodic and cathodic areas are of microscopic, instead of macroscopic, size, the hydroxide is precipitated close to the surface, and tends to cling to it. Thus the rust produced under these conditions of uniform aeration is far more adherent than that produced by differential aeration.

---

[2] American Chemical Society Corrosion Symposium, 1925. See *Ind. Eng. Chem.*, 17, 1925, 370.

[3] This yellow colour is due to the characteristic tint of ferric hydroxide, and in no way resembles the yellow temper colour.

[4] *J. Chem. Soc.*, 127, 1925, 2605.

Climatic Changes during Geological Times.[1]

By C. E. P. Brooks.

II. Causes of Geological Changes of Climate.

THE preceding article closed with a discussion of Wegener's theory of continental drift. That theory is still *sub judice*, but it was pointed out that even if it be ultimately accepted, it does not solve the problem of climatic changes. Köppen and Wegener themselves recognise this, for they adopt astronomical changes as an explanation of glacial and interglacial stages, and suggest also that astronomical changes may have been important in the Tertiary succession of Europe. Apart from this, however, any one looking at Wegener's reconstructions and remembering the way in which the land and sea distribution at the present day dominates the local distribution of climate, cannot but realise that these extensive rearrangements must have brought about corresponding changes of climate, quite apart from those due to the supposed changes of latitude. Köppen and Wegener implicitly assume that the distribution of climate depends only on the distribution of solar heat at the outer limit of the earth's atmosphere, but even if the radiation from the sun be supposed to have remained constant, there are many factors of climate other than the astronomical conditions. These factors have been discussed in a large number of books and papers which include some very brilliant work. This great mass of literature is surely worth a thought.

In the middle decades of the nineteenth century, when radio-activity had not been discovered and pre-Quaternary glaciations were a heresy, the earth was believed to be cooling from an original molten state and the uniform warmth of the earlier geological periods was attributed to this earth-heat. In this scheme of things the Quaternary glaciation—"The Great Ice-Age"—marked the gap between the waning of earth-heat and the assumption of full control by the sun. This primitive view is no longer tenable, but still it occasionally crops up, as in the ingenious speculations of Marsden Manson, who supposes that the internal heat maintained the oceans at a high temperature, thus giving rise to a dense mantle of cloud which shut out the heat of the sun. The earlier ice-ages were due to local cooling in the centres of the great continents, the Quaternary to the final cooling of the seas, while the introduction of the present zonal distribution occurred when the last remnants of the universal cloud layer broke down.

Another early theory of climatic changes, variations in the heat received from the sun, perished from lack of evidence. Dubois attempted to bolster up his hypothesis that during the Quaternary glaciation the sun was a red star by arguments from colour blindness regarded as an ancestral trait belonging to the time when the earth was bathed in a perpetual sunset glow. Other views attributed the Quaternary ice-age to the shutting out of the sun's heat by a cloud of cosmic dust, and one ingenious theory gives us an ice-age for the birth of each planet between the earth and the sun. Recently Huntington and Visher[2] have attempted to revive the theory of solar control. Starting from the accepted view that the earth is slightly warmer at minima of the eleven-year sunspot period than at maxima, and the controversial view that storminess increases from minima to maxima of sunspots, they suppose that the warm periods were times of few sunspots and the ice-ages times of many sunspots. Such an enormous extrapolation from a small and imperfectly understood basis would not be warranted unless supported by convincing evidence. At present we know nothing of the variations of solar activity during the geological past, and even if the variations which Huntington and Visher postulate have actually occurred, it is improbable that they would have the results which are attributed to them.

Whatever may be the case with the total radiation received by the earth in a year, there can be no doubt that its distribution in seasons and latitudes has varied greatly with changes in the obliquity of the ecliptic and in the eccentricity of the earth's orbit. The idea that these changes were responsible for geological changes of climate is very old, but it was not until the appearance of Croll's brilliant essay, "Climate and Time," that they won general respect. Croll supposed that the most favourable conditions for glaciation occurred during times of great eccentricity, and were located in the hemisphere with winter in aphelion, the short hot summer being insufficient to melt the accumulated snowfall of the long cold winter. Murphy first pointed out that the reverse was more likely to be true, and subsequent research has confirmed Murphy's view. Although the total quantity of heat received over a whole hemisphere in a year is not affected by astronomical changes, this is not true of individual belts of latitude, and in high latitudes more heat is received in the course of a year when summer falls in perihelion than when summer falls in aphelion. Moreover, the summer conditions are of greater importance for glaciation than are the winter conditions.

---

[1] Continued from p. 17.

[2] Huntington, Ellsworth, and Visher, S. S., "Climatic Changes: their Nature and Cause." New Haven, 1922.

This astronomical theory of climatic changes has to face two great difficulties. First, it requires glaciation to alternate in the northern and southern hemispheres, while geologists believe that glacial stages have been synchronous over the whole world; and secondly, the astronomical time-scale is incompatible with the geological time-scale as set out in the absolute chronology of de Geer. Recently, means have been found to overcome the first of these difficulties; thus R. Spitaler,[3] after an elaborate computation of the temperature of land and sea in different latitudes under a great variety of astronomical conditions, considers that each stage of the Quaternary ice-age represents a time of maximum eccentricity covering several precession periods of 21,000 years each, the ice-sheets advancing when aphelion fell in spring or summer and retreating when aphelion fell in autumn or winter, but being able to persist through the whole stage owing to the general cooling of the oceans. Spitaler's scheme, however, requires much more time than the geologists will allow. W. Köppen[4] attributes a similar persistence to the cooling introduced by the ice-sheets themselves; on the basis of calculations by M. Milankovitch, in which the heat received in summer is regarded as the essential variable, he achieves a more moderate time-scale, which, however, still presents several difficulties. Thus Spitaler and Köppen make the main glacial stages synchronous in each hemisphere, but with secondary maxima at different times. The astronomical theory has this in its favour, that we can be reasonably certain that the postulated astronomical changes have occurred. But if they were of such dominant importance during the Quaternary, it is curious that they have not been recognised in the climatic alternations of earlier geological periods—for example, there should have been several ice-ages at intervals during the Tertiary. If until the Quaternary they were masked by much greater effects due to non-astronomical factors, why not attribute the Ice-Age itself to the latter also?

The interval between the founding of the astronomical theory by Croll and its recent revival has witnessed the birth and death of the carbon dioxide theory, introduced by Arrhenius[5] in 1896 and taken up by F. Frech, T. C. Chamberlin and others. The theory is that carbon dioxide acts like the glass of a greenhouse, allowing the sun's rays to reach the earth's surface almost unchanged, but absorbing the greater part of the return long-wave terrestrial radiation. Subsequent research has shown, however, that water-vapour has exactly the same properties, and that there is always sufficient water-vapour present to absorb practically all the radiation which would be taken up by carbon dioxide, so that the latter can play only a very minor rôle.

Chamberlin introduced another remarkable conception—the reversal of the oceanic circulation.[6] Ocean currents are due to three causes, differences of temperature in different parts of the surface, differences of salinity, and the action of the wind on the surface layers. At present the latter cause predominates, the warm surface waters of the tropical oceans being driven westwards and then polewards by the prevailing winds. Chamberlin supposed that at times the evaporation in the inter-tropical regions was so great that the surface layers, owing to their increased salinity, became heavy enough to sink to the bottom, where their heat was conserved as they spread polewards, until they emerged in high latitudes and brought about mild polar climates. The chief objection to this is that great evaporation implies also heavy rainfall, while the periods in which the mild polar climates prevailed are marked by aridity in middle latitudes.

Somewhat less sensational variations in the system of ocean currents have frequently been adduced as causes of climatic change. The remarkable difference of climate between the British Isles and Labrador is usually attributed to the fact that the former are washed by the warm Gulf Stream Drift, the latter by the cold Labrador Current, and it has been supposed that the opening of a gap between North and South America, by allowing the warm water of the Guiana Current to pass through into the Pacific, caused the Quaternary ice-age in Europe. This particular conclusion is not warranted by the premises, but from the great differences of climate which can exist between places along the same parallel of latitude, it is obvious that the redistribution of land and sea may account for considerable changes of climate. This was the view of Lyell, who attributed the Quaternary ice-age to an expansion of the tropical oceans, from which much water was evaporated, and in high latitudes an extension of the land areas, on which the water-vapour fell as snow. Similarly, W. Ramsay[7] has insisted on the importance of high ground in lowering the temperature, not only locally but also over the whole world. Such ideas must remain speculative, however, until they have been supported by an adequate numerical basis.

F. Kerner has done more than any one else to calculate what effect a given change of land and sea distribution would have on the local and general temperatures; his results show that geographical changes go a long way towards accounting for the climatic vicissitudes of Europe during the Tertiary,[8] but he failed to account for the mild Arctic climates of the Jurassic and Eocene, his calculated January temperatures for the 75th parallel being nowhere above the freezing-point.[9] One of Kerner's papers, however,[9] contains a suggestion of what may ultimately prove to be the most important factor in climatic changes, namely, the cooling power of an ice-covered polar ocean. Brooks had previously shown a similar cooling power of land ice; when an ice-sheet reaches certain dimensions, the cold ice-winds bring the neighbouring land below the snow line, and the process continually repeated enables the ice-sheet to grow to very large dimensions. Calculations show that the extension of the Scandinavian ice to England, and the rapid collapse of the ice-sheets at the close of the Quaternary glaciation, are accounted for by this effect. A floating polar ice-cap can be dealt with in the same way; at the close of a warm period the ocean will remain entirely free of ice until the temperature falls to freezing-point in winter. A small further fall, and a floating ice-cap will spread over the whole of the polar ocean. Kerner's and Brooks's calculations indicate that a general rise of temperature by 5° F. persisting over many years would suffice to render the whole Arctic Ocean non-glacial, a change which would reverberate over the whole globe.

---

[3] Spitaler, Rudolf, "Das Klima des Eiszeitalters." Prag, 1921. (Lithographed)

[4] Koppen, W., und Wegener, A., "Die Klimate der geologischen Vorzeit." Berlin, 1924.

[5] Arrhenius, Svante, "On the Influence of the Carbonic Acid in the Air upon the Temperature of the Ground," *Phil. Mag.*, 41, 1896, p. 237.

[6] Chamberlin, T. C., "On a Possible Reversal of the Deep Sea Circulation and its Influence on Geologic Climates," *Jour. Geol.*, 14, 1906, p. 363.

[7] Ramsay, W., "Orogenesis und Klima," *Öfvers Finska Vetensk. Soc. Förh.*, 52, 1910. "The Probable Solution of the Climate Problem in Geology," *Geol. Mag.*, 61, 1924, p. 152.

[8] Kerner, F. "Synthese der morphogenen Winterklimate Europas zur Tertiärzeit." Wien, 1913.

[9] Kerner, F., "Das akryogene Seeklima und seine Bedeutung für geologischen Probleme der Arktis." Wien, *Sitzungsber. Ak. Wiss.*, 131, 1922, p. 153.

This idea entirely alters the scale of the problem. Many factors which are inadequate to account for the temperature change of some 40° F. in the polar and cold temperate regions between an ice-age and a warm period may easily account for a change of 10° F., the remaining 30° being due to the cooling power of land ice and sea ice. Only two types of climate are possible, the 'non-glacial' or warm and the 'glacial' or cold. The transition from one to the other may be due to any of the climatic factors which have been so ardently advocated, but the close association between cold climates and mountain-building suggests the dominance of geographical causes. After a major orogenic period the continents are high and extensive, the ocean currents are restricted, and perhaps volcanoes send out large quantities of dust to interfere with the free passage of the sun's rays; all these causes, combined perhaps with unfavourable astronomical conditions, lower the amount of heat reaching high latitudes, so that the temperature of the polar oceans falls below the freezing-point in winter and a floating ice-cap is formed. After a long period of rest and erosion, the continents are low and small, there is a free oceanic circulation, and volcanoes are unknown; so much heat reaches high latitudes that the polar oceans are above the freezing-point even in winter, and there is no ice.

What of the Upper Carboniferous glaciation of the tropics? The geographical theory can be indicated only briefly; it postulates a high plateau, with a cold ocean to the south, a warm ocean to the north, and a permanent 'south-west monsoon' blowing from the former to the latter, covering the plateau with a dense layer of low cloud which with the assistance of a volcanic dust veil reflected a large proportion of the sun's rays back to space and kept the temperature low enough for snow to fall abundantly above a level of about 6000 feet, giving rise to ice-sheets which reached the sea. Whether the difficulties which confront this theory are greater than those confronting the theory of continental drift which is its only alternative, time will show.

Recent Developments in the University of Sheffield.

On July 1 and 2 the University of Sheffield celebrated the twenty-first anniversary of the granting of its charter of incorporation. Congratulatory addresses were presented by sister universities throughout Great Britain and the Dominions, scientific and other institutions and societies, and public bodies. Among the recipients of honorary degrees may be mentioned H.R.H. Princess Mary, Lord Derby, Sir Austen Chamberlain, Sir Charles Eliot, Prof. P F. Frankland, and Engineer Vice-Admiral Sir Robert B. Dixon. New engineering and metallurgical laboratories were formally opened by Sir Robert Hadfield, and the numerous delegates and other visitors were afforded an opportunity of acquainting themselves with the work of the various departments.

The University of Sheffield received its charter twenty-one years ago, but the history of the institutions out of which it grew goes back much further. The Technical School, the germ of the present Applied Science Department, was founded in 1886; Firth College, from which the faculties of arts and pure science took their origin, dates from 1879; while the Medical School will be able to celebrate its centenary in 1928. These three institutions united in 1897 to form the University College of Sheffield, which received full university status in 1905. The history of the University during the past twenty-one years has been one of almost unbroken progress in every direction. The numbers of its students and staff have greatly increased, especially since the War; the amount of research work carried on within its walls has grown steadily; new departments and courses have been established as the need for them arose and the resources of the University permitted; and generous financial support has been received from private and public sources. Though a complete survey of recent progress is not possible here, a few notes on the main lines of development may perhaps be not without interest.

The most rapid and extensive progress in recent years has taken place in the Department of Applied Science, which includes the faculties of engineering and metallurgy, and a number of associated departments. Expansion in these branches has been made possible largely by the growing recognition in industrial circles of the importance of technical training and scientific research. Thanks to the generous support of leading Sheffield industrialists, the departments of the faculty of engineering have been able to make several important additions to their resources. The Edgar Allen and Jonas Research Laboratories, opened in 1923, are designed respectively for research in magnetism, magnetic properties of materials, and allied subjects, and for investigations on the mechanical properties of materials. Further provision for research in this latter subject has been made in the new laboratory opened by Sir Robert Hadfield on July 2, which is being used at present for work on the effects of high temperatures, heat treatments and repetition stresses, but can be adapted, as the need arises, for the investigation of many other engineering problems. All these new laboratories are equipped with the most modern machines and apparatus, constructed in many cases in the engineering workshops.

One of the most important post-War developments is the establishment, in association with the faculty of engineering, of a Department of Fuel Technology. This is essentially a research department, and the majority of its students are honours graduates in chemistry. It co-operates closely with the mining and metallurgical departments, and has entered into a working arrangement with the Safety in Mines Research Board and the Fuel Research Board, whereby the facilities for research work at the disposal of each body are shared mutually, and the respective staffs engage in conjoint work. Among the subjects that have particularly engaged the attention of the department have been the properties and production of blast-furnace coke, the constitution and properties of coal, and problems of gaseous combustion.

The Mining Department, an integral part of the faculty of engineering, has also made rapid progress, especially on the research side of its work, which has dealt chiefly with flame-proof electrical apparatus, coal-cutter steels, winding and haulage ropes, and mine ventilation. The Department has co-operated with the Safety in Mines Research Board and with the mining industry of the surrounding area. Its work has grown to such an extent that the present accommodation is inadequate, and a scheme is in hand for the erection in the near future of an entirely new mining department.

No account of the progress made in applied science would be complete without a reference to the Department of Glass Technology, which is equipped with a complete glass works, and laboratories in which a large body of research has been carried out. In connexion with the Department there has been formed the Society of Glass Technology, with a membership of about 650, distributed through twenty-two countries.

The faculty of metallurgy has existed separately since 1917, but the subject has played a leading part in the activities of the Applied Science Department since its earliest days. Owing to the nature of the chief industries of Sheffield, the needs of which it was originally created to serve, the faculty chiefly concentrates on the metallurgy of iron and steel, and it is now the best equipped in the country for work in this sphere. Recently, in response to the growing interest in scientific research among the lighter industries of the city, increasing provision has been made for non-ferrous metallurgy. A notable feature of the activities of the Department is the close association of practical training with theoretical instruction. Its equipment includes a complete steel works, fitted with plant of sufficient capacity to produce open-hearth, crucible and electric steels for the use of both the Metallurgical and Engineering Departments. Recent developments include the provision of a new laboratory designed specially for post-graduate research work on the physical properties of steel, and the institution, with the aid of a grant from the Department of Scientific and Industrial Research, of research work on electrodeposition, which will be of great importance to the Sheffield plating trades. Other Government departments and research associations maintain research workers in the metallurgical laboratories.

Though the rapid expansion of the Applied Science Department has been a notable feature of the recent history of the University, considerable development in other directions can be recorded. There has been a great increase in both teaching and research work in the faculty of pure science. Chemistry has had to extend its laboratory accommodation by the erection of a large hut in the quadrangle, and there has been a steady output of research, carried out largely with the aid of students, which has been concerned mainly with investigations on the reactivity of substituents in the benzene nucleus, the remarkable isomerism of diphenyl derivatives, and adsorption by porous bodies. Physics also has been compelled to provide for its enlarged teaching work by the erection of a hut, and has further acquired four new research rooms. The research work carried out in the Department has followed the line, laid down originally by Emeritus Prof. W. M. Hicks, of specialisation in spectroscopy, and a very considerable equipment in this branch of physical study has been gathered together.

In the faculty of medicine three recent developments are worthy of notice. There have been, in the first place, changes in the curriculum and organisation of the faculty, with the object of bringing both its teaching and research work into closer contact with the city hospitals. Anatomy and physiology, formerly taken for the second M.B., Ch.B. examination, have been extended into the third M.B., Ch.B. course, and thus, during the third and part of the fourth year, theoretical work in these subjects is carried on simultaneously with clinical training. A series of posts in physiology and pathology, the holders of which work both in the University and in the hospitals, has been created. An important part in linking up the teaching work of the University with the clinical part of the medical course is played by the Department of Pharmacology, established in 1921, which has devoted itself to extensive investigations on subjects of combined laboratory and clinical interest. In addition to the accommodation at the University, the Department possesses a field laboratory in the country, specially created for experimental work on nutritional and other problems. The opportunities for medical research provided in the Department have resulted in a large output of work, including amongst other subjects the etiology and treatment of rickets, the factors of diet and environment responsible for the structure of the teeth, conditions controlling the rate of development of caries in children, the treatment of exophthalmic goitre, the action of alcohol and the toxic action of cereals. The third line of development in the medical work of the University has been the re-establishment of the dental school, in connexion with which new laboratories, provided with the most modern equipment for the teaching of dental mechanics, have been opened. A complete course of instruction for degrees and diplomas in dental science has been arranged, and hospital accommodation for clinical work is provided.

The foregoing notes, though they mention only the most important developments of recent years, show that Sheffield has taken its place side by side with the other universities of Great Britain, as an institution actively engaged both in the propagation and in the expansion of knowledge. The main lines of expansion which it is destined to follow are laid down, and further progress may confidently be expected as funds become available.

News and Views.

The King's birthday honours list, publication of which was delayed on account of the General Strike, was issued on July 3. It includes the following distinctions conferred in recognition of scientific services or association with scientific work :—*Privy Councillor*: Sir Halford Mackinder—chairman of the Imperial Shipping and Imperial Economic Committees and first Principal of University College, Reading, now the University of Reading. *K.B.E.*: Sir Frank W. Dyson, Astronomer Royal; Prof. W. Somerville, late Sibthorpian professor of rural economy, University of Oxford. *D.B.E.*: Dr. Mary A. D. Scharlieb, consulting gynæcologist, Royal Free Hospital. *Knights*: Colonel H. G. Lyons, Director and Secretary of the Science Museum; Dr. Brajendra Nath Seal, Vice-Chancellor of the University of Mysore. *C.B.* (*Civil Division*): Dr. G. C. Simpson, Director of the Meteorological Office; Mr. F. E. Smith, Director of Scientific Research, Admiralty. *C.M.G.*: Dr. A. W. Hill, Director, Royal Botanic Gardens, Kew; Mr. J. O. Shircore, Director of Medical and Sanitary Services, Tanganyika Territory. *C.B.E.*: Mr. A. Abbott, Chief Inspector of Technical and Continuation Schools, Board of Education. *O.B.E.*: Mr. E. W. Wallis, secretary of the Royal Sanitary Institute. *I.S.O.*: Mr. D. d'E. de Charmoy, Assistant Director and Entomologist, Agricultural Department, Mauritius; Mr. A. R. Wright, assistant comptroller, Patent Office.

The Commonwealth House of Representatives has passed two Bills dealing with the reconstitution of the Institute of Science and Industry. The Bills received the hearty approval of members on all sides of the House, the sole complaint from the Opposition (Labour) being that their introduction had been unduly delayed. The first Bill outlines the scheme of reorganisation, which abolishes the former directorship and provides for a central council composed of three members appointed by the Governor-General (who will constitute an executive committee and exercise all the powers of the council between meetings), the chairman of the six State advisory committees, and such other members as the council may desire to co-opt on account of special scientific knowledge. A sum of 250,000*l*. is appropriated for the purposes of the council, and this will ensure that for the first few years its programme will not be subject to yearly modification to accord with the exigencies of the Treasury. The name "Institute of Science and Industry" has been discarded, and the body will in future be known as the "Council for Scientific and Industrial Research," which is more in accord with British and Canadian practice. The second Bill establishes a Trust Fund of 100,000*l*., the income from which is to provide assistance (*a*) to persons engaged in scientific research, and (*b*) in the training of students in scientific research. Considerable progress has already been made by the executive committee in the preparation of proposals for the first session of the new council, which will commence on June 22. It is hoped to establish very close relations with the British Department for Scientific and Industrial Research, and to that end the chairman of the executive committee (Mr. G. A. Julius) will visit Britain towards the end of this year.

The Mellon Institute of Industrial Research is a good example of what can be done by the co-operation of enlightened manufacturers and by able administration. Its system of industrial fellowship was initiated in 1906, and although this remained in the experimental stage for nine years, since 1915 it has been in a strong position both financially and administratively. Dr. E. R. Weidlein, the director, states in his recent report that fifty-four of these fellowships, employing ninety-four research chemists and engineers, were held in the Institute during the year ended February 28, 1926, and that more than 125,000*l*. was contributed for their maintenance by the fellowship donors. The total sum of about 775,000*l*. has been received from companies and associations during the last fifteen years. In a separate document the Institute issues a list of the contributions made to scientific literature and of patents taken out during 1925. This list is of formidable length, but what strikes one most is the exceedingly practical nature of the majority of the investigations pursued and their great diversity. Problems relating to coal, coke, and petroleum are, perhaps, most conspicuous, but there is also a goodly array of contributions relating to metallurgy, refractories, laundering, and foodstuffs.

Dr. Weidlein has also written an essay entitled "The Administration of Industrial Research" (*Industrial and Engineering Chemistry*, January 1926), in which he discusses the various factors that make for success in the conduct of a research organisation, such as the selection of research workers, organisation, co-ordination of effort, and the virtues of team work. The principles involved in the management of a research laboratory are set out on the lines of Taylor's "Principles of Scientific Management," and "the functions of laboratory organisation" are analysed in detail. The essay may be recommended for perusal by directors of research; it will interest them, although they may not find it entirely convincing. Many of the 'principles' and 'functions' enumerated appear to be obvious, not to say platitudinous, and one is left with the impression that an organisation in which every entity and activity, physical, moral and intellectual, is dissected, described, catalogued, charted and labelled, is scarcely the place where the free spirit of scientific adventure can dwell with patience or good will.

Dr. Weidlein is undoubtedly on strong ground when he pleads for a proper business foundation for every institution devoted to industrial research, but we foresee trouble if, as he advises, the activities of a research department are "adjusted constantly to suit the needs of the concern," or if the research worker becomes too intent on "keeping in line with psychological laws." Some of the author's *obiter dicta* are also open to question. We can, for example, hear

Candide and the initiators of gas-warfare chuckle when they read: "If a scientist is productive in his investigations, his work must result for the good of humanity"; and we do not think that Schiller, who wrote that "talent is formed in quietude, character in the current of the world," would have agreed with the assertion that "The character of virtue is best seen in the life of a scientist devoted to the service of research."

On Thursday last, July 1, unfortunately too late for insertion in our issue of July 3, we received the following telegram from Prof W. H. Keesom, of the University of Leyden: "Helium solidified under a pressure of 150 atmospheres at the temperature of its boiling-point and under 28 atmospheres at 1·5° Abs. Solid helium forms transparent mass." This achievement thus rounds off the work of the late Prof. H. Kamerlingh Onnes, begun more than thirty years ago. By his extraordinary energy and organising ability Kamerlingh Onnes built up his cryogenic laboratory in Leyden, and in 1904 was able to obtain supplies of liquid air. By 1906 he was liquefying hydrogen on a large scale, and in 1908 he succeeded in liquefying helium. This enabled him to obtain a temperature of 4·22° Abs., and by reducing the pressure the temperature was further reduced to 0·9° Abs. Attempts were made with the pressure so low as 0·2 mm. to solidify helium but without success, and it has remained for Prof. Keesom, apparently using an increased pressure method, to complete the work which 'the master' left unfinished.

To all interested in navigation the problem of the issuing of suitable signals at danger spots in the ocean or near the coast is of the greatest interest. There are many spots where it is too expensive to provide a keeper to attend to the light and fog signals; where also, on account of the rocky bottom, strong tides, and ships' anchors, it is impracticable to maintain a submarine cable connexion. It is interesting to hear, therefore, that the Marconi Company has established an unattended fog-signal station on Rosneath Beacon on the Firth of Clyde. It was installed last January and its working has proved very satisfactory. The control is by radio waves, and we see no reason why the same method should not be applied to control other kinds of mechanical apparatus acting at a distance. Rosneath Patch is a sandbank in mid-channel at the mouth of the Clyde between Gourock and the opposite Argyllshire coast. A reinforced concrete beacon marks the Patch. Automatic apparatus has now been installed which gives signals by exploding a mixture of air and acetylene gas. Once started, the 'guns' continue giving explosions until they are switched off or until the acetylene gas is exhausted. These guns are the only automatic signals at present in use, being cheap to install and maintain. At Rosneath Beacon they get their supply of acetylene gas from a carbide-to-water plant. A radio receiving apparatus is fitted and is synchronised with the transmitting set on Gourock Pier, 1½ miles from the Beacon. When fog is observed, the transmitting apparatus is put into operation and the radio impulses act on the receiving apparatus. The signals being periodic prevent atmospherics acting on the receiving set. When the fog clears, another set of periodic impulses having a different period is transmitted and stops the signals. The annoyance to the neighbourhood is thus reduced to a minimum. The essential features of the sending apparatus are a pendulum and mercury break, a spark coil and a quenched spark transmitter.

The Cretan earthquake on June 26 has been followed by others in various parts of the world, on June 28 in Sumatra and Rhineland, on June 29 in southern California and at Salisbury in southern Rhodesia, and on June 30 by another in Sumatra. In a letter published in the *Times* of June 30, Prof. Turner places the epicentre of the Cretan earthquake in 35° 0′ N. lat., 24° 0′ E. long., or just south of Crete, the same spot having been the seat of seven smaller earthquakes between 1913 and 1922. The damage at Candia and in some of the surrounding villages was considerable, including injury to many of the remains from Knossos collected in the Candia museum. A telegram from Rome, dated June 28, states that more than two thousand houses have been destroyed by earthquake-shocks in several villages in the province of Foggia in southern Italy, but these shocks can scarcely be connected with the Cretan earthquake, even if they occurred on the same day. The earthquake in Rhineland at 11 P.M. on June 28 was evidently felt over a wide area, at Cologne, Freiburg and other places in Germany, at Basel and Bern in Switzerland, and at Strasbourg, Epinal and Belfort in France. Though few details are as yet known of the Sumatra earthquake of June 28, it was clearly one of great strength, for many villages have been destroyed, and the railway and main roads near Padang have been much damaged. One of the most interesting of the recent earthquakes was that in southern California on June 29. At Santa Barbara it was strong enough to cause some very slight damage. It was probably an after-shock of the destructive earthquake in the same district on June 29, 1925 (NATURE, 1925, July 11, p. 56, and August 29, p. 324).

The Royal Air Force display, such as was seen at Hendon on July 3, is more spectacular than the old *Kaisermanover* and more exacting than Fleet exercises, and sums up from year to year the visible progress in design, operation, and discipline. A hundred and thirty aeroplanes in the air during the day, with half-a-dozen out of action from minor causes, is a remarkable achievement of design and maintenance Types ranged from the 700 h.p. single-seat fighter, with corresponding speed and climb, to the eight-ton twin-engine bomber (900 h.p.), and the three-engine 20-seat commercial aeroplane (1000 h.p.). 'Aerobatics' by individual pilots, squadron drill with nine aeroplanes, orders being given by radio telephony, and group drill with six squadrons, stirred the layman to loud applause and the expert to deep appreciation. The Hill tailless aeroplane and the first British-built Cierva autogyro might be considered as outward signs of the work of the Director of Research, which also lies less directly and visibly behind all manner of detail advances in standard equipment. From this pageant and from day to day work we may judge soberly that the British Air Service is holding its own in a keenly competitive world.

SIR FLINDERS PETRIE, in a letter to the *Times* of July 2, reports on the work of the British School of Archæology in Egypt during the past season. The investigations of Mr. R. S. Sandford on the history of the Nile during the pluvial period, carried out in the region between Thebes and Sohag, have linked the gravels carried down from the eastern granite mountains with palæolithic man. Starting from a gravel terrace at 150 ft., the 100-ft. terrace was laid down during the Chellean and early Acheulean period, the 50-ft. terrace in Acheulean times, while the latest gravel terrace at 10 ft. above river level contains Mousterian implements. Miss Thompson, continuing her work in the Fayum, has found, in addition to crude pottery and a large number of flint arrow heads and knives, a new feature in the form of granaries situated at a higher level. These are about 3 ft. across and sunk in the gravel. They are lined with coiled straw rope. The grain was mostly emmer and barley, but also included true wheat. Investigation of the tumuli on the island of Bahrein in the Persian Gulf by Mr. Mackay produced scanty results; but a bronze spearhead indicates a date of 1200–1500 B.C., which is supported by the character of the pottery. The forms of the pottery include Mesopotamian types, but the greater part is entirely independent. The work on the back of an ivory statuette is like nothing known elsewhere.

THE weather for the second quarter of the year, April-June, was generally wet, cool, and dull in the British Isles. Warm and bright weather at this season is so essential for vegetation that a few facts gathered from the Greenwich weather observations, which represent the south-east of England, may help to show the absence of fair conditions. The rainfall was in excess of the average in each month, yielding an excess of 3·66 in. for the three months ending June. April was mild, but the latter part of the month was colder than the early part; April 25 and 26 had maximum day temperatures below 50°, and for seven days from April 20-26 the maximum day temperature was below 54°, the normal maximum for the month being 57°. May was unusually cold for the first 20 days, and during this period the maximum temperature was only above 60° on 4 days; the highest day temperature was 63°. Warmer weather set in after the third week, which brought the mean temperature for the month to 52°·5, which is only 1°·5 below the normal. In June only 8 days at Greenwich were above the average, and 22 days were below the average temperature. The absence of bright sunshine was evidently the cause of the continued cool weather. April had sunshine for 101 hours, which is 3·37 hours a day, or 1·65 hours a day less than the normal; there were only 11 days with more than 5 hours' sunshine, and in all, only 6·4 hours' sunshine in the last 11 days of April. May had 149 hours' sunshine, which is 4·81 hours a day, or 1·66 hours a day less than the normal. In June the total sunshine was 180 hours, or 5·99 hours a day, which is 0·71 hours a day less than the normal.

THE evolution controversy in the United States still sends echoes across the Atlantic. The *Forum*, an American periodical for an intelligent but non-specialising public, has in its June issue a reply by Prof. H. Fairfield Osborn to an article attacking the "Fancies of the Evolutionists," by John Roach Straton, which appeared in February last. Prof. Osborn sets out to demonstrate "certain irrefutable facts" constituting the evidence for the geologic antiquity and creative evolution of man. The article is both a summary of present knowledge relating to the origin, evolution, and distribution of mankind, and a history of discovery in this province of research, necessarily in both cases brief and in outline only. The accusation of a conspiracy among evolutionists is met by a statement of the fact that in the case of crucial discoveries, such as that of the Trinil skull or Neanderthal man, the interpretation which assigned them the place in the human evolutionary series which they now hold was not immediately and universally accepted by scientific men. Further, Prof. Osborn points out that the experience of a hundred and fifty years, or on some matters of centuries, has brought the methods of scientific research in this field to such a point that the evidence can be interpreted with certainty and precision. The data are not "blurred or indecipherable documents like the palimpsests of many sacred writings, but are absolutely unchallengeable records as clear as daylight to the man who has learned how to read them"—a statement to which Prof. Osborn's own article may perhaps suggest some slight reservation. The existence of a fact is indisputable, but what of its interpretation? Prof. Osborn himself did not at one time accept the human attribution of the Piltdown jaw. However, his position is sound, and the main argument is not to be shaken by a minor inconsistency.

MR. HERBERT KRIEGER, of the United States Museum, while on his way to south-eastern Alaska, where he will carry on the work of restoration of the totem poles of that area, has made a survey of the pit-house sites of the old Yakima and Klickitat Indians of the Columbia River region of the State of Washington. This area would appear to have supported one of the densest populations in early America. Mr. Krieger reports the existence of a chain of house-sites stretching for 500 miles along the banks of the Columbia from the Dalles in Oregon to the Canadian border. The river was undoubtedly one of the great trading centres and routes of travel. Eight skeletons and forty-five artefacts were obtained by excavation in a burial ground. The artefacts showed no sign of Hudson Bay Company influence. The skulls exhibited cradle-board deformation similar to that of neighbouring tribes of to-day. Pictographs cut in the basalt cliffs of the river bank showed shields, bows, arrows, goats, big-horn sheep, and designs suggestive of the rising sun, lightning, and so on. It is perhaps worth mention that Mr. Harlan I. Smith has recently recorded pictographs, which these would appear to resemble, found in a similar position in British Columbia.

THE *Times* of June 29 contains an interesting account of the recent Hokkaido eruption written by its Tokyo correspondent. Like some other Japanese volcanoes, Tokachi has two peaks. One of them has a fairly well-defined crater with its north-east wall denuded or blown away. The other, known as Iwo-dake or sulphur mountain, had a small crater occupied by a lake. On May 7 the mountain, supposed to be extinct, showed some signs of activity: slight rumblings were heard and a small column of steam was emitted. On May 23 the rumblings, which had continued, became more pronounced, and on the following day the crater of Iwo-dake was breached by the rising lava-column, a large portion of the crater-wall fell down the mountain-side, and the water of the lake was released. The resulting destruction and loss of life were caused chiefly by the avalanche of mud, which swept over an area ten miles long with a maximum width of four miles. Its force is shown by the fact that at Kami Furano a mile and a half of the railway line was torn away and twisted like wire. When the water subsided, an area of ten square miles of highly cultivated rice land was left covered by a layer of sandy mud with an average thickness of 18 inches.

WE must all deplore the disappearance of examples of English architecture dating from the Middle Ages and later which is rapidly taking place in our villages owing to economic and social development. The awakening of public interest in this matter is tardy and spreads but slowly among those in whose hands control is vested. Sir Frank Baines's lecture on "The Preservation of Ancient Cottages," delivered before the Royal Society of Arts on May 6 last and now published in that Society's journal, is opportune, and should be made widely known. As he points out, the ancient workman's cottage is not merely a thing of considerable beauty, it is almost the sole piece of tangible evidence we possess of the social and economic position and of the material conditions of life among the peasant population from the Middle Ages up to the seventeenth and early eighteenth centuries. The lecture, as published, is illustrated by photographs of a large number of examples of this class of domestic architecture. Of these, the number which have now disappeared, among them some of the most beautiful and characteristic, is in itself an eloquent argument for the urgent necessity of early action.

DR. F. A. BATHER, president of the Geological Society, will unveil a mural tablet to William Smith on July 10 at 29 Pulteney Street, Bath. After the unveiling ceremony, there will be a luncheon at the Guildhall, to be followed, in the afternoon, by an address by Dr. Bather at the Royal Literary Institution on William Smith and his work.

SIR ERNEST RUTHERFORD (Cambridge), Sir Frederick Hopkins (Cambridge), Prof. H. A. Lorentz (Haarlem), and Dr. H. L. le Chatelier (Paris), were elected foreign members of the Académie Polonaise des Sciences, Cracow, last year. In conformity with the statutes of the Academy, such elections have to receive the sanction of the president of the Republic of Poland. We are glad to know that this has now been given, and that the elections can be announced.

SIR JAGADIS C. BOSE, founder and director of the Bose Research Institute, Calcutta, who is at present in England lecturing and giving experimental demonstrations on plant stimuli and responses, has been elected president of the Indian Science Congress to be held in Lahore in January next.

ROYALTY has always been credited with the parentage of anecdote, but we hope that this one is genuine. A charming young American, having met the Prince of Wales at a reception, asked him to tell her how he ought to be addressed, as, for example, on an envelope. The Prince—says the story—took her programme and wrote upon it: "To His Royal Highness, The Prince of Wales, K.G., F.R.S."

UNDER the title of "Illumination Research," the Department of Scientific and Industrial Research has issued a pamphlet, which will be supplied gratis on request, in which the work of the Illuminating Research Committee appointed in July 1923 is described. At the present time the following problems are under investigation: The transmission of light by window glass, the effect of the colour of the walls of a room on the light in the room, the use of prismatic glass in the windows, the lighting of picture galleries, the effects of enamel reflectors as used in works, the effect of glare on the eye and the influence of the amount of light on the ease and accuracy with which fine work can be done. The pamphlet does not deal with finance, but there are few who would care to challenge the expenditure of a few thousand pounds in this way in order to determine how best to get value for the millions of pounds spent annually in Great Britain on illumination.

WE have received the "Classified List of Publications of the Carnegie Institution of Washington" dated December 1925. This, with its detailed abstracts, is itself a publication of some value; but it does not appear to indicate clearly those works that have been issued since the distribution of the previous list.

WE have recently received volume 3, for 1924, of the *Publications biologiques de l'École des hautes Études vétérinaires*, Brno. Ten contributions are contained therein; in the index they are paged consecutively, but in the text, pagination commences afresh with each paper, a much less convenient arrangement. Botanical problems of development are dealt with, by Staroštík, on the bud of *Ficaria verna* and the influence of external agents on its growth, by Pavlů on the histology of the beet, and by Václavík on correlation between cotyledon and axillary bud in the pea. The other seven papers are zoological or physiological, again with emphasis on the experimental study of development.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in experimental physiology in the University of Manchester—The Internal Registrar (July 14) A junior lecturer in mechanical and electrical engineering and a junior lecturer in geography at University College, Nottingham—The Registrar (July 17). An organiser of mining instruction for Derbyshire—Director of Education, County Education Office, S. Mary's Gate, Derby (July 17). A research chemist for work on plasters and other materials used for impressions and models in dentistry—Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (July 21) An assistant at the Commonwealth of Australia Observatory at Mount Stromlo—The High Commissioner for Australia, Australia House, Strand, W C.2 (July 22). A temporary assistant chemist at the Naval Ordnance Inspection Depôt, Holton Heath—Secretary of the Admiralty (C.E. Branch), Admiralty, Whitehall, S.W.1 (July 24) An assistant lecturer in pure mathematics at the University College of Wales, Aberystwyth—The Secretary (July 28). Temporary assistant chemists in the Government Laboratory—The Government Chemist, Clement's Inn Passage, Strand, W.C.2 (July 31). An additional zoologist for the *Discovery* Expedition—The Secretary, *Discovery* Committee, Colonial Office, Downing Street, S.W.1 (July 31). A junior technical officer for the wireless experimental department of the Royal Aircraft Establishment—Superintendent, R A E., South Farnborough, Hants (July 31, quoting A.79). A botanist for the agricultural department of the Government of Nigeria—Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, Westminster, S W.1 (August 15). A director of the Veterinary Laboratory of the Ministry of Agriculture and Fisheries at New Haw, Weybridge—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W.1 (November 1). A director of research under the Research Association of British Paint, Colour and Varnish Manufacturers—Mr. J. B. Graham, 8 St. Martin's Place, W.C.2. A man with teaching experience in physics, chemistry and mechanics—Cordwainers' Technical College, St. John's Lane, E C.1. An assistant at the Darlington Technical College, chiefly for geometrical and engineering drawing, and either engineering science or mathematics — Chief Education Officer, Education Office, Darlington. An advisory agricultural economist at the Midland Agricultural and Dairy College, Sutton Bonington, Loughborough — The Principal.

Our Astronomical Column.

LARGE SUNSPOTS.—The naked-eye sunspot recently noted in these columns was followed shortly afterwards by the appearance of another which was seen as a naked-eye object from June 26 until July 1 In a small telescope, the spot appeared elongated with a double umbra; there were several small companions near it and others in a cluster following at some distance. Details of position, etc., are given below in the usual tabular form This latest spot brings the total number of naked-eye spots to eight for the first six months of 1926, as compared with eight for the whole of the preceding year.

No.	Date on Disc	Central Meridian Passage	Latitude	Longitude.	Area
8	June 23–July 5	June 29·1	21° N	140°	1/1250

(Area expresses the proportion covered of the sun's hemisphere)

PONS-WINNECKE COMET AND METEORS.—Mr W. F. Denning writes: "Announcements emanating from Russia have been published to the effect that a meteoric shower might occur between June 24 and July 1. The fact that the parent cause, Pons-Winnecke's comet, would be situated at a distant point of its orbit, which it occupies twelve months before perihelion, robbed the prediction of any weight that it might otherwise possess. It is true that in 1916 there was a meteoric shower ten months after the comet had passed its perihelion, but there were great doubts as to whether the cometary materials were abundant at a spot so remote in front of it. The result of observation was anticipated, for though June 24-30 proved fairly clear, few meteors could be seen in the brilliantly moon-lit skies of the period.

Meteoric observers will anticipate a shower next year with more confidence and with conditions which appear to be favourable. Even in 1928 there may be many meteors seen, judging from the experiences of 1916, which showed that they were distributed far behind the comets. Probably also the stream is spreading out with time, and that even if the ellipse is not at present continuous it will ultimately assume that form

The brightest meteor lately seen was on June 27, 23^{h} 20^{m} G M.T. The meteor was moderately slow and about equal to Jupiter duration, 2 sec. The probable radiant was in Sagitta and far from that of the Pons-Winnecke comet. The meteor was also observed by several other persons in Bristol, and they mention it as giving a distinct flash like summer lightning"

NOVÆ.—The *Observatory* for June contains a detailed summary of the paper read by Dr J. Lunt on Nova Pictoris at the May meeting of the Royal Astronomical Society. The radial velocity indicated by the dark lines gradually increased, being (in km./sec.) −71 in 1925 May, −81 in early June, −92 in late June, −320 July to August, −395 in mid-September, −411 in January, −436 in March. Bands resembling those in η Argus began to appear in October, and gradually became more evident The nebular bands customary in the later stages of novæ did not appear until March. Dr. Lunt endorses the words of Prof. Hartmann's telegram to *Astr. Nachr.*, "The star swells up and bursts." He considers that the star was discovered at the simmering preparatory stage, and that the explosive ebullition came later. The cause is conjectured to be a release of atomic energy within the star.

F. Pingsdorf of Parana (Argentine) gives a series of measures of brightness of the nova. The following summary gives the magnitude at the beginning of each month December 4·2^{m}, January 4·3^{m}, February 4·6^{m}, March 5·1^{m}, April 5·4^{m}, May 5·5^{m}. The star thus remained an easy naked-eye object for a year, which is longer than most recent novæ, though less than Tycho's famous star.

Beobacht. Zirk No. 23 contains a note by Prof M. Wolf on his faint nova in the spiral nebula N G.C. 4303 (Messier 61). He obtained two photographs on June 1 that show a marked diminution of light since discovery on May 12. Its magnitude was then about 14^{m}, and 15^{m} on June 1; on the latter date it was 0·2^{m} fainter than the star south preceding the nucleus at a distance of 1·3′. This rapid decline makes the American estimate of the star's total light as being 10 million times that of the sun appear somewhat doubtful.

Research Items.

DEPOPULATION AND DISEASE IN THE NEW HEBRIDES.—Dr. P. A. Buxton, of the London School of Hygiene and Tropical Medicine Expedition to the South Pacific, in a communication to the Royal Society of Tropical Medicine and Hygiene, which is published in vol. 19, No. 8, of the *Transactions* of that Society, discusses the question of depopulation in the New Hebrides and examines the evidence bearing on the statement generally made as to the extent to which this is due to diseases introduced by Europeans. Depopulation appears to be going on rapidly on all the islands except Tanna, Aniwa, and the north part of Pentecost. On Tanna, Tonga, Tongariki, and Buninga, numbers are stationary or rising, and on Futuna and Aneityum they may have reached their lowest and begun to rise. A calculation based on figures going back as far as any records are available for the five islands Aneityum, Aniwa, Futuna, Erromanga, and Epi, shows that there is no consistent rise or fall throughout the period, which in one case goes so far back as 1865. This seems to imply that the principal causes of depopulation were as active in the last century as now. To some extent the decline may be due to native customs—the institution of gerontocracy, which reserved marriageable females to the old males, abortion, a practice which repression of polygamy tends to increase, wars, belief in magic, bad housing, and unsuitable feeding of infants. The evidence of pedigrees shows an actual decrease in the birth-rate. The recruitments of native labour carried off the younger men as well as introduced disease. Of diseases, the most serious are malaria and yaws, but dysentery and pulmonary diseases play an important part. Two disquieting facts are that the rate of decline is no less now than it was fifty years ago, notwithstanding the abolition of 'blackbirding' and the reduction in the severity of epidemics, and that about 118 males are born per hundred females, this disproportion persisting through life. These facts almost warrant the prediction of the eventual extinction of many of the races now living in the New Hebrides.

THE ARTIFICIAL PRODUCTION OF LUSTRE ON FLINT IMPLEMENTS.—Mr. W. J. Lewis Abbott, 8 Grand Parade, St. Leonards-on-Sea, writes to say that he has discovered a process which simulates the somatic change in flint implements responsible for the production of the high glaze usually accepted by archæologists as a criterion of age. He points out the inapplicability of the term 'patina'—in origin a term used to describe the surface lustre of bronze—to all the various types of metamorphosis to which flint is subject. These metamorphoses are either superficial or somatic. The high glaze which arises from the superficial metamorphosis is due to attrition and can be produced artificially by sand-blast or running water charged with sand. The somatic metamorphosis in Nature is practically confined to the vitreous variety of flint, although it sometimes occurs in the normal and very rarely in the cryptogranular. In mixed flint it will appear in the vitreous and stop at the cryptogranular. The black, almost opaque flint becomes like a slightly clouded, otherwise colourless, clear hyalite, more brilliant and transparent than 'Hungarian' opal, taking the most brilliant colours in the presence of various salts of iron. The metamorphosis takes place below the surface and works towards it until the conversion is complete, or it may occur in excessively small islands. The specimen may retain its elasticity, but if this is lost, it is obvious that the implements were made before the alteration set in. This form of metamorphosis has now been produced artificially. Flint—vitreous, normo-vitreous and normal—fashioned into implements by Mr. Abbott himself, has been submitted to a certain process which has entirely opalised it, with the result that the nearly opaque flint is now translucent, of various shades of brown, and has a most brilliant glaze. Specimens have been submitted to Sir Arthur Keith, who states that he has "never seen a richer or finer patina," and characterises Mr. Abbott's discovery as "very clever and dangerous."

FISH STOCKING IN AMERICA.—Mr. C. W. Creaser has recorded the results of successful attempts at stocking the upper waters of the Great Lakes with smelt, *Osmerus mordax* (*Michigan Academy of Science, Arts and Letters*, vol. 5, 1925). All the eggs used in the various stocking operations were from Green Lake, Maine; the smelt, which is a native of this lake, belongs to a freshwater race of the marine species common along the North Atlantic coast. Evidence is produced to show that transplantation of eggs, which was first started in 1906 and was continued in different years up to 1921, has led to firm establishment of the species, and that in some localities natural spawning has been going on for several years. Mr. Creaser gives an interesting account of the spawning of this fish in Crystal Lake, Michigan; this takes place very early in the spring (April), before the ice breaks up in the lake as a whole. The fish move in a body into small streams; the main run is at night, most fish returning to the lake in the daylight. A vivid description is given of the solid masses of fish assembling to spawn. The fish were extremely susceptible to light, which they avoided; so strong was this reaction that the entrance of fish into the stream could be regulated by a flash-light. A reaction to currents was also exhibited. A note on the feeding habits of the smelt elicits the fortunate fact that the adults feed in the summer almost entirely on a species of minnow on which other fish do not feed, and that hence they cannot be regarded as serious competitors for food. Details of age determination by scale reading are given; the smelt first breeds at the end of its second winter.

BOT FLIES OF THE PUNJAB.—*Bulletin* 160, *Agricultural Research Institute*, Pusa, 1926, is devoted to an account of certain of the bot flies prevalent in the Punjab and is written by Captain H. E. Cross. A very common species, forming warbles in goats, is *Hypoderma crossii*, which infects 40-90 per cent. of those animals in the Salt Range area. The larvæ, pupa and adult of this species are described and figured, but the eggs have so far remained undiscovered. The ox warble, *Hypoderma lineatum*, and its occurrence in the Punjab is noted, and this appears to be the first record of its being found in India. The camel bot fly, *Cephalopsis titillator*, is widely distributed throughout the Punjab and various stages in its life-cycle are figured and described. This insect is viviparous and the first stage larvæ occur in the nostrils of the camel. When about 7 mm. long until fully grown they are met with in the pharynx and are finally expelled through the nostrils, pupation taking place in the soil a few hours later. So far as known, the species does not entail much injury to its host, but it is possible that it may cause *kapauli* (pus in the sinuses), which is a fatal disease. Among other species the common sheep bot, *Oestrus ovis*, the wild sheep bot, *Oestrus*, sp. nov. ?, the horse bot, *Gastrophilus equi*, are also dealt with. The bulletin concludes with a brief discussion of the injuries caused by these flies and of the methods of treatment.

THE SWAMP CYPRESSES.—The swamp cypresses, and particularly Glyptostrobus, are not well known in Great Britain, so that the taxonomic and anatomical notes by Prof. Augustine Henry and Marion McIntyre in the *Proceedings of the Royal Irish Academy* (vol. 37, B. 13, 1926) will serve a useful purpose. Glyptostrobus, the water-pine of the Chinese, they conclude, is a monotypic genus; this species being found only in two swampy localities in south-eastern China. The Chinese regard the presence of the tree as propitious to the rice crop, and the villagers resist its molestation, even by the photographer. *Glyptostrobus pensilis* is also one of the rarest cultivated trees in Europe, only one specimen growing in the open being known to the authors (at Nymans, Sussex). There are living plants under glass at Kew and Glasnevin. The three living forms of the much better known swamp cypress of America, Taxodium, are also passed in review as to macroscopic and microscopic characters of branchlets, leaves, flowers and cones, in order to permit a comparison with Glyptostrobus In view of the necessity, often present to the palæobotanist, of distinguishing between genera on structural features alone, a comparative study of the wood of these two genera and also of Wellingtonia and Sequoia is included in the paper.

BIOCHEMICAL DIFFERENCES BETWEEN THE SEXES OF MUCORS.—In the Mucors, Blakeslee, in particular, has shown that in many species two sexual strains may be distinguished, individual mycelia of the same sex will not conjugate, whilst conjugation occurs freely between mycelia of different sex. These 'heterothallic' strains thus occur in sexual pairs, but the form and structure of one sex is practically identical with that of the other, and, apart from the behaviour on conjugation, the two sexes cannot be distinguished, except, perhaps, by a difference in vigour of growth. Blakeslee has provisionally designated these as (+) and (−) strains, the plus strain being the more vigorous when this growth distinction can be drawn. Sophia Satina and Blakeslee now report (*Proc. Nat. Acad. Sci.*, Washington, March 1926), in a preliminary manner, upon a biochemical study of these Mucor sex strains. They conclude that the (+) and (−) races show significant, average, biochemical differences in respect to (*a*) the Manoilov reaction, (*b*) catalase content, (*c*) reduction of potassium permanganate by extracts of the mycelium, and (*d*) reduction of tellurium salts in living cells. In a subsequent paper they apply biochemical tests to unisexual flowering plants, obtaining additional evidence in support of the conclusion that the female plant and the (+) strain of a Mucor show similar biochemical behaviour. A certain statistical element enters into this type of observation. As the authors put it, the general rule that the human male is the heavier is not vitiated by the fact that on chance selection of a human pair an especially buxom female might be put in contrast with a meagre male.

AGRICULTURE IN ARID LANDS.—In a paper on the struggle with arid conditions in the Volga region (*Matériaux pour l'étude des calamités*, No. 8, January–March 1926) Mr. N. M. Toulaikoff, who is director of the experimental station at Saratoff, makes several constructive suggestions for safeguarding agriculture against the arid conditions in the Volga region. An average rainfall of about 16 inches is small enough considering the summer heat, but it is not the slight total amount that matters so much as its irregularity in fall While poor crops and want occur generally in years of deficient total rainfall, there have been instances of abundant crops in years of scanty rainfall. In those years the rain fell in the seasons demanded by the crop. The main crop of the peasants has always been summer wheat, which suffers severely from spring drought and cannot recover when the rains come so late as June and July. More satisfactory crops would be rye, which develops before the most usual period of drought, and maize, millet, sorgho, and beet, which develop in June and July and do not suffer from the prolonged heat of summer. A study of these problems has been made on experimental farms, and it is considered that the likelihood of famine could be minimised if not banished by adapting agriculture to the peculiarities of the climate.

GEOLOGY OF THE WEALD.—Among regional surveys now being carried out may be mentioned the work of the Weald Research Committee of the Geologists' Association. This consists of a geological survey on the 'six-inch' scale of the Weald, which is being actively pursued by the members of the Committee, who number about two dozen, each member having undertaken to survey the country comprised in at least one 'six-inch' sheet. It is just over fifty years since the survey by W. Topley was published by the Geological Survey, but while our knowledge has been extended locally, no general geological survey has been attempted previous to the initiation of this committee. No point of geological interest is being neglected; the petrology as well as the palæontology of the beds is being worked out in detail, while a good start has been made in the complex problems involved in the denudation of the area. This branch of the work will occupy a considerable time, but some points of interest are already being elucidated; for example, a late Pliocene terrace discovered in the Mole gap has produced widespread planation in the district especially north of Ashford. The Committee has very properly not set itself any definition of the Weald, for its researches must extend well beyond the region to which the name applied originally. In this connexion the gravels of Rayleigh in Essex may be cited. These contain pebbles of Lower Greensand chert, which may have been derived from the Weald through the Medway gap, and if this proves to be the case the pebbles travelled across what is now the lower Thames

THE TRAVEL OF DEPRESSIONS.—The *Meteorological Magazine* for April gives an interesting and descriptive account by Lieut.-Col. E. Gold, assistant director of the Meteorological Office, on the foregoing subject The article should prove most instructive to meteorologists not well versed in the new ideas relative to cyclones which are proving of immense value to the weather forecaster, either official or otherwise. From the initiation of forecasting, cyclonic depressions have necessarily proved almost the controlling feature. The movement of cyclones in the British Islands and their vicinity differs so widely, and the area controlled or affected varies so considerably, that it seems almost impossible to forecast effectively. The development by Bjerknes of the idea of cold and warm sectors in the individual cyclones separated by definite surfaces of discontinuity has enabled the Bergen school to divide cyclones into different classes according to their stage of development. They draw a distinction between (*a*) cyclones which have a definite warm sector with definite lines of separation from the cold sector, and (*b*) cyclones in which there is no warm sector at the surface of the earth. Class (*a*) are generally growing cyclones which usually move with increasing speed as they grow, and Class (*b*) are dying cyclones, which tend to become stationary. In Class (*a*) the centres of the cyclones move in the direction of motion of the air in the warm sector, and approximately with the speed of motion of the warm air; a diagrammatic representation is given of such a cyclone. A description is also given of Class (*b*), in which there is no warm sector. Cyclones of Class (*a*) eventually lose their warm sector and change into Class (*b*); the warm sector only disappears at the earth's surface, the warm air being lifted up by the colder air, and the discontinuity will continue to exist at greater heights. The author alludes to the difficulty of giving in so short an article anything like a complete account of the technical investigations, but his mastery of the subject has suggested much which is helpful to the less-initiated.

ELECTRON EMISSION ENERGY WITH OXIDE CATHODES.—In the *Zeitschrift fur Physik* of April 30, Herr H. Rothe describes a series of measurements on a number of triode valves with oxide cathodes in which the energy of emission of the electrons was determined, using Richardson's equation, and also by means of the cooling effect produced by the emission. The values found by the two methods, which agreed quite well with one another when the emission current was saturated, were exceedingly small. The relation between the emission from such cathodes and the amount of gas removed from them was investigated. It seems that it is not possible to free oxide cathodes from gas perfectly; apparently the emission current which passes through the oxide layer radially decomposes the oxide and so constantly produces new gas. The author considers that the high emission of these cathodes depends on the metal particles, produced by this decomposition, which remain embedded in the oxide. It is noted that if the emission current is below the saturation value the cooling effect is considerably greater than that corresponding to the energy of emission. A fatigue phenomenon has been investigated, which in almost all the tubes caused the emission current to fall off rapidly with the time.

THE PALLADIUM-HYDROGEN EQUILIBRIUM.—The absorption of hydrogen by palladium has been the subject of much experimental study since it was first reported by Graham, and the results of the latest investigation by L. G. Gillespie and F. P. Hall appear in the *Journal of the American Chemical Society* for May 1926. They describe a method of securing equilibrium by means of a new heat treatment, and the isotherms which they determined indicate the presence of two solid solutions. At the higher temperatures the solution richer in hydrogen is said to consist of a hydride $\mathrm{Pd_4H_2}$.

SILVER IODIDE IN GELATIN IODO-BROMIDE EMULSIONS.—R. B. Wilsey has recently found, in studying the crystal structure of mixed crystals of silver iodide and bromide, that the cubic lattice characteristic of silver bromide has some of its bromine replaced by iodine with an enlarged lattice spacing when it is crystallised with silver iodide But when the iodide is present to the extent of about 40 per cent or more, there was a second lattice spacing corresponding to that of silver iodide. Emery Huse and C. E Meulendyke of the Kodak Research Laboratory (*Journal of the Royal Photographic Society*, June, p. 306), have sought to fix the proportion of silver iodide present when it begins to form separate crystals from a mixture of the two salts. A series of gelatin emulsions was prepared containing increasing quantities of iodide, and exposures in a spectrograph were developed physically, as silver iodide is scarcely amenable to alkaline development. The physical development of silver iodide gives a very sharp-edged sensitivity limit at wave-length 440 mm., and as the iodide was increased this first appeared when the iodide constituted 32 per cent. of the mixed haloids, and remained as the iodide was increased, and was entirely lacking at 30 per cent. or less. The authors therefore conclude that silver iodide separates in emulsions of this type as definite crystals, apart from the silver bromide, when the silver iodide content reaches approximately 32 per cent.

HELIUM IN NATURAL GASES OF JAPAN.—The thirteenth report of the Aeronautical Research Institute, Tokyo Imperial University, published early this year, contains an account of an examination of natural gases from Taiwan, Hokkaido, Honsyu and Kyusu, primarily for helium, by Messrs. Y. Kano and B. Yamaguti. The gas samples were taken from various sources, such as oil reservoirs, coal-mines, mineral springs and volcanoes, and were analysed for helium by Cady and McFarland's method, for other constituents by Hempel's standard method. The purity of the helium was tested spectroscopically. Carbon dioxide, sulphuretted hydrogen, oxygen, carbon monoxide, methane, ethane, nitrogen and heavy hydrocarbons were among the chief constituents of the gases investigated, and from the analytical results it has been possible to classify the natural gases into three types rich in carbon dioxide, in hydrocarbons and in nitrogen respectively; as in the case of helium in American natural gas, the percentage of this element is highest in nitrogen-bearing gas. The helium content of some mineral spring gases examined reaches 0·2–0·3 per cent, but unfortunately the amount of gas available from this source is strictly limited and insufficient for industrial purposes; very small quantities of helium were found in the gas from the Taiwan and Hokkaido areas, where it is associated with petroleum, the average being 0·005 per cent, again an impracticable amount for commercial purposes The oil and gas reservoirs of Taiwan and Hokkaido are of Tertiary age, from which the low helium content of the gas from these sources is accordingly explained. The authors find that the percentage of helium in a hot spring gas depends to a certain extent on emanation content, though no direct ratio could be established, this agreeing with McLennan's conclusions with regard to Canadian natural gas. Samples containing no helium generally possess the least radioactivity, and this to some extent supports the theory that the origin of helium in natural gas is to be ascribed to disintegration of radioactive substances; if this is so, then it is clear that the geological age of a gas reservoir is an important criterion of helium possibilities.

SIZES OF AERODROMES.—It is a matter of some considerable importance to determine the size of aerodrome necessary in order that a landing may be made on it if engine failure occurred at any time during getting off. In an interesting paper by H Glauert to the Aeronautical Research Committee (R. and M. 996, pp. 10. London: H M Stationery Office, 1926, price 6*d*.), this question is investigated more especially in the two cases: (1) where the aeroplane continues in its original direction after the engine failure; and (2), where the aeroplane, climbing on a steady turn, on failure swings back into the wind. A comparison of the results of these two cases shows that an important saving in the necessary size of the aerodrome can be secured by the turning climb, but the size of aerodrome indicated is larger than that of current practice unless the stalling speed and power loading are limited. Curves are given showing the necessary size of aerodrome in terms of stalling speed and power loading of the aeroplane. In particular, the required size of the aerodrome was found to decrease as the angle of climb increases and as the stalling speed decreases

The Chemical Constitution of Thyroxine.

ALTHOUGH the stimulant action of the thyroid gland upon the general metabolism of the body has been recognised for more than a generation, yet it is only within the last decade that the isolation of a pure crystalline principle, possessing the stimulating effects of the whole gland, has been successful. This was first accomplished by Kendall in 1914; since then this author has described a number of the derivatives of the pure substance, which he called "thyroxin," and has suggested a structural formula for it. Our knowledge of it has now been carried a step further by Harington, who has improved the method of extraction so that it gives a much higher yield than Kendall's method, and has proceeded, with the larger amount of material thus available, to determine its chemical constitution by methods of degradation and synthesis. Although at present synthesis has only been carried to the penultimate stage, there is every reason to hope, considering the way in which the author has unravelled the constitution of this compound, that the complete synthesis will soon be successful.

Before describing Harington's work, a few words may be said about the physiological properties of thyroxine. This subject, together with some recent work on its derivatives, has been reviewed by Kendall in his Chandler lecture ("Influence of the Thyroid Gland on Oxidation in the Animal Organism" By E. C. Kendall. New York: Columbia University Press; London: Oxford University Press, 1925. Price 3*s.* net) The activity of thyroxine in stimulating metabolism is remarkable: 1 mgm. injected intravenously in a patient suffering with myxœdema will increase the basal metabolic rate 2 5 per cent., corresponding to an increased output of 400 gm. carbon dioxide; the effect is, within limits, proportional to the dose. Moreover, the time relations of the response are characteristic. Thus, in a normal adult there is a latent period of six to eight hours; thereafter the metabolic rate rapidly increases but the maximum is not reached until the eighth or tenth day. The metabolism then returns slowly to normal, the rate of fall depending on the amount present in the body. A dose of 5-10 mgm. affects the metabolism for five or six weeks. It can replace the administration of dried thyroid gland in the treatment of cretinism and myxœdema; in a normal person, not only is the metabolism increased, but also the signs and symptoms of over-activity of the thyroid gland are also produced. Under normal conditions the thyroxine formed in the body appears to be responsible for about 40 per cent. of the metabolism, since complete thyroid deficiency causes a drop in the basal metabolic rate of this order.

The principle of the method of extraction from the thyroid gland is hydrolysis with alkali, followed by precipitation of the filtrate with acid, but whereas Kendall used 5 per cent. sodium hydroxide, Harington found that 10 per cent. barium hydroxide resulted [illegible] a greatly increased final yield (C. R. Harington, *iochem. Journ.*, vol. 20, 293, 1926). After about six hours' boiling of the dried thyroid in ten volumes of alkali, 60-70 per cent. of the total iodine appears in the filtrate; 40 per cent. of this can be precipitated on acidification as a creamy flocculent precipitate. The latter requires further hydrolysis with the alkali, when about half the iodine remains in solution and half is carried down with the insoluble barium salts; the latter contain the thyroxine. The precipitate is boiled in alkaline sodium sulphate solution to remove the barium and the filtrate precipitated with acid. The precipitate of crude thyroxine can be further purified by solution in alcohol made alkaline with caustic soda and re-precipitating with acetic acid. Further material is obtained from the gland residues by boiling with caustic soda, adding sodium sulphate, filtering and precipitating the thyroxine in the filtrate with acid. After re-crystallisation, by dissolving in alkaline alcohol and adding acid, further purification is effected by dissolving in dilute hot sodium carbonate, when the sodium salt separates out on cooling. This is re-dissolved in alkaline alcohol and the thyroxine precipitated with acid. The pure substance crystallises in rosettes and sheaves of fine needles. On heating, it darkens at 220° C. and melts with decomposition and evolution of iodine at 231°-233° C It is insoluble in water and organic solvents; it is soluble in cold dilute solutions of alkali hydroxides, but insoluble in acids. It is soluble in 90 per cent. alcohol with the aid of either alkali hydroxide or mineral acid. The yield was about 0 027 per cent. of the fresh, or 0·12 per cent. of the dried gland, corresponding to about 14 per cent. of the total iodine originally present; Kendall's yield was 0 0011 per cent. of the fresh gland. The physiological activity of the material extracted by Harington's method was shown to be the same as that of thyroxine prepared by Kendall's process.

The compound contains 65·3 per cent. iodine; analysis led to the empirical formula $C_{15}H_{11}O_4NI_4$; Kendall's formula is $C_{11}H_{10}O_3NI_3$, and the difference between the two is due to the fact that Harington found a lower nitrogen content than Kendall. The former observer confirmed his analysis, however, on a commercial sample of thryoxine prepared according to Kendall's process. Kendall considers thyroxine to be triiodo-dihydro-oxindole propionic acid; Harington considers it to be the tetraiodo substitution derivative of the parahydroxy-phenyl ether of tyrosine.

The arguments in favour of the latter appear conclusive: the products of disintegration of the molecule have been identified; the foundation of the molecule has been synthesised and only requires the addition of the iodine atoms to become identical with the original thyroxine. The first step in the breakdown of the molecule is the removal of the iodine; this Harington accomplished by shaking a dilute alkaline solution in an atmosphere of hydrogen with a palladium hydroxide—calcium carbonate catalyst. The iodine was split off as potassium iodide, and the hydrogen taken up was exactly equivalent to the iodine removed. The resulting compound was called desiodo-thyroxine (*Biochem. Journ.*, vol. 20, 300, 1926). Its formula was found to be $HO.C_6H_4.O.C_6H_4.CH_2.CHNH_2.COOH$.

The interest of the subject appears to justify a somewhat detailed account of the successive steps in the disintegration and synthesis of desiodo-thyroxine The facts that the latter gave positive Millon's and ninhydrin reactions, and that all the nitrogen was present as amino nitrogen, suggested that the compound was an α-amino-acid with at least one phenolic group; the proportions of carbon and hydrogen suggested the presence of two benzene rings. Fusion with potassium hydroxide produced parahydroxybenzoic acid, quinol in varying amounts according to the conditions, ammonia, oxalic acid, and a substance with the formula $C_{13}H_{12}O_2$. The latter possessed only one phenolic group; the experiment thus suggested the presence of two benzene rings, one of which has a phenolic group in the para position to a side chain, from which a two-carbon fragment is split off as oxalic acid.

Exhaustive methylation of desiodo-thyroxin gave a product which lost trimethylamine on boiling with alkali and yielded an unsaturated acid, $C_{16}H_{14}O_4$, containing only one methoxyl group. On oxidation with potassium permanganate, oxalic acid and $C_{14}H_{12}O_3$ were formed; the latter was found to be an aldehyde which on further oxidation yielded an acid $C_{14}H_{12}O_4$. Thus methylation shows that desiodothyroxin is almost certainly an amino acid, and that it contains only one phenolic group; the splitting off of oxalic acid suggests the presence of a three-carbon side chain. Now fusion with potash led to the conclusion that two benzene rings are present; if linked through a carbon atom, a ketone should have been formed instead of an aldehyde on oxidation of the methylated product; hence they must be linked either directly or through the oxygen atom, which is still unaccounted for. Considering the latter supposition the more probable, the author proceeded to meet the degradation by synthesis.

The steps in the disintegration by exhaustive methylation and in the subsequent synthesis may be rendered clearer if the following structural formulæ are given:

Desiodo-thyroxin: $HO . C_6H_4 . O . C_6H_4 . CH_2 . CHNH_2 . COOH$.
$C_{16}H_{14}O_4$ (unsaturated acid) $CH_3O . C_6H_4 . O . C_6H_4 . CH \cdot CH . COOH$.
$C_{14}H_{12}O_3$ (aldehyde) $CH_3O . C_6H_4 . O . C_6H_4 . CHO$.
$C_{14}H_{12}O_4$ (saturated acid) $CH_3O . C_6H_4 . O . C_6H_4 . COOH$.
$C_{13}H_{12}O_2$ (from potash fusion) $HO . C_6H_4 . O . C_6H_4 . CH_3$.

The starting-point in the synthesis was parabromanisol, $CH_3O . C_6H_4 . Br$; on condensation with the potassium salt of paracresol in the presence of copper bronze, 4 (4′ methoxyphenoxy) toluene, $CH_3O . C_6H_4 . O . C_6H_4 . CH_3$, was formed. On boiling with hydriodic acid, the compound $C_{13}H_{12}O_2$ was produced, whilst on boiling with permanganate the toluene compound was oxidised to the corresponding benzoic acid, $C_{14}H_{12}O_4$.

The complete synthesis of desiodo-thyroxin was carried out by a slightly different route; parabromanisol was condensed with potassium phenate to give (4′ methoxyphenoxy)-benzene, from which, by the hydrocyanic acid method, the aldehyde $C_{14}H_{12}O_3$ was obtained. The latter could be oxidised to the acid $C_{14}H_{12}O_4$. From the aldehyde both the acid $C_{16}H_{14}O_4$ and desiodo-thyroxin were synthesised; two methods were used in the case of the latter. The aldehyde was condensed with glycine anhydride in the presence of acetic anhydride and sodium acetate; the product on boiling with hydriodic acid and red phosphorus underwent simultaneous reduction, demethylation and hydrolysis, with the production of desiodo-thyroxin. In the alternative method the aldehyde was condensed with hydantoin, which on boiling with the same reagents yielded the desired product.

As regards the position of the iodine atoms in thyroxine, the author considers that it is probable that two are present in each benzene ring, in each case lying on either side of and next to the oxygroups, *i.e.* in the 3, 5, 3′, 5′ positions. The details of the final synthesis will be awaited with interest.

Annual Visitation of the National Physical Laboratory, Teddington.

ON Tuesday, June 22, the General Board of the National Physical Laboratory made its annual visitation of the Laboratory. As in previous years, a large number of members of scientific institutions, technical societies, Government departments, and industrial organisations were also invited to be present. The visitors were received by Sir Ernest Rutherford, president of the Royal Society and chairman of the General Board, and the Director.

The extensive programme of exhibits illustrated well the comprehensive nature of the work which the Laboratory undertakes.

In the 14-foot wind channel a model of the Cierva autogyro, which has aroused so much interest in aeronautical circles, was undergoing test. The model is mounted on three supports forming an inverted pyramid. The vertical forces on the feet of these supports can be measured, enabling the three component forces on the model to be determined, and quantitative data to be obtained for comparison with the conventional type of aeroplane. Another exhibit showed experimental arrangements for the investigation of the spinning characteristics of a model aeroplane The model under test is mounted on an axis parallel to the wind direction in such a manner that its incidence can be varied. Examination of its behaviour permits the main features of the spinning motion to be studied so that it is possible to indicate what features in design are undesirable from this point of view.

In one of the smaller wind channels experiments were in progress to determine the convective dissipation of heat from the surface of an aerofoil in a wind current. Thin strips of platinum foil cemented to the entire aerofoil and parallel to the span can be heated electrically. Their temperatures can be determined by resistance measurements and equalised by adjustment of the currents traversing them. Measurements of their resistance and of the currents determine the rates of loss of energy from the individual strips.

A new 1-foot wind channel has been added to the equipment of the Department. This is intended primarily for the development and calibration of instruments for measuring wind speed and direction.

Among the exhibits of the Metallurgy Department were eight samples of British Standardised Steel, issued jointly by the Iron and Steel Institute and the National Physical Laboratory. These comprised four carbon standards containing respectively 0·10 per cent., 0·27 per cent., 0·65 per cent., and 1·09 per cent. of carbon, two sulphur standards containing respectively 0·027 per cent. and 0·071 per cent. of sulphur, one standard containing phosphorus (0·029 per cent.) and one manganese (0·69 per cent.). These standards are prepared from fine millings taken from six-inch bars. Millings taken from the outer layers and the core are rejected, samples of the remainder being subjected to analysis by the Laboratory and various co-operating authorities.

Specimens of pure elements prepared in the Department were also on view. Mention may be made of two of these with which some advance has been made, namely, beryllium and silicon. The former is prepared by the electrolysis of a mixture of the fluorides of beryllium, sodium, and barium, a rotating cathode being used. This is slowly withdrawn at a predetermined rate with the pure metal adhering. Special precautions are taken to prevent contamination of the metal by enclosing the salts in special crucibles. Specimens of these made of magnesia and alumina were shown in the foundry. For work on the constitution of silicon-aluminium alloys and on age hardening in aluminium alloys, very pure silicon is required. Samples were shown of 99·8 per cent. purity. Another exhibit illustrated the microscopic examination of metals usually liquid at ordinary temperatures. Such materials as are used in dental practice are included in this category. By surrounding them with a freezing mixture of carbon dioxide snow and acetone, it is possible to polish the surface to the degree requisite for microscopic examination.

In the William Froude National Tank a model self-propelled single screw vessel was shown under test. Simultaneous measurements were recorded of propeller thrust, shaft revolution, and distance travelled These enable the propeller torque and power expended under varying conditions produced in the tank to be compared, and permit the losses due to the propeller, hull, and sea conditions to be apportioned.

In the Engineering Department research was in progress on the mechanical properties of metals and alloys for use at high temperatures, such as are experienced in modern steam engines and gas engines. At high temperatures metals generally used undergo continuous creep under steady loads, lower than those obtained in normal tensile stress determinations Experimental work is being done to determine the rate of creep of such materials at various temperatures. For this purpose the test pieces are surrounded by an electric furnace maintained at the required temperature, a steady load being applied by a lever system. Any elongation can be measured by means of micrometers attached to the apparatus. Fatigue can also be studied in a special machine in which the stresses are produced by means of an alternating current, the specimen being heated in position by heating coils.

An investigation was also being carried out on the impact strength of chains. Normally chains are annealed periodically in order to counteract any tendency to embrittlement and the tests were designed with the view of determining the effect of this annealing on the strength of the chain. Of interest also was a trough in which the production of capillary and gravitational waves in water by means of a current of air acting on the surface was demonstrated.

In the Metrology Department, apparatus was shown for the absolute measurement of end gauges up to 4 in. in length. The gauge is converted into a Fabry-Perot étalon by means of two optical flats wrung on to its end faces, the flats having portions extending beyond the edges of the gauge, these portions being semi-silvered on their inside faces. When placed in a convergent beam of monochromatic light, interference fringes in the form of concentric circles are produced. Measurements of the angular diameter of such fringes in various monochromatic radiations enable the optical length between the two semi-silvered surfaces to be determined. The semi-silvered flats are produced at the Laboratory by the method of cathodic deposition, the glass to be silvered being placed near a silver cathode in a vacuum chamber. The apparatus employed for this purpose was on view. A monochromator, designed and constructed for use in connexion with interference measurements, was also exhibited.

In the workshop was apparatus for the study of the deformation of pivots under load. The pivot to be tested is mounted so that its point can be brought into contact with a flat sapphire by a balance arm. An image of the pivot is projected on to a screen and measurements made without and with a load in the balance pan, the magnification being 200 times.

A very large number of exhibits was shown in the Physics Department. Among these was apparatus for the determination of the thermal conductivities of materials at high temperatures by the measurement of the radial gradient in an electrically heated rod of the material.

A resistance bridge for platinum thermometry, made to the design of Mr. F. E. Smith and capable of measuring temperatures to 0·001° C., was exhibited. To obtain this accuracy special precautions are taken to control not only the temperature of the oil tank in which the coils are immersed but also the humidity of the oil, since this latter factor affects the resistance of the coils.

A new apparatus has also been designed for the purpose of measuring the change of length of 'constant length' type bubbles in spirit-level tubes under extremes of atmospheric temperatures likely to be encountered in surveying practice, namely, −18° C. to 55° C. For this purpose an optical device is used by means of which both ends of the bubble are viewed simultaneously and brought into coincidence, the length being determined in one observation. In this apparatus special attention is given to the geometrical design of the moving parts and to the fine adjustments.

A variety of problems connected with refrigeration were being investigated for the Engineering Committee of the Food Investigation Board. These included apparatus for measuring the heat evolution in fruit by a process which may be compared with that of respiration in animals. In this apparatus a differential arrangement is used in which the heat evolved by apples is balanced by that from an electrical supply. For comparing the relative values of the resistance to indentations of specimens of cork slab and other heat-insulating materials, an apparatus has been constructed in which the depth of penetration of a steel ball about 3 in. in diameter is measured by a dial indicator.

Several forms of the Ewing ball and tube flow-meter were shown. In this instrument a glass or metal sphere is placed in a glass tube of conical bore and the displacement of the ball under the action of the flow of liquid is observed.

In the Optics Section was shown the "Vector" colorimeter, an instrument which enables colour to be specified by measurements involving colour-matching only. In use the colour to be tested is matched first against a mixture of extreme red with some suitable monochromatic light and then against a mixture of spectrum blue with another suitable monochromatic constituent. These matches determine two vectors on a colour chart and the intersection of these determines the unknown colour. Other apparatus included a flicker photometer for heterochromatic photometry and a spectrophotometer not involving polarising constituents.

In the Radiology Section was shown a new X-ray tube with detachable electrodes In this tube, porcelain is substituted for the glass and the electrodes are fitted with rubber washers. The arrangement allows the tube to be dismantled for cleaning or other purposes and reassembled in a very short time. Apparatus for the study of the wave-forms of high tension generators by oscillographic methods was also shown working. By means of optical trains the wave-forms to be examined, together with a time curve from a tuning fork, are simultaneously recorded on a photographic plate.

In the Electrotechnics Department was shown a method of measuring high voltage dielectric loss. The Schering bridge is a capacity bridge specially suited for measurements of power losses at high voltages and small power factors; it ensures safety to the observer together with the accuracy attainable by other methods. Thus the method is applicable to the study of small phase defects in condensers. Power factors of 1 per cent can be measured correct to 1 per cent. The dielectric loss in a cable at 20,000 volts was being investigated; in this application the vibration galvanometer and bridge operating arms need never be more than 2 volts above earth potential.

Research work was being carried out in the Direct Current Section on the earthing of electric circuits. Various forms of earthing electrodes suitably spaced are sunk in the ground, and their resistances determined and compared under varying conditions of soil humidity.

In the Photometry Division a large integrating sphere 10 feet in diameter, constructed by the Metrology Department, was shown in use It is intended primarily for the photometry of large illumination fittings. Apparatus has also been installed for the purpose of measuring candle-power by means of photo-electric cells. Light from the lamp under test falls on a rubidium cell mounted at one end of a photometer bench. A lamp mounted in a whitened cube, in the floor of which is a second cell screened from the direct light of the lamp, provides a suitable source for comparison. The cells, connected in series, are arranged to form part of a Wheatstone bridge and their currents are balanced by suitable adjustment of the illumination. In the illumination building experimental arrangements were shown for determining the daylight illumination in large or small rooms by means of models. Such information indicates the probable behaviour of their full scale prototypes with regard to daylight and is thus of value in architecture.

In the Wireless Division experience has shown the importance of complete screening of local oscillators and receivers from local electrical disturbances. Several pieces of apparatus, so protected, and including oscillators and receiving apparatus, a variometer and a model frame aerial, were exhibited. The knowledge has been used in the case of amplification tests on valve amplifiers. The amplifier under test and the local oscillator are both carefully protected, the former being placed in a specially screened room Experimental work in connexion with short wave transmission is also being developed and various transmitting and receiving circuits were on view.

In the Electrical Measurements Department, in addition to the usual equipment, were various quartz piezo-electric resonators for use as radio frequency standards These, on account of their constant frequency, are very suitable for the control of oscillators. One such oscillator with amplifying valves designed to produce radio frequency oscillations of great power and extremely constant frequency has been installed. L. J C.

University and Educational Intelligence.

BIRMINGHAM.—The annual degree congregation was held on July 3. There were 6 successful candidates for the degree of Ph.D., 9 for M Sc., 77 for the degree of B.Sc. with Honours, 48 for the ordinary B.Sc, and 24 for M.B., Ch B. The degree of Doctor of Medicine was conferred on Gladys Mary Evans and Mr. Victor Goode Williams.

Dr. Laurence Ball, assistant to the chair of medicine and physician to the Queen's Hospital, has been appointed joint professor of medicine to fill the vacancy caused by the resignation of Prof Kauffmann.

BRISTOL.—Sir George Wills, Pro-Chancellor and chairman of the Council of the University, has given 25,000*l*., to be used with the 110,000*l* which he presented two years ago, for the erection of a residential hall for students.

CAMBRIDGE.—The Mayhew Prize in applied mathematics has been divided between J. A Gaunt, Trinity College, and A. H. Wilson, Emmanuel College. The Rex Moir Prize in mechanical sciences has been awarded to H L. Cox, Emmanuel College, and the John Bernard Seely Prize in aeronautics to R. E. Stevenson, St. John's College.

DURHAM.—Dr. Arthur Holmes, hitherto reader in geology, has recently been made professor of geology at Durham. Two new lectureships have been filled by the appointment of Dr. R. K. Schofield (physics), and of Dr. G. H. Christie (chemistry).

LONDON—A University post-graduate travelling studentship of the value of 275*l*. has been awarded to Miss C. L. T. Lucas. Miss Lucas obtained the B.Sc. with honours in zoology as an internal student of Bedford College in 1923, and has worked since at the London School of Tropical Medicine. She proposes to carry out research on Amœbæ living in insects, chiefly at the Johns Hopkins University, Baltimore.

ST ANDREWS.—The degree of D.Sc. in engineering has been conferred upon Mr. William John Walker for a thesis entitled "Developments of Engineering Thermodynamics Analysis for Variable Specific Heat Conditions." Dr. Walker has resigned the post of lecturer in mechanical engineering and machine design held by him in University College, Dundee, having been appointed professor of mechanical engineering at the University of the Witwatersrand, Johannesburg.

PROF. A. E. MORGAN, professor of English language and literature in the University of Sheffield, has been appointed principal of University College, Hull.

DR. W. E. CURTIS has been appointed professor of physics and director of the Physics Department at Armstrong College, Newcastle-on-Tyne, in succession to Prof. Henry Stroud, who retires at the end of the present session. Dr. Curtis, who is at present reader in physics in King's College, London, was educated at the Imperial College of Science and Technology, London, and was for a time lecturer in physics in the University of Sheffield. He is the author of important papers on spectroscopy.

THE third Congress of the Universities of the Empire will be in session at Cambridge on July 13–16. The subjects for discussion and the names of the chairmen are as follows: "The State and the University," Lord Balfour; "The Desirability of establishing in London a School of Advanced Legal Studies," the Lord High Chancellor, "Co-operation in Research throughout the Empire," Lord Londonderry, "Mutual Recognition of Examinations and of Time spent in Study Elsewhere," Sir Matthew Nathan; "The Desirability of making Provision for the Physical Welfare and Training of Students and the Organisation of Athletics with a View to securing more general Participation," the Duke of Devonshire; "The Actual Working of the Ph.D. Scheme," Viscount Cecil of Chelwood, "The Desirability of Articulating other Pension Schemes with the Federated Superannuation System of Great Britain and Ireland," Lord Haldane. Among the invited speakers on "Co-operation in Research" are Sir Thomas Holland, Sir John B. Farmer, Sir Arthur Shipley, and Dr. Andrew Balfour, on the Ph.D. scheme, Mr. R. A. Priestley, Prof. Wenley, of the American University Union, Prof Dobson of Bristol, and Prof. H. P Newton, of King's College, London. Representatives of India, Australia and Canada, as well as Sir Alfred Hopkinson and Sir Theodore Morison, are among those who have promised to contribute to the discussion on "The State and the University." The sessions at Cambridge will be preceded by series of visits by delegates from overseas to all the other universities of Great Britain and Ireland. On July 12 there will be a Government luncheon in honour of the delegates, at which Lord Peel will preside, and in the evening they will have an opportunity of meeting the members of the second Anglo-American conference of professors and teachers of history at a reception given by the University of London.

Contemporary Birthdays.

July 10, 1854. Dr. George Lindsay Johnson.
July 11, 1857. Sir Joseph Larmor, F.R.S.
July 12, 1863. M. Léon Charles A. Calmette, For. Mem. R.S.
July 12, 1869. Prof. Charles Riborg Mann.
July 13, 1869. Prof. Frederick W. Gamble, F.R.S.

Dr. LINDSAY JOHNSON, whose studies in ophthalmology have had practical issues in South Africa as well as in England, was educated at Owens College, Manchester, and Caius College, Cambridge. He has written memoirs on the refraction and vision of the seal's eye; and on the pupils of the Felidæ. A monumental paper, brilliantly illustrated in colour, appeared in the *Philosophical Transactions* for 1901, entitled, "Contributions to the Comparative Anatomy of the Mammalian Eye, chiefly based on Ophthalmoscopic Examination."

Sir JOSEPH LARMOR was born at Magheragall, Co Antrim, and educated at the Royal Belfast Academical Institution, Queen's College, Belfast, and St. John's College, Cambridge, of which College, since 1880, he has been a fellow. Following professional teaching in Ireland, he was for eighteen years a lecturer in mathematics in the University of Cambridge and in 1903 was elected Lucasian professor of mathematics. From 1901 until 1912 Sir Joseph was one of the secretaries of the Royal Society, a period of fruitful activities In 1915 he was awarded the Royal Society's Royal medal at the hands of Sir William Crookes, who remarked that the recipient's chief claim lay possibly in the establishment of the theory that radiant energy and intramolecular forces are due to the movements of minute electric charges.' The theory was sustained in his treatise "Æther and Matter." In 1921 Sir Joseph was awarded the Copley medal. Mention should be made of his extended and masterly obituary notice of Lord Kelvin, published by the Royal Society in 1908.

M. CALMETTE, the accomplished assistant director of the Pasteur Institute, Paris, was born at Nice. Honorary professor of bacteriology and hygiene in the University of Lille, he is a commander of the Legion of Honour. In 1921 M. Calmette was elected a foreign member of the Royal Society of London. He is Hon. LL.D., Cambridge.

Prof. CHARLES R. MANN was born at Orange, New Jersey. After graduating at Columbia University he studied at the University of Berlin. John Tyndall fellow in physics at Columbia, 1892–95, he was afterwards professor of physics in the University of Chicago from 1896 until 1914. Prof. Mann acted as special investigator (1914–19) of engineering education for National Engineering Societies, and the Carnegie Foundation for the Advancement of Teaching Author of several standard works on optics, he has written "The American Spirit in Education" (1919).

Prof. GAMBLE, a Manchester man, was educated there at the Grammar School, and at the University, serving after graduation on its zoological staff for some time. In 1909 he was appointed to the chair of zoology in the University of Birmingham. President of the Zoology Section at the Toronto meeting of the British Association in 1924, he gave an address on "Construction and Control in Animal Life."

Societies and Academies.

LONDON

Geological Society, June 9.—W. D. **Lang**: *Naos pagoda* (Salter): the type of a new genus of Silurian corals. The detailed structure of the hitherto overlooked species *Ptychophyllum pagoda* Salter is described; it is intermediate between Ptychophyllum and Chonophyllum (in their proper interpretation), and the new generic name Naos is proposed.—J. F. **Jackson**: The junction-bed of the Middle and Upper Lias on the Dorset coast. Deposits of *Harpoceratoides hemera* have been traced throughout the 'Western Cliffs' and a richly-fossiliferous representative of part of the 'transition-bed' of the Midlands has been found at Doghus Cliff. A compact limestone crowded with well-preserved fossils in the marlstone at Thorncombe Beacon appears to be transitional from the sandy clay below the junction-bed, but it is probably a case of pseudo-sequence due to deposition on a sea-bottom of incoherent materials. The strata at Watton Cliff were measured and photographed *in situ*. All the evidence indicates slow accumulation under perfectly tranquil conditions. The massive lithographic limestones contain redeposited matter, and were formed under much less tranquil conditions —P. G. H **Boswell** A contribution to the geology of the eastern part of the Denbighshire moors The eastern part of the area, about 72 square miles in extent, between Llanefydd, Denbigh, Ruthin, and the centre of the moors is discussed. The greater part of the area consists of Upper Salopian strata, comprising rocks belonging to the zones of *Monograptus nilssoni*, *M scanicus*, and *M. tumescens*, but the succession is much obscured by a thick mantle of glacial drift. The sediments are all of shallow-water facies, increasing in coarseness as they become younger, and this is attributed to the filling-up and shallowing of the geosyncline. Tectonically, the area constitutes the north-eastern part of the syncline of the Denbighshire moors, pitching north-eastwards. The dominant faults are of north-and-south trend, but swing north-north-westwards in the northern part, and apparently south-south-westwards south of the district. The structure is interpreted as the result of successive upthrows towards the west, but some lateral movement is probable. Numerous cross-faults, usually antedating the north-and-south faults, carve the country into blocks. While much of the faulting is of pre-Carboniferous age and related to the folding, movement on the north-and-south faults was, at least in part, renewed in post-Carboniferous times.

Linnean Society, June 10.—J G. **Dollman**: Exhibition of a supposed new 'mutation' in the rabbit. The specimen showed the fur thickly interspersed with what appeared at first glance to be 'bristles' an inch or more in length. The 'bristles' were the awns of an Australian grass of the genus Stipa, the fruits of which had implanted themselves in the fur of the rabbit.—I H. **Burkhill**: Exhibition of Hawaiian volcano plants. Eight mature vascular plants from the surface of one-year-old lava in the crater of Kilauea, Hawaii, three being sedges and five grasses, were found in cracks of the lava-flow of 1924 at places where steam issued. Within the steam-cracks was a mass of the genus Trematodon, its capsules weighted down with condensed water; algæ were observed, as well as a number of sporeling ferns and three small dicotyledons, but none of them were mature enough for identification. On lava three years older isolated plants of *Vaccinium penduliflorum* Gaudich, and *Cyathodes tameiameia* Cham. existed where, steam being absent, the surface was sheltered by boulders from the perennial north-east trade-wind. But neither of these two species, which seem to be the most xerophytic of the local plants, nor any other broad-leaved plants were observed upon the 1924 lava, which lava alone was hot enough to return rain as steam. The drying is obviously a greater hindrance to encroaching vegetation than the sterility of the lava.—T. A. **Sprague**: The taxonomic position of the Adoxaceæ. The position of Adoxa depends primarily on the interpretation placed on the two perianth whorls, those who regard these as 'calyx and corolla' or 'involucre and corolla' placing the genus near the Caprifoliaceæ, whereas those who regard them as 'involucre and calyx' place it next the Saxifragaceæ or Araliaceæ The former hypothesis involves fewer assumptions than are required by the other hypothesis, and the evidence from abnormal or rarer types is greatly in its favour. It is suggested that the Adoxaceæ should be placed in Rosales — Saxifragineæ beside Saxifragaceæ. — S. K. **Mukerji**: The vegetation of Kashmir: a contribution to the ecology of the Kashmir Himalayas. Investigation of the plant communities of the Kashmir Himalayas was undertaken during the years 1918–24. Three regions are recognised: the aquatic and marsh vegetation of the Dal Lake of Kashmir, the plant communities of the temperate region of the Kashmir Himalayas (5000–9000 ft.), the sub-Alpine and Alpine vegetation of the Kashmir Himalayas (9000–18,000 ft).

Physical Society, June 11.—J H. **Awbery** and **Ezer Griffiths**. The latent heat of fusion of some metals. The method of mixtures was used and refinements were introduced, of which the chief were the use of fairly large charges of metal (of the order of 2 kilograms), and a device by which the hot charge was not allowed in contact with the water of the calorimeter until the latter was completely closed. This device consisted in the provision of a sheet-metal vessel suspended by threads from the main lid of the calorimeter The aperture through which the charge was introduced was closed by a rotating lid, in the main lid, and the crucible being introduced, was submerged after the closing of this smaller lid by means of a wire passing through an eyelet in the base of the calorimeter, and out at the top.—D. W. **Dye**: The piezo-electric quartz resonator and its equivalent electrical circuit Such a resonator can be represented by an inductance, a resistance and a capacity all in series. These are pictured as in parallel with another small condenser and the whole is in series with a third condenser, the additional condensers representing air-gaps The agreement between theory and experiment holds for longitudinal resonators of a frequency so low as 44,000 and for transverse resonators with a frequency up to 15,000,000 periods per second. The temperature coefficient of frequency of a considerable variety of resonators is examined over a range of temperatures up to 40° C; very diverse results are obtained. The effects of displacement of the resonator from the position of centrality are small but not quite negligible. —Evan J **Evans** The current-voltage characteristics of electrostatic machines when supplying current to non-inductive loads and to a Coolidge X-ray tube. A large electrostatic machine was used as a source of potential for the discharge through (*a*) a Coolidge X-ray tube, and (*b*) a non-inductive resistance. In the former case, above a certain critical voltage the discharge is intermittent, while in the latter case the discharge is continuous for all voltages. The intermittence observed is due to the operation of the Pearson-Anson effect, and this implies that the effect of the residual gas in such tubes is not completely insensible above a certain voltage.

DUBLIN

Royal Irish Academy, June 14.—J. **Doyle**: The ovule of Larix and Pseudotsuga. The ovule of all species of Larix is provided with a large outgrowth on the cone-axis side of the micropilar edge. It is definitely one-sided, and covers the mouth like a hood; the other edge of the slit-like micropilar mouth is unchanged. The outgrowth has a stigmatic function, receiving the pollen and afterwards bending over and in, thus bringing the pollen into the micropilar canal In Pseudotsuga the micropilar mouth is more slit-like and both edges are differentiated, the cone-axis side being prolonged into a large mass as in the Larix, the scale side forming a second lip very much smaller. Though thus two lipped, it is only the larger one which functions as a pollen-receiving device in a manner strictly similar to Larix The natural and very close relationship in most characters, except habit, between Larix and Pseudotsuga is again emphasised.

EDINBURGH

Royal Society, June 21—W H. **Lang**: Contributions to the study of the Old Red Sandstone flora of Scotland. (iii.) On *Hostimella* (*Ptilophyton*) *Thomsoni*. A new specimen of the fossil, originally named by Dawson *Ptilophyton Thomsoni*, is described. The investigation of this has shown that the linear bodies are sporangia, enclosing large winged spores. The specimen by which Kidston demonstrated that this fertile tip terminated a frond-like branch-system is described. The genus, Milleria, is founded to include *M Thomsoni* (Dawson) and *M. pinnata* (Lang). (iv) On a specimen of Protolepidodendron from the Middle Old Red Sandstone of Caithness. A unique specimen from the Thurso flagstones, which was referred by Kidston to *Protolepidodendron karlsteini*, P. and B, is described; it is the first record of this genus from British rocks. (v.) On the identification of the 'Large Stems' in the Carmyllie beds of the Lower Old Red Sandstone as Nematophyton The striated incrustations, so common in the Carmyllie beds, have been critically investigated. They prove to have the characteristic structure of Nematophyton, which must have been a very abundant plant at this period. Two types are distinguished, the commoner constituting a new species (*N. caledonicum*), while another, with wider tubes, is compared with *N Forfarense*, Kidston sp.—S. **Williams**: A critical examination of the Vittarieæ. The genera Vittaria, Monogramma (limited to the Eumonogramme section), Antrophyum, Hecistopteris and Anetium, form a natural group All are tropical epiphytes with creeping dorsiventral rhizomes. The fronds are simple in outline except in Hecistopteris, where they are dichotomously branched. The venation is typically reticulate, but in some species of Monogramma lateral veins are entirely absent The central type of stele is the dorsiventral dictyostele. The dermal appendages are always clathrate scales, and the epidermis of the fronds is characterised by the presence of spicule cells The sporangia are constant in structure throughout the group, and the origin of the sorus is probably always intramarginal. The spore output varies from 32 to 64. The gametophyte, where known, is always divergent from the common cordate type The prothalli are deeply lobed and multiply rapidly by vegetative means From a general survey of the structural characters it is concluded that the Vittarieæ must be placed in any natural classification along with the complex of genera containing Adiantum, Cheilanthes, Pellæa, Gymnogramme and Ceratopteris —F. R. **Cowper Reed**: Some new Ordovician and Silurian fossils from Girvan. Two new trilobites, one belonging to a genus (Glaphurus) hitherto known only in America, and some other new forms. are described —Graham **Kerr** · A gigantic poison fang of a snake obtained from the (?) pleistocene of the Gran Chaco The name *Bothrodon pridii* has been given to the specimen. The fang measured nearly 65 mm. along the convex side, and has a deep poison-groove along its outer side. The uniform curvature, forming practically a semicircle, suggests that the fang was not adapted for striking but rather for the retention of struggling prey while the poison took effect.—G Donald **M'Intyre** . Development of the vascular system in the human embryo prior to the establishment of the heart. A detailed account of early stages of vascular formation in some embryos, such as have not been hitherto published, and a summary from the original descriptions of the vessels in a number of young human embryos.—J. M. **Whittaker**: On a polarised light quantum. The refraction and frequency of the light quantum of Sir J. J. Thomson and Prof Whittaker are discussed analytically, and a modification of it is proposed to explain the phenomena of polarisation.—W. W **Taylor**: (1) Ferric hydroxide sol and the lyotrope series. The concentration of the univalent salts of potassium which just completely precipitates ferric hydroxide sol in twenty-four hours under strictly comparable conditions has been determined. The order is—acetate, thiocyanate, chloride, bromide, nitrate, iodide, chlorate, the concentrations rising from $0{\cdot}01\ n$ to $0{\cdot}083\ n$. (2) Note on a theory of von Weimarn. According to von Weimarn's theory of the colloid state, the duration of life of a sol is longer when a precipitating ion contains the same element as the sol. Ferric hydroxide sol is completely precipitated in twenty-four hours by the same concentration of ferricyanide as of the trisulphonates, but the zone of partial precipitation is prolonged. With ferrocyanide the corresponding concentration is the same, and the zone of partial precipitation is also similar; there is in this case, however, at higher concentrations a second zone of precipitation, separated from the first by one of no-precipitation.

PARIS.

Academy of Sciences, May 31.—H. **Deslandres**: The distribution in time of terrestrial magnetic perturbations and the corresponding distribution in the sun of the regions which emit a corpuscular radiation In an earlier communication it has been suggested that the magnetic storms occur at intervals which are multiples of $R/6$, R being the mean duration of the synodic rotation of the spots. A detailed examination of the data for 1882, 1925 and 1926 is made, and the results exhibited in tabular form, they generally confirm the above view.—Gabriel **Bertrand** and M. **Mâcheboeuf**: The relatively high proportion of nickel and cobalt in the pancreas. It has been shown that animal tissues normally contain minute amounts of nickel and cobalt. The distribution of these metals varies with the nature of the tissue, being lowest in muscle and highest in the liver and pancreas. The original figures were obtained from the ox, but examination of the pancreas from several animals (ox, calf, horse, sheep, pig) proves that the pancreas is one of the organs always richest in nickel and cobalt. It has also been found that preparations of insulin contain several hundred times more nickel and cobalt than the glands from which they are extracted This raises the question whether these two metals intervene in the remarkable action of insulin, and further work on this is in hand.—H **Vincent** The general properties of the cryptotoxins, in particular of tetanus cryptotoxin The name cryptotoxin has been applied to microbial poisons which, in contact with certain substances, lose entirely under this influence their toxic power, keeping, however, some of their properties, in particular their immunising power. Sodium palmitate has been used as the modifying agent, and this salt rapidly neutralises, *in vitro*, microbial toxins. Experiments with guinea-pigs show that this animal can be injected with tetanotoxin 600 times the fatal dose without inconvenience if the toxin has been previously mixed with a suitable proportion of a solution of sodium palmitate. Similar effects are observed with the toxins of diphtheria, dysentery, typhoid, and *B. œdematiens*. The toxins are not really destroyed, since the sodium palmitate complex treated with hydrochloric acid and filtered from the palmitic acid gives a solution producing, in large doses, symptoms of tetanus in a guinea-pig.—Bertrand **Gambier**: The deformation of a surface with conservation of a conjugated network.—Gaston **Julia**: The conformal representation of areas —Rolin **Wavre** . The construction of a class of functional automorphs relating to a symmetrical nucleus of Fredholm —G. **Cerf**: The transformation of certain systems in involution of partial differential equations with two independent variables into an equation of the first order.—E. **Gau**: The transformation of a partial differential equation of the second order into an equation of the first order.—André **Roussel** . An extension of the method of Weierstrass.—**Riabouchinski**: Remarks on the problem of cavitations.—Emile **Belot** · The probable limits of the age of the planetary system, according to the theory of radiation and cosmogonic data.—Mlle M. **Hanot**: The enlargement by absorption of lines of Balmer's series.—Jean **Dufay**: The spectrum of lightning. A study of the part of the spectrum with wave-lengths less than 3850 Å.U.—C. G. **Bedreag**: The complex structure of the spectrum of copper.—P. **Vaillant**: The passage of the (electric) current in solid salts.—F. **Holweck**: Discussions and recent experiments on the soft X-rays. A discussion of the results obtained by M. Dauvillier and the author —P. **Lebeau** and A. **Damiens**: Carbon tetrafluoride.—Mme **Ramart** and Mlle. **Amagat**: Molecular transpositions in the series of the α α.α.-alkyl-diaryl-ethanols —René **Souèges** · The embryogeny of the Liliaceæ The development of the embryo in *Allium ursinum*.—J. **Beauverie** . The cytological bases of the theory of mycoplasma.—G. **Ollivier**: *Thalassoascus Tregoubovi* (new genus, new species), a marine pyrenomycete, parasitic on the Cutleriaceæ.—Théodor **Lippmaa** Hematocarotinoids and xanthocarotinoids —A. Quidor and Marcel A. **Hérubel** . The simultaneous and monocular perception of two different images of the same object. —Jules **Amar** Radiations and chlorophyll. The green pigment of leaves holds back the red radiations, the complementary colour, and red rays are most compatible with the persistence of chlorophyll.—P. **Vignon** . The anatomy of the organs of flight in the Phasgonuridæ of the present time and in the Protolocustidæ of the coal measures.—Robert **Weill**: The cnidome of the Trachylideæ (Trachymedusa and Narcomedusa)

Official Publications Received.

Práce Moravské Přírodovědecké Společnosti, Brno, Československo (Acta Societatis Scientiarum Naturalium Moraviae, Brno, Čechoslovakia.) Svazek 1, Spis 1-10 (Tomus 1, Fasciculus 1-10), 1924. Pp. iii+618+11 tab. (Brně: A. Píša.) 100 Kč.

Spisy Lékařské Fakulty Masarykovy University, Brno, Československá Republika (Publications de la Faculté de Médecine, Brno, Tchécoslovaquie). Svazek 1, Spis 1-10 (Tome 1, Fascicule 1-10), 1922-23. Pp. vi+265+14 tab. 40 Kč. Svazek 2, Spis 11-21 (Tome 2, Fascicule 11-21), 1923-24. Pp. ii+312+11 tab. 40 Kč. Svazek 3, Spis 22-32 (Tome 3, Fascicule 22-32), 1924-25. Pp. ii+258+5 tab. 40 Kč. (Brně: A. Píša.)

Biologické Spisy Vysoké Školy Zvěrolékařské, Brno, Československá Republika (Publications biologiques de l'École des Hautes Études vétérinaires, Brno, Tchécoslovaquie). Svazek 1, Spis 1-20 (Tome 1, Fascicule 1-20), 1922. Pp. xv+386. 50 Kč. Svazek 2, Spis 21-40 (Tome 2, Fascicule 21-40), 1923. Pp. iii+348+6 tab. 40 Kč. Svazek 3, Spis 1-10 (Tome 3, Fascicule 1-10), 1924. Pp. iii+276+1 tab. 40 Kč. (Brně: A. Píša.)

Agricultural Research Institute, Pusa. Bulletin No. 160: Bot Flies of the Punjab. By Capt. H. E. Cross. Pp. 16+8 plates. (Calcutta: Government of India Central Publication Branch.) 14 annas; 1s. 6d.

The Indian Forest Records. Vol. 12, Part 4 (Silviculture Series): Yield Table for clear-felled *Sal* Coppice (*Shorea robusta*). By S. H. Howard. Pp. v+19+6 charts. 8 annas; 10d. Vol. 12, Part 5 (Silviculture Series): Yield and Volume Tables for *Chir* (*Pinus longifolia*). By S. H. Howard. Pp. iv+21+10 charts. 1 rupee; 1s. 9d. Vol. 12, Part 6 (Silviculture Series): Yield and Volume Tables for Deodar (*Cedrus Deodara*). Pp. iii+28+10 charts. 8 annas; 10d. Vol. 12, Part 8 (Entomology Series): On some Indian Cleridae (Coleoptera). Part 1. New Species of Cleridae from British India and Burma. By J. B. Corporaal. Pp. 15. 5 annas; 8d. (Calcutta: Government of India Central Publication Branch.)

R. Osservatorio Astrofisico di Catania. Catalogo Astrofotografico Internazionale 1900.0. Zona di Catania fra le declinazioni +46° e +55°. Vol. 1, Parte 2ª: Declinaz. da +46° a +48°, ascens. retta da 3^h a 6^h. Pp. xii+49. (Catania.)

Norman Lockyer Observatory. Director's Annual Report, April 1, 1925–March 31, 1926. Pp. 8. (Sidmouth, Devon.)

The British Institute of Philosophical Studies. Annual Report and Statement of Accounts for the Year ended 31st March 1926, to be Presented at the First Annual General Meeting of the Members to be held at The Royal Society of Arts, 18 John Street, Adelphi, London, W.C.2, on Friday, 18th June 1926. Pp. 16. (London: 88 Kingsway, W.C.2.)

Koninklijk Nederlandsch Meteorologisch Instituut. No. 104a: Supplement; Oceanographische en Meteorologische Waarnemingen in den Indischen Oceaan, Juni, Juli, Augustus (1856–1905). Tabellen Waarnemingen Noord van 5° N.B. (1856–1923). Pp. iv+24. 1.25 fl. No. 106a: Ergebnisse aerologischer Beobachtungen. 11, 1923. Pp. iv+42. 2.50 fl. (Utrecht: Kemink en Zoon.)

Littlehampton, Sussex. Official Guide, 1926. Pp. 100. (Littlehampton: Urban District Council.)

University of Leeds. Report on the Department of Mining, Session 1924–1925. Pp. 10. (Leeds.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 7, 1925. ii: Nederbörden i Sverige. Pp. 169. (Stockholm.) 5 kr.

The Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3. Report on the Work of the Department of Petroleum Technology, Session 1925–1926. Pp. 4. (London.)

Report on the Health of the Army for the Year 1924. Vol. 60. Pp. iv+146. (London: H.M. Stationery Office.) 3s. 6d. net.

University of California Publications in American Archaeology and Ethnology. Vol. 21, No. 7: The Uhle Pottery Collections from Chancay. By A. L. Kroeber. Pp. 265-304+plates 80-90. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 60 cents.

Diary of Societies.

SATURDAY, July 10.

Biochemical Society (in Biochemical Department, Museum, Oxford), at 2.30.—H. W. Buston and Prof. S. B. Schryver: The Isolation of a Hydrolysis Product of the Proteins Hitherto Undescribed.—L. G. McGuire and Prof. S. B. Schryver: The Isolation of a Hydrolysis Product of the Proteins Hitherto Undescribed.—L. F. Hewitt: The Rotatory Power and Dispersion of Proteins.—H. A. Abramson, P. Eggleton, and M. G. Palmer: The Fate of Sodium Lactate Injected Intravenously.—C. E. Grover and A. C. Chibnall: Preparation of Asparaginase from the Rootlets of Germinating Barley.—Prof. J. C. Drummond and G. F. Marrian: Relation between Vitamin B and Metabolism.—V. B. Reader and Prof. J. C. Drummond: Relation between Vitamin B and Protein in the Diet.—J. Needham: The Non-protein Nitrogen in the Developing Avian Embryo.—H. W. Dudley, O. Rosenheim, and W. W. Starling: The Constitution and Synthesis of Spermine.—C. G. Douglas: The Ferricyanide Method of Blood-Gas Analysis.—F. Hawking: Synthesis of Antineuritic Factor by Yeast.—V. B. Reader: Effect of the Interfacial Tension of the Medium on the Growth of Streptothrix.—H. W. Kinnersley and R. A. Peters: A Case of Inactivation of Torulin.—Demonstrations by V. B. Reader: Abnormal Growth of *Streptothrix corallinus*; and A. E. Garrod and L. Mackey: Congenital Porphyrinuria.

Physiological Society (in Department of Physiology, University, Sheffield), at 2.—Prof. H. S. Raper and E. C. Smith: Insulin and Acetone Production in the Perfused Liver.—Prof. H. S. Raper and E. J. Wayne: A Quantitative Study of β-oxidation.—H. Florey: The Function of the Lacteals.—A. S. Parkes and C. W. Bellerby: The Œstrus-inhibiting Hormone of the Corpus Luteum.—May Mellanby and C. Lee Pattison: Diet in relation to the Onset and Spread of Caries in Children.—E. Sudie and Prof. E. Mellanby: The Influence of Light on the Antirachitic Action of Foods.—M. H. MacKeith: A Note on the Action of Alcohol on the Perfused Isolated Rabbit Heart.—M. Hurst and C. G. Imrie: Nitrogenous Metabolism in Post-encephalic Rigidity.—C. Tingle and C. G. Imrie: Effect of Pituitrin on Blood Sugar Curves.—E. C. Eaves: Changes in the Pituitary following Repeated Insulin Injections.—E. C. Eaves and G. A. Clark: Changes in the Pituitary after Section of the Right Vagus.—G. A. Clark: Antagonism of Insulin and Pituitrin.—W. H. Newton and B. A. McSwiney: The Reaction of Smooth Muscle to Changes in the H-ion Concentration.—E. N. Wilmer: The Influence of Glucose on the Survival of Cells *in vitro*.—A. Hemingway and Prof. R. J. S. McDowall: The Acid-Base Control of the Capillaries.—C. A. Mills: The Rôle of Tissue Fibrinogen in Blood Clotting.—F. W. Lamb and K. R. Fraser: Oxygen Tension in Mixed Venous Blood.—J. P. Hoet: The Action of Pilocarpine on the Spleen.—W. Smith: Insulin and Diastase.—J. C. Bramwell: Analysis of the Phonoarteriogram.—J. C. Bramwell and B. A. McSwiney: Hot-wire Record of the Venous Pulse.—Demonstrations by E. C. Eaves: Changes in the Human Pituitary associated with Abnormalities of Growth.—M. Croll and E. C. Eaves: (*a*) Ductless Glands of a Cretin; (*b*) Changes in the Pituitary produced experimentally in the Rabbit.—G. Wilkinson: The Mechanism of the Cochlea: the Influence of Fluid Load on the Vibration Period of Immersed Membranes.—F. W. Lamb and G. J. Woolham: Records of Muscle Tremor and Muscular Balance.

TUESDAY, July 13.

Royal Society of Medicine (Anæsthetics Section—Visit of American and Canadian Anæsthetists) (at 1 Wimpole Street, W.), at 10 a.m.—Papers by Prof. J. S. Haldane, T. P. Dunhill, and Dr. J. Blomfield.

WEDNESDAY, July 14.

Royal Society of Medicine (Anæsthetics Section—Visit of American and Canadian Anæsthetists) (at 1 Wimpole Street, W.), at 10 a.m.

THURSDAY, July 15.

Royal Society of Medicine (Anæsthetics Section—Visit of American and Canadian Anæsthetists) (at 1 Wimpole Street, W.), at 10 a.m.—American Session.

SATURDAY, July 17.

Society for Experimental Biology (in Department of Natural History, University of Edinburgh), at 10 a.m.—Dr. F. A. E. Crew: The Developmental Capon and Poulard.—E. A. Spaul: The Metamorphic Principle of the Anterior Lobe of the Pituitary.—W. P. Kennedy: Diet and Reproduction in the Rat.—Prof. J. H. Priestley: The Perception and Transmission of Stimulus in the Coleoptile of the Grass Seedling.—L. A. Harvey: The Relation of Cell Inclusions to Cell Metabolism.

MONDAY, July 19.

Society for Experimental Biology (at the Botanical Gardens, Edinburgh), at 10 a.m.—J. Gray: The Growth of Fish.—E. Philip Smith: The Effect of Acidity on Regeneration in Coleus.—J. W. Gregor: The Influence of Environment on the Formation of definite Habitat Types.—K. B. Blackburn: Some Observations on Sex and Chromosomes in Plants.—(In Department of Natural History, University of Edinburgh), at 2.30.—A. Walton: The Survival of Fertilising Capacity of Rabbit Spermatozoa *in vitro*.—A. D. Hobson: The Formation of the Fertilisation Membrane in *Echinus esculentus*.—E. Ponder: The Kinetics of Hæmolytic and Bacteriolytic Reactions.—T. Rettie: Demonstration of a Histological Method for the Early Stages of Cell Injury.

CONFERENCES.

July 13 to 16.

Royal Medico-Psychological Association (at House of British Medical Association).

Congress of the Universities of the Empire (at Cambridge).—Subjects for discussion and names of chairmen: The State and the University (Earl of Balfour); The Desirability of establishing in London a School of Advanced Legal Studies (the Lord High Chancellor); Co-operation in Research throughout the Empire (Marquess of Londonderry); Mutual Recognition of Examinations and of Time spent in Study Elsewhere (Sir Matthew Nathan); The Desirability of making Provision for the Physical Welfare and Training of Students and the Organisation of Athletics with a View to securing more general Participation (Duke of Devonshire); The Actual Working of the Ph.D. Scheme (Viscount Cecil of Chelwood); The Desirability of Articulating other Pension Schemes with the Federated Superannuation System of Great Britain and Ireland (Lord Haldane).

July 15 to 17.

Oxford Ophthalmological Congress.

July 15 to 19.

Journées Médicales de Paris (at Paris).

July 20 to 23.

British Medical Association (at Nottingham).

July 22 to 28.

International Congress on Alcoholism (at Dorpat).

July 26 to 31.

French Association for the Advancement of Science (at Lyons).

August 16 to 23.

International Botanical Congress (at Cornell University).

SATURDAY, JULY 17, 1926.

CONTENTS.

PAGE
Bird Protection in Great Britain. By Dr. James Ritchie . . . 73
Physiological Optics and Psychology. By Prof. W. Peddie . . . 74
The Future of America. By T. Ll. H. . . . 76
Colloid Chemistry . . . 77
Aspects of the Oceans. By Dr. Hugh Robert Mill . . . 78
Our Bookshelf . . . 79
Letters to the Editor:
  Solidification of Helium.—Prof. W. H. Keesom 81
  Supplementary Note on Radiation.—Sir Oliver Lodge, F.R.S. . . . 81
  Prof. Miller's Ether Drift Experiments.—Prof. Hans Thirring . . . 81
  The Molecular Spectrum of Carbon Dioxide.—Joseph W. Ellis . . . 82
  Higher Order X-ray Reflections from Fatty Acids.—J. A. Prins and Dr. D. Coster . . . 83
  Transmutation Experiments.—Milan W. Garrett . 84
  The New Element of Atomic Number 61: Illinium.—Prof. Bohuslav Brauner . . . 84
  Identity of *Herpetomonas papatasii* and *Leishmania tropica*.—S. Adler and O. Theodor . . . 85
  Pernicious Grafting.—Dr. Michael Grabham . 85
  Organo-Metallic Compounds.—Wm. H George . 85
  Blood Reactions and Sex.—Dr. F. A. E. Crew . 85
X-Rays and Living Matter. By Prof. J. A. Crowther . . . 86
The Rhynie Crustacean. By Dr. W. T. Calman, F.R.S. . . . 89
Obituary:—
  Dr. Edward J. Bles. By Sir F. G. Hopkins, F.R.S. . . . 90
  Prof. V. A. Steklov. By Prof. A. Kriloff . 91
News and Views . . . 92
Our Astronomical Column . . . 97
Research Items . . . 98
Studies in Eugenics and Human Heredity in South Africa. By E. W. M. . . . 101
Research in Illumination . . . 102
Primitive Time Reckoning and the Calendar . . 103
The Need for Precision in Botanical Terminology . 103
University and Educational Intelligence . . . 104
Contemporary Birthdays . . . 105
Societies and Academies . . . 105
Official Publications Received . . . 107
Diary of Societies and Conferences . . . 108

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Bird Protection in Great Britain.

THE re-introduction to the House of Lords a few days ago of a Bill for the Protection of Wild Birds suggests a glance at some aspects of bird protection in Great Britain. The new Bill proposes to repeal the Statutes, nine in number, extending from 1880 to 1908, which regulate the legal protection of birds in this country, and to replace them by a single body of law more in keeping with present-day notions of bird protection, and in some respects more stringent in its defence of the birds and more exacting in the penalties to be demanded from law-breakers.

This consolidation of bird protection legislation is a welcome move, for the multiplicity, and to some extent confusion, of the old laws militated against their successful working, and unfortunately the need for rigorous protection is still clamant. During the present season we have had the unedifying spectacle of a well-known naturalist and observer being heavily fined for abetting in the taking of clutches, twenty-three eggs in all, of the crossbill in Norfolk. In the Grampians, Mr. Seton Gordon found that the golden eagle's eggs which he had under observation were taken from the eyrie after they had been incubated for nearly five weeks, that is to say, when the chicks were on the point of hatching and the eggs could have been of no value to the collector. These cases are symptomatic of a vast amount of raiding of the nests of the rarer birds which is taken part in and encouraged by unscrupulous collectors who have the audacity to put science in the forefront of their excuses. It is almost impossible, however, for the law unaided to check such misdemeanours. They will be discouraged and arrested only when public opinion makes its voice heard with no uncertainty in the matter.

It is gratifying to know that public opinion is awakening to the realities of the situation and that steps have been and are being taken, by the Government, by municipalities, and by private bodies, which should go a long way to arouse interest in a vast section of the public which has few opportunities of observing Nature at large. To the enthusiasm of Sir Lionel Earle, chairman of the Bird Sanctuaries Committee (England), was largely due the formation of that committee, under H.M. Office of Works, and the institution, following on the report of the committee issued in 1922, of bird sanctuaries in the Royal Parks in London. The report for 1925, just issued, shows that the sanctuaries continue to give great encouragement to bird life, and that efforts are continually being made, by increasing the amenity of the reserves from the birds' point of view, to encourage the influx of greater numbers and greater variety of wild birds. Supplementary reports dealing with the sanctuaries at Hyde Park, Kensington Gardens, Richmond Park, Bushey Park, Greenwich Park, St. James's and Green Park show not only that the reserves were largely used as resting-places by birds on migration, but also that a very considerable variety of wild birds took up their summer residence there At least 18 species nested in Hyde Park and Kensington Gardens, 47 in Bushey Park, and 55 in Richmond Park.

There can be no doubt that a great part of the success of a small sanctuary depends upon the selection of the proper vegetation, and that the steps taken by the Bird Sanctuaries Committee, with the view of offering an attractive food supply to winter migrants, and suitable shelter for summer residents, have done much to ensure the increasing success of the sanctuaries in the Royal Parks. These steps include the planting of berry-bearing trees and of suitable nesting bushes for summer residents, the thinning out of plantations in order that wild flowers, such as foxgloves, willow-herb, and thistles, may grow and seed, and the sowing of teazles, a winter food particularly favoured by goldfinches.

In Scotland, similar steps have been taken in the Royal Park of Holyrood, where Duddingston Loch with its extensive reed-beds, a much-frequented winter haunt of immigrant ducks, promises to become a reserve of outstanding interest. During the present season, it is recorded by Mr. Kirke Nash that the common pochard, which has not hitherto been known to nest in Midlothian, has reared two broods on the Loch.

In several cases city corporations have taken part in the sanctuary movement, the lead having been taken in Scotland by Glasgow, which has created bird reserves, with feeding-tables and so on, in its public parks. The movement is well fitted to stimulate public interest, for it affords new and hitherto unattainable opportunities to town-dwellers for the observation, if not of nests and eggs, at any rate of adult and young birds at the most interesting stage of their existence. Furthermore, it places before the minds of all and sundry, with steady insistence, the facts that birds have an interest and afford pleasure, and that they require protection. The extension of the municipal formation of bird sanctuaries in public parks is a movement worthy of every encouragement because of its possibilities in moulding a wide appreciation of living things; but it must be recognised that such steps can have no bearing on the pressing question of the protection of the rarer birds which are threatened by the attention of the collector.

For the progress made, no body deserves more credit than the Royal Society for the Protection of Birds. The annual report of this influential society indicates the part taken by the Society's watchers in ensuring the safe breeding in certain localities of some of the rarer birds, such as choughs, Kentish plover, Norfolk plover, Dartford warbler, phalaropes, and others. It points out to how great a degree the extension of motor traffic, the breaking up of great estates, and expansive building, are gradually obliterating woods, parks, and meadows, and spreading disturbance in the countryside. In the result, the homes, haunts, and food supplies of wild birds are being altered, and a steady change is taking place in the character, though not in the numbers, of the bird population. It points out that the destruction of sea-birds caused by the deposition of oil at sea, either as waste from oil-driven ships or as cleanings of tankers, is a problem that still seems far from solution, in spite of the three-mile limit imposed upon such discharge by law. But several nations have taken up this matter with energy, and sooner or later some means may be found through international action of avoiding needless destruction.

The report states that afforestation, which had become an imperial necessity, gave many a qualm to the lover of natural woodlands not planted for profit or grown for the axe. In this connexion, the Government could not do better than emulate the action of the various States of Australia, which automatically convert forests under the charge of Government departments into wild animal reserves. Were similar measures taken in Great Britain with regard to the Government afforestation areas under the control of the Forestry Department, a first and important step would be made towards the protection of the rarer birds and beasts, and towards the realisation of that national park which Britain alone amongst the great nations still lacks.

JAMES RITCHIE.

Physiological Optics and Psychology.

Helmholtz's Treatise on Physiological Optics. Translated from the third German edition. Edited by Prof. James P. C Southall Vol. 3: *The Perceptions of Vision.* Pp. xi + 736 + 6 plates. (Ithaca, N.Y.: Secretary, Optical Society of America, Rockefeller Hall, 1925.) 7 dollars.

> *"To the solid ground*
> *Of Nature trusts the mind which builds for aye."*
> —WORDSWORTH

THE issue of this volume completes a great task. The English-speaking public has now at its disposal for the first time an edition in English of the epoch-making work of von Helmholtz as it originally appeared, along with the new material which was included in the third German edition to bring the work up-to-date, and some additional matter specially included in the American edition. In the present volume, this additional matter, contained in two notes by von Kries, one on the perception of depth, the other on visual rivalry, is less in amount than the corresponding matter in the first two volumes. But the whole volume is considerably larger than either of the others, and about one-third of it is occupied by the notes and the appendix contributed by von Kries, on almost every branch of the subject dealt with, which were added to the third German edition of the text. The notes appear at the ends of the several divisions of the subject, and the appendix is given at the end of the volume. It deals with the nature of the idea of space in general, the relations of normal localisation, localisation and anomalous eye adjustment, learning to see, and forgetting, the physiological foundations of judgment and learning, empiricism and nativism or intuitionalism, the origin of the laws of the ocular movements, historical and critical comments, and the theory of binocular instruments.

The whole subject of physiological optics involves physical, physiological, and psychological questions. The present volume deals specially with the latter and the phenomena which give rise to them. In this department, as in the other two which were specially treated in the first and second volumes, Helmholtz was a pioneer. Much time has elapsed since he wrote his discussion; and it might be expected that much, perhaps radical, change of view may have taken place especially where opposing theories were concerned. Helmholtz realised his position clearly. "It ought to be said in the beginning," he remarks, "that our knowledge of the relevant phenomena is still too limited to justify us in acceptance of any one theory to the exclusion of all the others." "I acknowledge that we are still far from a real scientific comprehension of psychic phenomena." "I frankly admit, however, that these questions under discussion are not altogether ready for final decision. My own attitude to them is due partly to the simplicity of the explanations that are afforded in this way, but especially to systematic considerations also; for I think it always advisable to explain natural processes on the *least* possible number of hypotheses and on those which are as *definitely formulated* as possible." Here we have Helmholtz's creed, which we have already recognised (NATURE, vol. 114, p. 887, vol. 116, p. 88) in rigid application in the physical and the physiological tracts of the subject, carried over scrupulously into the less well-charted psychical region—simple postulation, simple formulation, simple explanation, appeal to facts. "To the solid ground of Nature trusts the mind which builds for aye."

In accordance with this undeviating search for truth as tested by its outstanding characteristics, in accordance with this systematic presentation of it in a form of statement the most easily testable, is there also to be found, in this volume as in the other two, the impress of the hall-mark of time, stamping it as the enduring creation of genius? In answer we need only select, almost at random, words of von Kries, the writer of the notes and the appendix which review and estimate the further advance of the subject during half a century. He takes, in one respect at least, a line of thought differing from that of Helmholtz, but his words are such as these.

> "Helmholtz's classical work, published more than forty years ago, was based partly on philosophical considerations, partly on comparatively simple results of direct self-observation, and, partly too, it should be added, on a vast amount of empirical observation in the ordinary sense. But even in this latter respect, in spite of many new facts that have been gleaned and some corrections that have to be made here and there, the material contained in the first edition of the 'Physiological Optics' may still be said to be essentially correct and pertinent."

> "Those points in regard to localisation where we have been obliged to differ from Helmholtz (or rather, strictly speaking, where it was found necessary to develop his theory further) are only of secondary importance after all, no matter how much weight may be attached to them."

> "It would be therefore a complete misapprehension of Helmholtz's views (as has been intimated sometimes) that he meant to deny altogether the participation of innate factors in the case of localisation. The truth is, rather, that Helmholtz was disposed to think that from his point of view it was extremely probable that there was some kind of co-operation such as we have deemed likely; that is, with respect to the relationship existing between the visual direction and the location on the retina, although he doubted whether such an assumption could be absolutely verified. The fact that modern investigations of strabismus have enabled us to develop still further assumptions of this sort need not imply that any fundamental modification has been made in Helmholtz's theory."

> "The main thing to be remembered is that to a great extent these modern investigations have *corroborated* in a very positive manner inferences that Helmholtz had already made from the scant material at his disposal at that time. The main conclusions which he reached have been shown to be absolutely probable."

> "The facts tend to support the fundamental conceptions of an empirical theory to a remarkable degree, although perhaps not altogether to the extent that Helmholtz supposed. It would be turning things upside down, it seems to me, to regard these new facts as a corroboration of the points of view of the intuition theory. They are certainly the opposite of what might be anticipated on the basis of those conceptions."

> "After all, naturally disposed as I am to agree with many of my *confrères* and to regard learning as being a physiological process, I never have been able to consider this as amounting to any profound or fundamental divergence from Helmholtz's views."

> "Helmholtz was absolutely right in disputing the very principle on which the whole nativist conception was based."

> "It was stated at the outset (and the fact has been brought out still more clearly in the course of this discussion) that it would be a mistake to think of nativism and empiricism as two mutually antagonistic conceptions involving a choice one way or the other. Experience is placed in the foreground in the empirical theory, and innately determined relations in the intuition theory; and undoubtedly (speaking perfectly generally) both of these things have something to do with our perceptions of space. Here, if anywhere, it will be true that there is a certain amount of justification for each of the two originally conflicting opinions, according to the degree of importance that was attached to one or the other of these things."

> "Any one who will follow the argument as here presented will see that the principle which has guided us, and which remains still to-day the best way of obtaining an insight into those problems and is the basis of future investigation, has been the empiricism of Helmholtz, even though it has had to be modified and amplified in many respects."

In the development of any scientific subject, fundamentally unprovable postulates have to be made. In the present case these are the postulates of the innateness of certain ideas or intuitions. The aim in all sciences is to reduce these to a minimum, and Helmholtz, in his development of the subject, strove to push the unexplained intuitional basis as far back as possible. There are three ways in which the expression of conditions may be made in regard to vision: the physical, the physiological, and the psychical. Each of these is equally fundamental and contributive. Each, if the interconnexions were given, is equally valid and available for the expression of the ultimate laws and explanations. Yet Helmholtz's use of the psychological mode of description of the phenomena, for example, especially in regard to phenomena of colour contrast, has been decried as a subterfuge and an error. "The more attentively I have studied the phenomena," he says, "the more I have been impressed by the uniformity and harmony everywhere of the interplay of the psychic processes, and the more consistent and coherent this whole region of phenomena has appeared to me." The whole of his psychic treatment of the phenomena of colour contrast, far removed from the exclusion of future development, can be expressed in mathematical symbols and equations involving the external stimuli and the threshold values which sum up the effects of the internal physical, physiological, and psychic activities.

No mistake is made by von Kries in this connexion. He says: "Some brief allusion may be made to the utter inaptness of an opinion which is sometimes expressed, namely, that, since Helmholtz's views were *psychological*, they had put an end to all further investigation." "In fact we owe it to the 'empiricists' and not to the 'nativists,' that a new and fruitful line of inquiry has been started by studying strabismic vision, for instance." "On the other hand, the feature of the nativist systems that aroused Helmholtz's special opposition must also be pronounced unsound and untenable at present"

Recognition should be made of the unusually fair and careful way in which von Kries states his own views when they differ from those of von Helmholtz. He has attained to that absolute impartiality which is so difficult to reach even in scientific discussion. Alike in judicial fairness, in acuteness of perception, and in concise clearness of expression, his work is worthy of its place alongside that of the master.

The editor of this edition, along with his band of able co-workers, are to be congratulated on the completion of the task of translation. Resting from their labour, they can await the award. For the issue of this edition cannot fail to have its influence on future work in the field with which it deals. It is fitting that its home should be in America, for a strong group of the workers dwells there, but it should, and will, go out into all the world. W. PEDDIE.

The Future of America.

(1) *Midas: or, The United States and the Future.* By C. H. Bretherton (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1926.) 2s. 6d. net.

(2) *Atlantis: America and the Future.* By Colonel J. F. C. Fuller. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E P. Dutton and Co.; n.d.) 2s. 6d net.

THESE two small books on a great subject are included in the "To-day and To-morrow" series, designed by the publishers to provide a stimulating survey of the most modern thought in many departments of life. Both are accordingly written in a critical and provocative style, compact with aphorisms. America's place in the world is assured and no resentment will be felt there at attempts to discover chinks in her formidable armour. Of the two books, Mr. Bretherton's is the longer and more careful study. Colonel Fuller's suggests the rapid travel impressions of a writer possessing a mature knowledge of world-history.

What is the basis for the strong and not altogether comfortable feeling that America is destined to exercise a powerful influence on the future of the world? The American, "the new white man," marches round the world with his war drum and the European falls in behind "with many a backward glance at the good old days" Nevertheless, the achievements of the United States in art, literature and science are unimportant in relation to their wealth and population. Jazz music and the skyscraper are "the only two new art forms" which Mr. Bretherton is prepared to concede to America as contributions to civilisation. As to their education, the United States, he says, have countless universities but no educated class "outside of their college professors, who rank in the social scale a little higher than the average preacher, and a little lower than the average bootlegger." The matter can be tested by the output of books. "More books on natural history, botany and country life generally are published every year in England than have been published in the United States since the *Mayflower* landed there. The same is true of almost every other branch of literature outside of fiction."

As to forms of government, were we not given to understand that America wished to make the world safe for democracy? Mr. Bretherton produces no evidence of any genuine enthusiasm for democracy. Professional politicians, fanatics with a mania for inhibitions, bosses and spellbinders pullulate. The American reacts by forming the habit of acting, thinking, living and believing 'by numbers.' Prohibition, it is well known, does not prevent an American from getting a drink. But this necessitates a mental process. "He will in the end decide that it is simpler (and more profitable) to stay dry and reserve his mental processes for money-making." So with Fundamentalism. The vast majority of American people, Mr. Bretherton asserts, are reconciled to evolution and have no quarrel with science, which scatters machines and fertilisers with a fatherly hand. Fundamentalism will 'win through' because big business will decide that the man-machine who pauses intermittently from wielding his shovel to ask himself unanswerable questions about the macrocosm is a shade less efficient—say by one-tenth per cent.—than if he accepted "the Bible as written." "The most striking thing about the young Americans of to-day," says Mr. Bretherton, "is that they know nothing and have no ideas of their own." They are forgetting how to think. Like goldfish, they chase feverishly round a glass globe, seeming in some mysterious way to be unaware of one dimension. Their industry is amazing, whether in money-making or in ticking off the sights of Europe in Baedeker.

Significantly, neither author attempts a chapter on American humour, perhaps because it would have resembled the famous chapter on snakes in Ireland. The discussion of the American woman seems inadequate to the importance of the subject. Mr. Bretherton regrets her limited output of poetry, fiction and ephemeral literature. Colonel Fuller is captivated by her charms, contrasting her favourably with her brothers, who appeared to him "gross, ill-mannered, and in their straw hats and trouser belts more or less offensive to the eye."

The question obtrudes—How will it all end? It would be unfair to the authors to reveal their conclusions. Both recognise that something will happen some day when America is disillusioned about the power of money and the booster's curve approaches horizontality, its tangent vanishing like the Cheshire cat. The fate of Rome is not reserved for America, for the simple reason that there are no barbarians to rush in and submerge the American counting house and lobster palace "in one red burial blent." Authors who attempt to foretell the future of America in a hundred years are on safer ground than men of science who predict the position of an unknown planet or the properties of an undiscovered element. Their work should be encouraged, for the national tendencies which they explore have their bearing on our daily life. Possibly the jazz music wafted across the Atlantic sounds a clarion bugle-call if we would listen and interpret.

T. Ll. H.

Colloid Chemistry.

(1) *Das kolloide Gold.* Von R. Zsigmondy und P. A. Thiessen. (Kolloidforschung in Einzeldarstellungen, Band 1.) Pp. x + 229. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1925.) 14 gold marks.

(2) *Das kolloide Gold in Biologie und Medizin: die Goldsolreaktion in Liquor Cerebrospinalis.* Von Dr. Ernst Joel. (Kolloidforschung in Einzeldarstellungen, Band 2.) Pp. viii+115. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1925.) 7·50 gold marks.

(3) *Einführung in die Chemie der polymeren Kohlenhydrate: ein Grundriss der Chemie, der Stärke, des Glykogens, der Zellulose und anderer Polysaccharide.* Von Prof. P. Karrer. (Kolloidforschung in Einzeldarstellungen, Band 3.) Pp. ix+295. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1925.) 7·50 gold marks.

(1) THIS is the first of a new series of monographs on colloid chemistry, and the preface, signed by Prof. Zsigmondy alone, serves as a general introduction of the enterprise. The distinguished author deals somewhat severely with certain tendencies which

he discerns in the rapid development of the discipline during the last twenty years; the failure of authors to maintain the standard expected from workers in the field of exact science; a preference for philosophical treatment and undue generalisation; neglect of the chemical nature of the systems investigated, and other shortcomings. Against these has to be set much exact work carried out by isolated investigators, and the object of the series is to collect and co-ordinate such work and to make it generally accessible.

The first volume may certainly be said to have achieved this object; it contains everything worth knowing about gold sols. The methods of preparing them, which are due to the author, are described in every detail, and the necessity of strict adherence to these directions is duly emphasised. Their electrical and optical properties are then treated exhaustively, as well as a number of phenomena which, while not specific to gold sols, have been largely studied on this material; such are coagulation velocity and protection. The chemical composition of the sols is also discussed at length, and the author produces ample evidence to show that stable sols need not contain oxygen; a result which contradicts the view held—at least at one time—by Pauli and his school, that 'aurate' complexes impart the negative charge to the gold particles.

The volume illustrates the important part played by the study of gold sols in the development of modern colloid physics and chemistry. That this study leaves untouched some of the most important and difficult problems in this field, such as viscosity and solvation, is worth pointing out to students who are invariably attracted by the ease with which gold sols—of sorts—can be made and by their somewhat spectacular properties.

(2) Dr. Ernst Joel's volume deals with a highly specialised application of gold sol: the Lange method of diagnosing luetic and meningitic infection in the cerebro-spinal fluid. The protective effects of these morbid fluids differ from that of the normal and from one another, so that they can be distinguished by coagulating gold sol with sodium chloride in the presence of the fluid, of course in strictly defined ratios and conditions. By way of introduction the author gives a lucid and detailed account of the phenomena of protection by proteins and protein mixtures, and of the related phenomenon of sensitisation of these bodies. Critical application of this vast and difficult evidence to the Lange reaction seems to lead to the conclusion that the essence of the difference in the three types of fluid is a shifting of the albumin-globulin ratio.

(3) Although the eminently colloidal character of the polymerised carbohydrates has never been in doubt, their systematic study by modern methods has, until recently, lagged far behind that of the proteins. Some impetus has no doubt been given to it during the last decade by the enormously increased importance of cellulose and its esters in the arts of peace and war. The volume under review deals very exhaustively with starch, glycogen and cellulose; other carbohydrates receive briefer but adequate mention. The point of view is largely that of the organic chemist, structural formulæ being discussed at great length; the aspects which particularly interest the colloid chemist, such as apparent molecular or 'micellar' weights, are, however, not neglected. He will, at any rate, find here ample information regarding the chemical character of his materials which will enable him to approach one of the great tasks of the future—the co-ordination of colloidal properties with chemical constitution.

All three volumes are excellently printed and well bound, and the student of colloids who wishes to keep his library complete will have to face the purchase of these and of subsequent monographs in the series.

Aspects of the Oceans.

A Study of the Oceans. By Prof. James Johnstone. Pp. viii+215. (London: Edward Arnold and Co., 1926.) 10*s.* 6*d.* net.

LIVERPOOL is distinguished amongst British universities by the possession of a chair of oceanography from which Prof. Johnstone speaks as an exponent of the science. The subject naturally appeals most strongly to a seafaring people in those practical aspects which affect navigation, cable-laying, fisheries and the like; but Prof. Johnstone very wisely takes a wider view in opening out vistas of geological evolution and historical discovery. These considerations, rightly balanced, should serve to place the subject on a wide academic basis. The exact purpose of the book before us is not stated, but the seven chapters read like a series of semi-popular lectures each so far complete in itself as to involve a certain amount of repetition, not unhelpful to students though detracting in some degree from the close-knit unity which one looks for in a scientific treatise.

The elements of the book are rather difficult to blend. The first chapter deals with an advanced modern problem, the geological history of the oceans, and the next two with the speculations of the ancient Greeks and the history of nautical discovery since the time when the Mediterranean was 'The Great Sea.' The four remaining chapters deal from both points of view with the circumpolar regions, the Atlantic, the Pacific and the Indian Oceans respectively. The difficulty of developing such a plan is obvious. It might have furnished a satisfactory course of University Extension lectures delivered with the animation of an enthusiast to an eager audience, and some passages (*e.g.* p. 122) suggest that, like Huxley's "Physiography," the book owes its literary form to notes taken from extempore speaking. If, however, the object was not to stimulate general interest but to guide serious study, a more systematic treatment and more sedulous revision would have done fuller justice to the author's wide knowledge.

No one can bring a great subject within the compass of a small book without leaving out much which is really of importance. Hence an author should not be taxed with omissions which he probably recognises and regrets; still, it is surprising to find that even so brief a history of the oceans as this could be written without mentioning the name of Maury. The publication of Maury's "Physical Geography of the Sea," in 1855, seems to many of us to have been the launch of the modern science of oceanography, and the memory of the great American sailor deserves to be kept alive.

I confess that I do not know enough of geology or ancient history to pass an opinion on the exposition of these subjects, but I do venture to question Prof. Johnstone's subdivision of the oceanic depression (p. 11) into *Continental Shelf* and *Ocean Bed* with the boundary between the two taken as the line of 1000 fathoms. If room could have been found for a notice of the hypsographic curve, the advantage of a more detailed subdivision of the ocean floor and slopes would probably be recognised. Even granting that the 1000 fathom isobath is to be taken as a physical boundary, it is unfair to give to the region on its landward side the name of the Continental Shelf. Most other oceanographers have accepted that term as meaning the gently sloping zone covered by shallow water extending from low-water mark to a depth of about 100 fathoms, or in rare cases, as on the Antarctic coasts, to 200 or 300 fathoms. It corresponds to the old nautical 'in soundings,' and at its deeper end there is always a sudden increase in the gradient of the Continental Slope which leads to the ocean depths. When I introduced the term in 1888, I was impressed by the wide flat expanse of the Vidal Bank west of Scotland, and recognised that it was not a local but a world-wide feature of the transitional area between land and the deep sea. Prof. Johnstone has no doubt excellent reasons for departing from the international nomenclature settled for the great Monaco bathymetrical chart, and he may have stated them in some work with which I am not familiar. It would, however, have saved confusion and perhaps perplexity if he had chosen for this zone covered with water from 0 to 1000 fathoms deep, a name which was not already in use for a definite and restricted portion of the area which he includes within it.

The book has the advantage of a good index and a brief bibliography, which might well have been supplemented by reference to the foreign literature of the subject.

HUGH ROBERT MILL.

Our Bookshelf.

Ancient Greece at Work: an Economic History of Greece from the Homeric Period to the Roman Conquest. By Prof. Gustave Glotz. Translated by M. R. Dobie. (The History of Civilisation Series.) Pp. xii+402. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 16*s.* net.

IN "Ægean Civilisation," a previous volume in this series, Prof. Glotz traced Mediterranean culture from its beginnings to its culmination in Minoan Crete and its decline on the mainland. To present as complete a picture as possible he sketched such an outline of the social organisation of these early periods as may be deduced from archæological remains, eked out with evidence from other sources. In the present volume he takes up the social and economic story of Greece at the point where the previous volume ended. Beginning with the pastoral society of Homeric times, he traces the development of social and economic organisation through the archaic period, the predominance of Athens, and Hellenistic times. Each period has its peculiar characteristic and, as he points out, no general statement is applicable to Greek economics as a whole, but only with special reference to some one of these periods.

Those who are not already familiar with the data will probably be surprised at the amount of information Prof. Glotz has been able to gather together relating to the early Homeric period. The manner in which he extracts his material from incidental references and allusions in the Iliad and Odyssey commands our sincere admiration. At the same time, his deductions are capable of being checked by comparison with what we know of pastoral societies elsewhere which are organised in groups similar to the Greek *gene*. The archaic period, notwithstanding that evidence of a more direct character is available, is really more obscure. The treatment of the period of the Athenian hegemony is illuminating. It is, of course, recognised that slavery is the essential factor in the social and economic organisation, but it is especially in relation to the position of the metics that Prof. Glotz is most suggestive. Is it not possible that the influence of this element in the population in the subsequent development of the characteristics of the Greek people has been underrated?

The Chemistry of Drying Oils. By Dr. R. S. Morrell and H. R. Wood. (Oil and Colour Chemistry Monographs.) Pp. 224. (London: Ernest Benn, Ltd., 1925.) 21*s.* net.

CHEMICAL industry has become so highly specialised that at the present day it is practically impossible for one person to write from first-hand knowledge a trustworthy text completely covering even one industry. It is only by a series of monographs continually being brought up-to-date and written by experts with direct knowledge of particular processes that detailed information of real value can be secured. Under the editorship of Dr. Morrell we have an example of such a series of monographs for the oil and colour industry of which the volume under notice forms a part.

The expression and extraction of linseed and other less known oils from their seeds, the refining and bleaching of these oils as well as the preparation of boiled, blown and stand oils, receive detailed treatment. The use of these oils in the manufacture of linoleum and patent leather and the employment of drying oils as electrical insulators receive detailed consideration. The aim has been to give a trustworthy account of the most recent information regarding various processes and methods, with a critical survey of the literature by works' experts. Notwithstanding the bias towards the industrial aspect, stress has been laid by the authors on the importance of physical properties in relation to chemical changes. The composition of drying oils and their component acids, with the chemical changes occurring on drying, have been exhaustively treated before discussing manufacturing details. A valuable addition is the good list of references at the end of each chapter.

The book is excellently produced, and in fact for a monograph that will require frequent editions to keep abreast of practice, the finish is, if anything, too durable. The high price of this book, with only 200 pages of text, makes such a remark pertinent. J. REILLY.

Three Men Discuss Relativity. By J. W. N. Sullivan. Pp. xxx+233. (London and Glasgow: W. Collins, Sons and Co., Ltd., 1925.) 7*s.* 6*d.* net.

MR. SULLIVAN has achieved something new in the exposition of relativity by writing in dialogue form. One is inevitably reminded of Galileo, but in Mr. Sullivan's book, unlike that of the great Florentine, the characters are not provided with conflicting preconceptions. They are, in fact, not private individuals so much as actors whose parts are made to fit together in such a way as to provide a smooth, uninterrupted account of the theory for the reader. After a brief introduction, six dialogues are set forth, between a mathematical physicist, a philosopher, and an ordinary intelligent person. The mathematical physicist has undertaken to expound the theory of relativity to his companions, who make just the right remarks or ask appropriate questions at frequent intervals. It must be confessed that the ordinary intelligent person is much more intelligent than the sort of person one ordinarily meets with.

From an artistic point of view, the dialogue method as here employed can scarcely be regarded as successful. It does, however, add considerably to the interest of the exposition, and is on that ground justified. The mathematical detail of the subject is almost completely excluded from the dialogues and given in a 45-page summary at the end. Those who wish to obtain an accurate idea of relativity in rather more than its outline and are prepared to expend some mental effort, can do no better than read this agreeable and well-produced volume. "My own indebtedness," writes the author, "is chiefly to Prof. Eddington's 'Mathematical Theory of Relativity.' It is easily the best exposition I have read, and I have adhered to it almost slavishly in the following pages." It will be gathered that the treatment is not wholly original, but the book is not a superfluous paraphrase of Eddington's work.

The Geology of the Netherlands East Indies: Lectures delivered as Exchange-Professor at the University of Michigan in 1921–1922. By Prof. H. Albert Brouwer. Recorded and prepared by Laurence M. Gould. (University of Michigan Studies, Scientific Series, Vol. 3.) Pp. xii+160+18 plates. (New York: The Macmillan Co., 1925.) 3 dollars.

THE thanks of all students of geology are due to Prof. Brouwer and to the University of Michigan authorities for this very readable and well-illustrated digest of our present knowledge of East Indian geology; the more so because a large proportion of the extensive literature published on the subject during the last few years has appeared in Dutch.

Of especial interest are those chapters dealing with the tectonic and volcanic features of the region, and their bearing on modern theories of Alpine structure. The author explains how the configuration of a large part of the Archipelago—in particular the two festoons of islands which surround the Banda Sea—is a direct expression of mountain-building processes still in operation. The foreland is formed by the Australian continent and the bordering Sunda shelf; the rising festoons are actual geanticlines, and the deep, elongated sea-basins between them true geosynclines; the younger arc (the inner one) is characterised by active volcanicity, which is absent in the older one. If the compressive forces now in operation persist, a continental mountain range of the Alpine type may ultimately develop.

Higher Mathematics: for Students of Engineering and Science. By Frederick G. W. Brown. Pp. xii+488. (London: Macmillan and Co., Ltd., 1926.) 10*s.*

THIS work embodies those branches of pure mathematics required by senior engineering students up to degree standard and it covers the field very adequately. There are chapters on determinants, spherical trigonometry, several chapters on differentiation and integration and ordinary differential equations up to simultaneous systems, plane curves and three dimensional geometry. For an attempt to return from the monograph to the 'comprehensive' type of book it is eminently successful, and the numerous examples are well chosen with the correct practical bias. The theoretical parts are weaker in presentation than the practical portion, but not sufficient to vitiate a really useful book.

Wolfram: Fortschritte in der Herstellung und Anwendung in den letzten Jahren. Von Dr. Hans Alterthum. (Sammlung Vieweg, Heft 77.) Pp. viii+111. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1925.) 4·50 gold marks.

THIS useful monograph contains an account of the newer researches on tungsten, its alloys and more important compounds, made since 1910, and is not a complete account of the subject. The localities of the occurrence of tungsten ores, the preparation of tungsten and the physical properties of the metal, together with analytical information and some account of the compounds, are dealt with. There is no index.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Solidification of Helium.

ON June 25 helium was compressed in a narrow brass tube forming communication between two German silver tubes The brass tube and part of the two German silver tubes were in a liquid helium bath. At a pressure of 130 atmospheres the tube system appeared to be blocked. When the pressure was diminished by 1 or 2 atmospheres the tube system was open. The temperature of this experiment was somewhat uncertain By diminishing the pressure of the liquid helium bath the same phenomenon was observed at a temperature of about 3·2° K at 86 atmos., and at a temperature of about 2·2° K at 50 atmos From the regularity of the phenomenon it appears that we were observing the solidification curve of helium This method of observing solidification has indeed already been used by Kamerlingh Onnes and Van Gulik in preliminary measurements on the curve of solidification of hydrogen.

A repetition of the experiment on July 1 confirmed the early observations. At 4·2° K. helium solidified at 140 atmos. The solidification curve was prolonged to 1·1° K., and the helium solidified then at 26 atmos. The exact numerical data will be given elsewhere. The solidification curve bends so that at the lower temperatures it shows a tendency to become parallel to the axis of the temperatures So far as can be ascertained from these observations, helium is expected not to have a solid-liquid-gas triple point.

Finally, helium was compressed in a glass tube provided with a magnetic stirrer after the pattern of Kuenen. The observations on the solidification of helium were confirmed The stirrer was seen to stick when the helium solidified. In one experiment part of the substance was liquid and part solid. One could hammer the solid block with the stirrer that was in the liquid part A limiting surface between the solid and the liquid could not, however, be seen. Solid helium forms a homogeneous transparent mass, the refractive index of which probably differs extremely little from that of the liquid

W. H. KEESOM.

University of Leyden.

Supplementary Note on Radiation.

PERMIT me to make a little correction to my letter on page 891 (June 26) about the law of radiation. It is usual to quote Rayleigh's law in the form there given, namely, $8\pi RT\lambda^{-4}$, the $8\pi R$ part is, however, due not to Rayleigh but to Dr. Jeans (see *Phil. Mag.* for July 1905) In Rayleigh's 1900 paper he left the constant undetermined. Afterwards, in NATURE for May 18, 1905, he concluded, from simple gas-theory, that the constant would be $64\pi R$, but Jeans speedily pointed out a source of error, and made the constant $8\pi R$, a correction which Rayleigh at once accepted (see his "Collected Works," vol. 5, p 253; also p. 248).

It is interesting to note that had the possible modes of vibration been one-dimensional, as in sound, the numerical part would have been 4π; in light the transverse vibrations have two modes open to them. This makes the constant 8π; while if, as in an elastic solid, vibrations had been possible in all three directions of space, the constant would have been 12π (see Jeans's "Report," p. 14). In no case could it be 64π, but that was a slip, due to counting some integers twice over.

Another point in which my letter might be misleading is that the dynamical proof of the continuous-spectrum law of radiation had given no indication that the result would only be true for long waves. It must have been clear by common sense that it did not hold for short waves, but no reason for this was suggested by orthodox dynamics. The serious discrepancy remained a puzzle, until it was solved by the quantum

In other words, as I express it, neither gas-theory, probability, nor dynamics was competent to express fully the interaction between matter and ether. An expression obtained by attending to continuous equipartition of energy in matter alone, was bound to be incomplete; while if the doctrine of continuous equipartition was extended to the ether, with its apparently unlimited degrees of freedom, the result was impossible Indeed, thirty years previously, Maxwell had emphasised this outstanding difficulty of molecular theory, in his lecture on the "Molecular Constitution of Bodies," reported in NATURE, vol 11, pp. 375-6 (or "Scientific Papers," vol. 2, pp 433-438), and had decided that whatever the constitution of the ether might be it could not be molecular. Discontinuous partition, as represented by the quantum, enabled the true radiation law to be obtained; and the puzzle was thereby shifted to an explanation of the quantum itself—a problem which can scarcely be solved until we possess more knowledge about the intimate structure of the ether.

OLIVER LODGE

Prof. Miller's Ether Drift Experiments.

THROUGH the courtesy of Prof. Miller I have been made acquainted with the results of his February series of observations made on Mt. Wilson, to be published in the *Proc. Nat. Acad Sci*, Washington I am sorry to say that my opinion concerning the significance of the observed displacements disagrees with his so completely that I cannot attribute the effect to any cosmic cause.

The calculations of Prof. Miller and his collaborators lead to the conclusion that an ether drift directed towards a point in the constellation Draco (R.A. 17 h., Decl +68°) would agree best with the observed effects The drift is assumed to be caused by a motion of the solar system towards the given direction with a velocity of approximately 200 km./sec A partial drag of the ether is supposed to reduce this velocity to 10 km /sec. at the surface of the earth, thereby annulling the influence of the orbital motion

My objections against these assumptions are laid down in a paper published recently in the *Zeitschrift fur Physik* (vol. 35, p. 723, 1926). The theoretical curves of the line displacements as plotted against the azimuth of the apparatus are given there for different directions of the ether drift A comparison with the mean value of Prof. Miller's observations shows systematic deviations as large as the full amount of the effect occurring at certain hours of the day. The asserted good agreement between the assumed ether drift and the observations is due to the fact that Prof Miller has arbitrarily displaced the theoretical curves, giving the azimuth of drift as a function of sidereal time to match the empirical curves This procedure may be justified in all cases where only the *shape* of the curves is essential. In the present case, however, the absolute values of the curves play a fundamental rôle.

As Prof. Miller rightly remarks, the projection of a fixed direction in space on the horizontal plane ought to move equally to the east and to the west during a sidereal day. What actually happens is the occurrence of an effect pointing towards the north-west quadrant of the compass in about ninety-five per cent. of all observations. This fact seems to be fatal to the assumption of an ether drift of constant direction towards a certain point of the heavens. If the effect were really genuine it would prove the existence of a north-west drift of the ether accompanying the earth's rotation. The velocity of the drift would be at least 10 km./sec., whereas the velocity of the daily motion of a point of the equator is only about five per cent. of this amount. The advocates of the ether will find it difficult to account for a whirling motion of the ether round the earth with a velocity surpassing that of the earth's rotational motion about twenty times.

Apart from the systematic deviations, there are large irregular discrepancies in the observations. The mean value of the ether velocity at a certain hour of the sidereal day taken from twenty single observations differs sometimes by more than 100 per cent. from the total average for the same hour taken from all observations of a given epoch.

It appears that on account of the extreme difficulties of the measurements, which were vividly described in Prof. Miller's presidential address before the Kansas Meeting of the American Physical Society, the results of the Michelson experiments are less trustworthy and less stringent than they have been supposed to be. The Trouton Noble experiment offers considerably less difficulty, and its negative result may be regarded as more convincing. Dr. R. Tomaschek, of the University of Heidelberg, has repeated this experiment at an altitude of 11,400 ft. at the Jungfraujoch, Switzerland (*Ann. d. Phys.*, vol. 78, p. 743, 1926). The observed effects did not exceed the errors of observation, and it was concluded that there is no relative velocity of the ether greater than 3 km /sec at the given altitude

This result gives rise to doubts concerning the significance of the interference shifts observed at Mt. Wilson. The doubts are augmented by the great irregularity of the measured shifts and by the predominance of the north-western direction in the diurnal variation of the effect, which is inconsistent with the assumption of an ether drift of constant 'absolute' direction

My conclusion is, therefore, that the effect must not be attributed to any cosmic cause at all, but may be due to local disturbances

HANS THIRRING.

Institut fur theoretische Physik,
Universität, Wien,
June 19.

The Molecular Spectrum of Carbon Dioxide.

THE value of the specific heat of carbon dioxide indicates a triangular molecule. Bjerrum (*Deutsch Phys Ges.*, 16, 737, 1914) has made a study of this molecule and has decided that the atomic nuclei lie at the corners of an isosceles triangle the apex angle of which is either 145° or 40° 6. Dennison (*Phil Mag.* (7), 1, 195, 1926) decides in favour of the former angle. Such a model, according to these authors, should be characterised by three fundamental vibrational frequencies. Each tries to associate the three well-known bands of absorption at 14·66μ, 4 25μ and 2 73μ with these predicted frequencies. The model does not anticipate a fourth weak band which I found at 2·02μ (*Phys. Rev.*, 26, 469, 1925), especially since this is not harmonic with any of the other three.

Dennison associates the 4 25μ band with a motion of the carbon nucleus perpendicular to the bisector of the apex angle, and the other two bands with motions of the oxygen nuclei along the line joining them, the carbon nucleus moving along the bisecting line in such a way as to keep the same molecular configuration In attempting to identify the observed relative intensities of these three bands with his predicted amounts, he meets with success in the case of the two longer wave-lengths but fails in the case of the third one For whereas this band should be only 1/180th so intense as either of the other two, it actually is found to have 1/4th their intensity.

A new explanation for the presence of the 2 73μ band as well as of the weaker 2·02μ band has been sought on the basis of combinations of the frequencies of the strongest two bands. Table I. shows that the frequencies of the two weaker bands are approximately equal to $\nu_a' + 2\nu_a$ and $\nu_a' + 4\nu_a$ respectively, where ν_a' and ν_a are the frequencies of the 4 25μ and 14 66μ bands.

TABLE I.

ABSORPTION BANDS OF CARBON DIOXIDE.

λ in μ.	ν in mm.$^{-1}$	Designation	Calc ν	Diff. Per cent.
14 66	68 9	ν_a		
4 25	235 5	ν_a'		
2 73	366 3	$\nu_a' + 2\nu_a$	373 3,	1·9
2 02	495 0	$\nu_a' + 4\nu_a$	511 1	3 2

Emission bands corresponding to each of the carbon dioxide absorption bands, including the newly observed weak one at 2 02μ, have been found in the spectrum of the Bunsen flame Table II shows the values of these bands, as well as the agreement of the frequencies of the weakest two with values calculated on the basis of combinations similar to those of Table I

TABLE II.

EMISSION BANDS OF CARBON DIOXIDE.

λ in μ	ν in mm.$^{-1}$.	Designation	Calc ν.	Diff. Per cent.
14·1	70·8	ν_a		
4·4	227 0	ν_a'		
2 76	362 0	$\nu_a' + 2\nu_a$	368 6	1 8
1 99	502 0	$\nu_a' + 4\nu_a$	510 2	1 6

It will be noticed that in every case the calculated combination frequencies are somewhat larger than the observed values. This should be anticipated if we are to associate the terms $2\nu_a$, $4\nu_a$, etc, with approximate harmonic vibrations of some portion of the molecule, for the so-called harmonic vibrations arise from causes which also produce deviations from true overtone relationships, namely, the non-linearity of the force and the finite amplitudes of motion of the nuclei Thus in the case of hydrogen chloride the first harmonic absorption frequency differs by 1·7 per cent from a true multiple relationship (Brinsmade and Kemble, *Proc Nat Acad Sci.*, 3, 420, 1917), while extrapolation of the frequencies which I have observed to be characteristic of the C-H bond in all organic substances (*Phys. Rev*, 27, 298, 1926) indicates a corresponding deviation of 1 85 per cent.

Comparison of the above data shows an increase in frequency in the case of the longest wave-length band in passing from absorption to emission, while an opposite change characterises the 4 25μ band:

This in itself suggests separate origins of the two frequencies within the molecule Furthermore, it suggests a strengthening of one type of bond and a weakening of the other type when the molecule is subjected to the greater thermal agitation in the flame This is indicative of a slight change in the molecular configuration

Further support of the combination theory proposed above is the gradual predomination of the lowest characteristic vibration frequency in the combination bands This is shown in the approach toward equality in the 2 73μ, 2 76μ bands, and the greater frequency value of the emission band in the case of the 2 02μ, 1 99μ band.

JOSEPH W. ELLIS

University of California, Southern Branch,
Los Angeles, California

Higher Order X-ray Reflections from Fatty Acids.

As is known from recent researches, especially in the Davy Faraday Laboratory, X-ray reflection from fatty acids shows the existence of a long spacing, which increases proportionally to the number of carbon atoms in the molecule Using fatty acid crystals, we have succeeded in observing reflections up to a very high order. We were able to verify the work of Muller, Shearer and others; on the other hand, some new facts were brought to light.

Flaky crystals several millimetres square (the long spacing of which is normal to their surface), obtained by crystallising from acetone, were mounted on the calcite crystal of the X-ray spectrograph; lines due to the latter crystal served as reference lines. Iron-, copper-, and zinc-radiation was used.

As had been found by Muller and Shearer, the 1st, 3rd, 5th . . . orders of reflection from the long spacings are much stronger than the 2nd, 4th, . . . orders. Shearer has shown that this feature may easily be understood by assuming a simple model for the scattering power[1] of the fatty acid molecule. Our photographs show some new complications for the higher orders, as may be seen from the accompanying diagram (Fig. 1) In the upper portion the observed intensities in the case of palmitic acid (C_{16}) are given. These were estimated by eye, much help for a correct estimation being afforded by the fact that $K\alpha$ and $K\beta$ lines appeared at the same time on the plates; the intensity of the $K\beta_1$ is known to be about 25 per cent. that of the $K\alpha_1$ line.

As may be seen from Fig. 1, in the neighbourhood of the 9th order, even and odd orders are about equally intense, whereas at the 16th order the even orders are by far the strongest (the 16th order is about as intense as the 5th).

This intensity-distribution may be accounted for in its main features by a little more detailed model for the scattering power of the molecule[2] than that used by Shearer. Such a model is given in the right-hand part of the figure As in Shearer's model, two molecules are placed end to end in opposite directions. At one end of the molecule a deficit of scattering matter (CH$_3$ group) is found; at the other end a surplus (COOH group). Calculations based on this model give for the intensity of the rth order:

$$I_r = \left[\frac{\sin\left(\frac{r\pi}{12}\right)}{r}\right]^2 \text{ when } r \text{ is odd,}$$

$$I_r = \left[\frac{\sin\left(\frac{r\pi}{12}\right) - \sin\left(\frac{r\pi}{24}\right)}{r}\right]^2 \text{ when } r \text{ is even.}$$

These calculated intensities are given in the lower portion of Fig. 1 Bearing in mind that the assumed model is far too simple to express the real state of things, and that, in addition, no correction was applied to the observed intensities, the agreement between calculated and observed values must be called very satisfactory.

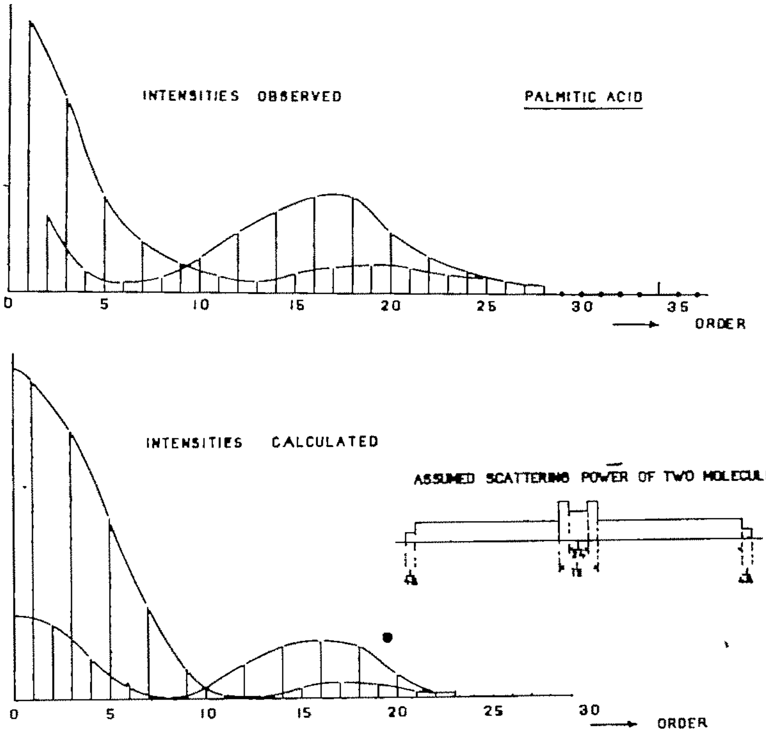


FIG. 1.

Similar results were obtained with lauric (C_{12}) and stearic (C_{18}) acids. In the first case a maximum of intensity for the even orders occurs at the 12-14th order; in the second case, at the 18-20th In these cases the observed intensities may be accounted for by similar models for the molecules with the same dimensions of COOH and CH$_3$ group.

A very remarkable fact has been revealed in the case of palmitic and lauric acids The 34th order of palmitic acid (see Fig. 1) appeared distinctly in four hours on our photographs, whereas other orders higher than the 28th could not be detected even with exposures varying from six to eight hours (such orders sought for but not observed are indicated in the figure by small circles). In the same way the 26th order of lauric acid was clearly visible, no other orders higher than the 21st being detectable. In the case of stearic acid, our crystals were unfortunately not good enough to go on to the corresponding (38th) order.

---

[1] In this case the scattering power may be assumed proportional to the number of electrons belonging to the different atoms in the molecule.

[2] Strictly speaking, the distribution of scattering matter in planes normal to the long spacing governs the intensities of the different orders, but in this and similar cases this distribution is intimately related to the structure of the molecule; most probably the molecules are inclined at a definite angle to these planes.

We are inclined to conclude that this singularity of the 34th order of palmitic and 26th of lauric acids depends upon the fact that the scattering matter is not uniformly distributed along the chain of the molecule, but contains a periodicity due to the successive CH_2 groups. The following facts seem to support this view. For twice the long spacing of palmitic acid we found 71·20 Å.U., and in the case of lauric acid, 54·46 Å.U. This means an increase per single CH_2 group of 1·045 Å.U. If we may assume this to be the mean distance of successive CH_2 groups, the double molecule of palmitic acid would be to a very high approximation 34 times this distance, and that of lauric acid 26 times.

The investigations are being continued with other chemical compounds.

Our samples of fatty acids were furnished by the kindness of Dr. Treub, chemist at the Kon. Stearine-kaarsenfabrieken at Gouda.

J. A. Prins.
D. Coster.

Physical Laboratory,
University, Groningen, Holland.

Transmutation Experiments.

Since so large a proportion of the discussion relating to the reported transmutation of mercury into gold has been carried on in the columns of Nature, it may be of interest to communicate briefly the results of experiments which have been in progress for some time in this laboratory, fuller details of which will be published shortly.

Various experimental arrangements were employed, but in no case has it been possible to establish the production of gold from the mercury. In the earlier experiments a condensed discharge, at a peak voltage of 15,000, was passed (*a*) between tungsten electrodes immersed in a fine emulsion of mercury droplets in white paraffin oil, (*b*) between aluminium rods in an emulsion of mercury in distilled water, and (*c*) between an iron pole and a mercury surface in an atmosphere of hydrogen. Secondary currents up to 75 ma. were passed for as long as twelve hours, but with uniformly negative results.

The most decisive experiment, however, was one which was designed to reproduce as nearly as possible the electrical conditions obtaining in Miethe's experiments with the rotating mercury interrupter, while reducing to a minimum the very grave danger of contaminating the mercury by contact with foreign substances. The mercury was sealed up in an atmosphere of hydrogen in a small quartz tube attached to a shaking machine, so that an arc was formed between pure mercury poles and drawn out to extinction six or eight times per second. A 30-ampere arc at 100 volts was run for 144 hours, followed by an 18-ampere arc at 240 volts for an equal period. During the last 24 hours of this run the tube was made to function as the interrupter for an induction coil, the secondary of which maintained a condensed spark discharge in air. Only 18 gm. of mercury was employed, and this remained perfectly bright and uncontaminated to the last. It was dissolved up at once in nitric acid, without being subjected to distillation, and a direct simultaneous determination proved that 10^{-8} gm. of gold could have been detected with certainty under the conditions of the experiment. No trace of gold was found.

The most conservative calculation based on the results of Miethe (*Zeitschrift f. anorg. Ch.*, 150, 350, 1926) leads to an expected yield of 0·11 mgm. of gold, or at least 10^4 times the quantity which could not have escaped detection had it been present. Since the electrical conditions were identical in all essential respects with those in Miethe's experiments, it seems necessary to conclude, with Haber (*Naturwissenschaften*, May 7, 1926; Nature, May 29, 1926), that Miethe's gold was derived from the materials of his electrodes and his vessels.

The mercury used in these experiments had been twice distilled, below 200° C., at the rate of about 100 gm. per hour, in mercury stills of quite ordinary design, and in no single instance could any trace of gold be recovered from the distilled mercury. The writer shares Miethe's opinion that the contrary results of other investigators have been due to mechanical carrying over of the amalgam, rather than to a true distillation of the gold.

An attempt to prepare indium from tin, by a similar method, also failed, though the spectroscopic method of detection was so delicate that great difficulty was experienced in obtaining indium-free tin for the experiments. A further attempt to produce scandium from titanium by electronic bombardment in an X-ray bulb proved equally unsuccessful.

Experiments are in progress upon the reported transmutation of lead into thallium and mercury. Obviously, no artificial production of such a common element as mercury can be regarded as established without the greatest rigour of proof that every possible source of contamination has been eliminated. The difficulty of completely excluding mercury has been well shown by its frequent appearance in the spectrum from the tin tubes, in which it was hoped to produce indium.

Milan W. Garrett.

Clarendon Laboratory,
Oxford,
June 25.

The New Element of Atomic Number 61: Illinium.

In their interesting note on the discovery of illinium (Nature, June 5, p. 792) upon which the authors, Messrs. Harris, Yntema, and Prof. Hopkins, may be congratulated, I find the statement that "there were no theoretical grounds for supposing that eka-neodymium [sic !] might exist until Moseley's rule showed that element number 61 was still to be identified." Having devoted almost all my scientific life—since 1877—to the theoretical and practical study of the elements of the rare earths, and especially to the question regarding their position in Mendeléeff's periodic system (the object was not very popular forty-eight years ago !), one of the results of which was the decomposition of the old didymium in 1882, I arrived at the conviction that the gap between the neodymium and samarium was abnormally large. In my paper read before the Bohemian Academy and the Russian Association of Scientists in St. Petersburg in 1902, I came to the conclusion—not reached by any chemist before—that the following seven elements, possessing now the atomic numbers 43, 61, 72, 75, 85, 87, and 89, remained to be discovered. As regards element No. 61, the difference between the atomic weights of Sm - Nd = 6·1, and it is greater than that between any other two neighbouring elements. It is remarkable that it is of the same order as that between the atomic weights of Mo - Ru = 5·7, between which stands ekamanganese, and of Os - W = 6·9, between which stands dwimanganese, recently discovered in our laboratory by Heyrovský and Dolejšek.

Personal knowledge of the chemistry of neodymium—the spectrum (absorption) I thought too complicated—and samarium brought me to the conclusion that also between those two elements an unknown element was missing, but all investigation by old methods was fruitless. Another reason may also be of interest. On arranging the true hydrides (in which the hydrogen is negative towards the positive metal) of the elements of the 8th series of the periodic system according to the order of their atomic weights, we find the following remarkable regularity of the composition of those peculiar compounds:

$$CsH_1,\ BaH_2,\ LaH_3,\ CH_4,\ PrH_3,\ NdH_2,\ (XH_1),\ SmH_0.$$

As samarium does not combine with hydrogen (Muthmann) there must exist between neodymium and samarium an unknown element which forms the hydride XH—*and this element is illinium.* My speculation has not proved futile.

BOHUSLAV BRAUNER.

Bohemian University,
Prague, June 12.

Identity of *Herpetomonas papatasii* and *Leishmania tropica*.

THREE successful experiments have been recorded by us in which cutaneous leishmaniasis was transmitted to man by inoculation of *Herpetomonas papatasii* from naturally infected sandflies (*Phlebotomus papatasii* ♀♀) (*Annals of Trop. Med. and Parasitol.*, vol. 20, No 2). Noguchi ("Action of Certain Biological Chemical and Physical Agents upon Cultures of Leishmania; Some Observations on Plant and Insect Herpetomonads." International Conference on Health Problems in Tropical America, 1924) and Kligler ("The Cultural and Serological Relationship of Leishmania." *Transact. Roy. Soc. Trop. Med. and Hyg.*, vol. 19, Nos. 5 and 6, 1926) have introduced methods of preparing immune sera and distinguishing *Leishmania tropica*, *L. donovani*, and *L. brasiliense* by agglutination. Agglutination and cross agglutination experiments with cultures from the three experimental lesions and three strains from naturally acquired lesions (two from Palestine and one from Baghdad) definitely proved the identity of the organisms from the experimental lesions with *Leishmania tropica*. *Herpetomonas papatasii* is, therefore, a synonym of *Leishmania tropica*, and the fact that *Phlebotomus papatasii* is a natural transmitter of cutaneous leishmaniasis is completely established, since in addition to the evidence of experimental transmission the Herpetomonas naturally occurring in the above insect is shown to be biologically identical with *Leishmania tropica*.

We hope to publish shortly complete details of our experiments elsewhere.

S. ADLER.
O. THEODOR.

Microbiological Institute,
Hebrew University,
Jerusalem.

Pernicious Grafting.

THE Madeira agriculturist will be glad of any enlightenment on a devitalising influence frequently experienced in grafting a vigorous wild peach or nectarine seedling with a scion from a cultivated example. The wild seedling germinates from any chance seedstone thrown upon our terraces and develops rapidly into a sturdy tree, almost evergreen in character, crowded in the late autumn with a wealth of fascinating flower before the deciduous annual foliage has left the branches bare, and yielding from early spring onwards an overwhelming crop of disappointing fruit.

If such a stock is cut across and grafted from a more worthy example in February, organic union is perfectly established and the new grafts speedily develop into sturdy ligneous growth which, by November, exhibits a promise of the vigorous output of leaf and flower customary in the wild seedling. But something now happens, and the tree, paralysed or devitalised, passes through the winter and spring months without a single leaf- or flower-bud breaking forth into activity.

Vitality is entirely suspended, and the tree is apparently poisoned by the introduction of an incompatible sap, although a modified life or mere existence may endure indefinitely. The removal of the intrusive grafts is unavailing, for the condition is all-pervading and not one of local obstruction.

Madeira is scarcely four days distant from the London markets, and it is of economic and commercial importance to remove any impediment to the almost perennial output of our sun-ripened produce.

MICHAEL GRABHAM.

Madeira, June 24.

Organo-Metallic Compounds.

AN X-ray investigation of the structure of the series of compounds carbon-, silicon-, germanium-, tin-, and lead-tetraphenyls, now almost completed, appears to indicate an interesting field of research in the organo-metallic compounds. It is proposed to extend the work to other series of these compounds so that after a time a systematic study may be made of the effects of varying (i.) the element, and (ii.) the groups. In order that this may be attempted, the writer appeals to chemists for the loan of small quantities of any related organo-metallic compounds which may be stable solids in air at ordinary temperatures.

To give an idea of the quantity of material sufficient for this work, it may be stated that the crystal of germanium tetraphenyl kindly lent by Prof. G. T. Morgan and found to give satisfactory results measured only 1·5 mm. by $[0{\cdot}065\text{ mm.}]^2$, whilst from 0·15 gm. of powdered tin tetraphenyl kindly lent by Mr. A. E. Goddard, Mr. W. B. Saville, who is co-operating with me in this work, was able to grow a number of crystals suitable for use on both the photographic and the ionisation X-ray spectrometers.

WM. H. GEORGE.

Davy Faraday Laboratory,
20 Albemarle Street, London, W.1.

Blood Reactions and Sex.

THE method elaborated by Manoilov for distinguishing the sexes has been used by us in the case of the fowl. Male can certainly be distinguished from female by this test. Seven birds which previously functioned as hens but now, having undergone complete sex-reversal, are fecund and potent cocks, all exhibit the female reaction indubitably. This being so, this test may be expected to provide valuable corroborative evidence concerning the genetic sex of certain kinds of sexually abnormal individuals.

The reaction in the case of blood from a fowl from which the gonadic tissue has been removed is, in our hands, not yet sufficiently definite.

F. A. E. CREW.

Animal Breeding Research Dept.,
University of Edinburgh,
July 5.

X-Rays and Living Matter.[1]

By Prof. J. A. Crowther, University of Reading.

The possible importance of X-rays in the medical world was recognised so clearly by their discoverer, Röntgen, that the first communication on the subject was made by him to a medical society, and was published to the world in a medical journal. Nor were medical men slow to appreciate the potency of the weapon which had thus been placed in their hands. The medical profession, be it spoken to its praise, has been unremitting in its search for new weapons in the fight against disease. Dr. Gilbert, himself no mean physician, and author of the first treatise on magnetism, records, with perhaps undue scorn, how, in the days when magnetism was the latest scientific marvel, patients were dosed with decoctions of lodestone as a possible panacea for all ills. It was not likely that so startling a discovery as X-rays would be overlooked, and we find medical men among the pioneers of X-ray work in nearly all countries. Further, the economically effective demand of medical radiology for more power, and still more power, has persuaded engineers and manufacturers to produce the modern high-power X-ray plant which has made possible the recent advances in the subject.

It was discovered early, but unhappily not early enough, that whatever healing power the radiation might possess, its destructive power on human tissue was indubitable and great. Few of the pioneers of radiography and radiotherapy escaped the painful and intractable X-ray burn, which arises from too prolonged an exposure to the radiation, and not a few have died as a result of the injuries thus received. Their labours have not been fruitless, and X-ray treatment is now a standard part of the work of any properly equipped hospital. At the same time one can detect to-day a certain undercurrent of dissatisfaction among radiologists. The rays have not yet fulfilled all their expectations. In particular, in some grave diseases where remarkable cures have been effected by X-ray treatment, a repetition of the same treatment in other apparently similar cases does not invariably produce the hoped-for result. There are undiscovered factors remaining to be elucidated. We need to ask how X-rays act on living matter, and in particular upon the living cell from which all living matter is built. The biologist, the physicist, and the chemist must be called in to assist, and the investigations must take in a wider sweep, before these problems can ultimately be solved. In science, as in other walks of life, it sometimes happens that the longest way round is the shortest way home.

It must not be supposed that so promising a field of research has been hitherto left uncultivated. There is, on the contrary, an overwhelming accumulation of observations and experiments. The results of different observers are, however, so conflicting that most of the evidence cancels out and leaves only a small residuum which can be said to be known with any certainty. This is scarcely surprising when we consider the conditions under which much of the work has had to be done. It is only within quite recent years that apparatus has been designed which makes it possible to repeat a given exposure with even approximate certainty, even with the same apparatus. It is not possible, even now, to give identical exposures if the apparatus is changed; if, for example, a high-tension transformer is substituted for an induction coil, or a Coolidge tube for a gas tube. Each type of apparatus for producing X-rays, one might almost say each individual set, has its own peculiarities, which are reflected in the quality and quantity of the radiation it produces. Our present state of knowledge does not allow us to assume that any of these variations have a negligible effect on the results.

Nor is there, at the present moment, any standardised or completely satisfactory method of recording these varied exposures. The properties of a given X-radiation are determined, physically, by its wave-length or frequency and its intensity. The radiation from an X-ray tube is, however, not monochromatic. It consists of a band of radiation stretching over a considerable range of wave-lengths. In optical terms, our X-ray tube gives us a continuous spectrum, which, moreover, may be crossed by intensely bright lines due to the characteristic radiation of the target from which the rays come. The band of maximum intensity moves towards the short wave-length end of the spectrum as the potential on the tube is increased, but the radiation is always mixed. In fact, for a given current, we shall get a larger absolute output of radiation of long wave-length from a tube working at high potential than from one at low potential. The distribution of energy in this complex spectrum depends on the wave-form of the high-tension apparatus used to supply the X-ray tube, and on the tube itself. If, as seems quite possible (there is ample experimental evidence both for and against the supposition), the biological effect is a function of the wave-length, it becomes a matter of considerable importance to determine not only the extreme wave-lengths but also the distribution of energy between the different wave-lengths in the radiation used. The discoveries of Prof. Laue, and their ingenious applications by Sir Wm. Bragg, have rendered this possible, but in very few researches so far conducted on the action of X-rays on living matter has any attention been paid to this important factor.

The measurement of the intensity of the radiation is a still more difficult problem, and one which cannot yet be said to have been solved by the physicist. The ideal method would be to measure the energy in the beam by absorbing it completely in some heavy metal, such as lead, and measuring the heat produced. Unfortunately, the actual energy even in a powerful beam of rays is so minute that, although it has been detected, it would strain the resources of a well-equipped physical laboratory to measure it with any accuracy. It is necessary to fall back upon some secondary property of the rays. The only secondary property which is capable of being measured with the necessary accuracy is that of producing ionisation in any gas through which it passes. Gas through which X-rays are passing becomes feebly conducting to electricity and the current which can be passed across the gas is a measure of the ionisation, and thus, indirectly, of the intensity of the radiation. Prof. Friedrich has proposed that the amount of X-radiation which will allow a charge of one electrostatic unit to pass across one cubic centimetre of air shall be taken as the unit quantity of X-radiation. This proposal has met with some opposition, but personally I do not see the possibility of finding a better unit, at any rate in the immediate future. At least it may be affirmed that until experimenters can agree upon some method of measuring their quantities, progress is not likely to be rapid.

---

[1] Substance of a course of two lectures delivered by the author at the Royal Institution on January 19 and 26.

If any apology should appear to be needed for devoting so large a portion of our space to the question of measurement, it is certainly provided, not merely by the large mass of painstaking observations which have been rendered almost nugatory for want of it, but also by the records of recent work in the subject. Everything, in fact, seems to indicate that the biological effect of the rays may vary in a perfectly astounding manner with quite trifling variations in the magnitude of the exposure and the wave-length of the radiation. Only within the last few months a paper has come through from Australia, in which the author, Dr. Moppett, claims to have demonstrated a selective effect of the radiation of surprising sharpness. Dr. Moppett spread out his beam of X-rays into a spectrum, by means of a Bragg spectrometer, and exposed one of the important membranes of an ordinary chicken embryo in turn in various parts of the spectrum. He found that at certain definite positions in the spectrum, that is to say for certain definite wave-lengths of the radiation, the cells in the membrane were rapidly killed by the action of the rays, while much longer exposures to neighbouring wave-lengths produced no effect. The effective radiations had wave-lengths of 0·11, 0·53, and 0·79 Ångstrom units. Wave-lengths differing by only a few per cent. from these values were quite inoperative.

The paper, it must be confessed, is sadly lacking in the details which a physicist requires to assess its accuracy, and in many particulars it is by no means clear. One would certainly not have expected to obtain a selective effect with radiation of so short a wave-length as 0·11 Å.U., and if this result is verified we may have to revise some of our physical ideas as to the absorption of X-rays by matter. It is desirable that Dr. Moppett's work should be repeated. If, however, for the moment we accept these results, it is not difficult to point the moral. The wave-length 0·11 Å.U. is somewhere near the limit of the spectrum for a hard X-ray tube. It requires for its excitation a voltage across the tube of about 120,000 volts. Suppose the experimenter to be working his tube somewhere about this voltage. A slight rise in the voltage will produce a copious supply of the deadly radiation. On the other hand, if the voltage falls by but a small amount this radiation may be absent altogether. A trifling change in the supply voltage, to which few of us would, in practice, pay any attention, may thus completely alter the nature of the results obtained.

Experiments indicate that the margin in the case of the dosage given is equally narrow. Although the effect of a prolonged exposure to X-rays is invariably lethal, small doses often produce a healthy stimulation. This has been proved, by Prof. Russ among others, in the case of rats. It is also very evident in the case of Protozoa. I have found that an old culture of *Colpidium Colpoda*, for example, may be stimulated to new growth and active division by a suitable dose of radiation. The margin between stimulation and death is a very narrow one. In fact it is possible, by a careful adjustment of the dose, to have as the result of a single exposure individual colpidia, showing every sign of stimulation, swimming about vigorously among the corpses of those which have been killed by the same dose. A slight increase in the dose, say an extra ten per cent., will kill off the whole culture. A decrease of ten per cent. produces only stimulation. It is clear, in this instance at any rate, how narrow is the margin which separates these diametrically opposite effects. In radio-biology—if we may be permitted to coin the word—as in other sciences, exact measurement is the key which unlocks the door of knowledge.

It is no part of the purpose of this article (the attempt would be impossible in any case) to give a résumé of the vast amount of observations made on the action of X-rays on living matter. It is doubtful whether most of them can throw much light on the fundamental problem which underlies them all. In irradiating an animal, or even a tumour growing on an animal, we are dealing with a part of a highly organised and closely interrelated structure, and any effects which are observed may be merely secondary and only indirectly due to the irradiation. So true is this that it applies even to the parasites on the body. Bacteria, for example, are notoriously resistant to the action of the rays when exposed in a pure culture. On the other hand, the same bacteria infecting a wound will often be killed by quite small exposures to the radiation, and such exposures are now frequently used as a means of cleaning and healing a wound. The problem, difficult enough in any case, only becomes manageable if reduced to its simplest form, and the simplest form in biology is the individual cell.

We are fortunate in possessing at least a preliminary study of the effect of X-rays on the individual cell. Methods have now been perfected by which it is possible to remove a number of cells from the tissues of a live animal and to cultivate them for long periods in glass vessels, where they continue to thrive and multiply, quite independently of the fate of the animal of which they were once a part. Dr. Strangeways has studied the action of X-rays on these isolated cells, and a preliminary account of his work was communicated a year or so ago to the Royal Society. One of the striking facts which emerges from his work is that it is extremely difficult to destroy a resting cell by the action of the rays. Doses far heavier than could be safely applied to the human skin leave them apparently unaffected. Further observation, however, showed that this absence of effect was only apparent. The cells had been very vitally affected, but the effects of the rays only became visible when the cells began to divide.

The first effect of the rays, produced by quite short exposures, was to lessen very materially the number of cells passing through the process of cell division, or mitosis. Dr. Strangeways records that an exposure of only 5 of Prof. Friedrich's units produces an appreciable diminution in the number of cells passing into mitosis. With a dose of 10 units the number was still less. After 15 units only a few cells in mitosis were visible, but the phenomenon was seen occasionally until the exposure reached as much as 85 units. Thus while a small dose of X-rays is sufficient to prevent the majority of the cells from dividing, a much larger dose is required before the whole of the cells are affected.

Dr. Strangeways has not yet provided us with a numerical estimate of this effect, but we hope that he and his collaborators may be able to do so before long. In the meantime, if we attempt to express his descriptions graphically, the curve which we shall have to draw relating the number of cells in mitosis with the exposure to the rays will be one which, plunging rapidly downwards at first, approaches zero asymptotically for prolonged exposures; it will, in fact, resemble closely an exponential curve. Now a curve of this type suggests strongly that the effect we are considering is a probability effect—in other words, that whether a cell will or will not go into mitosis after a given dose of X-rays is a matter of chance, the probability of its not doing so becoming greater as the dose is increased. This variability may, of course, be in the cell. Some may be more susceptible to the action of the rays than others. It is always legitimate, though not very helpful, to invoke the biological factor. I have ventured to suggest the possibility that it has nothing to do with the cell, but lies in the nature of the agent which we are using against the cell, that is, in the X-rays themselves.

An analogy, which is in fact a very close one, may help to make the matter clear. Suppose that we were firing at a swarm of midges with a machine gun. The number we should hit per second would be proportional to the number present in the swarm. At first we should claim a large number of victims, but, as the swarm gradually melted under our fire, the chance of hitting a midge would become smaller and smaller. To hit the last two or three would entail the expenditure of much ammunition and considerable patience. The survivors, however, would not owe their prolonged existence to any biological factor, or to any immunity either inherent or acquired, but simply and solely to their good luck. The number of survivors would, in fact, decrease exponentially as the number of bullets fired into the swarm increased.

Now, as Prof. C. T. R. Wilson's photographs show us very graphically, a beam of X-rays is very much like a swarm of bullets—only a negligible proportion of the atoms in the path of a beam of X-rays are affected in the least by the passage of the beam. It is quite easy to show that if the rays are conveying a dose of one unit per minute, as was the case in Dr. Strangeways' experiments, an individual atom would be effectively hit by the radiation on an average only once in a million years. The probability of a hit increases with the size of the particle, and a tissue cell would receive on an average about 14 hits per second, but as a hit is a matter of pure chance some would clearly receive more and others less than the average. This variation becomes more important as the size of the particles becomes smaller, and some of the important structures in the cell are much smaller than the cell itself.

It is not difficult to calculate what size the structure must have to fit in with the curve which we have constructed from Dr. Strangeways' description, on the assumption that a single hit registered by the rays on this particle suffices to put the cell out of action. Its diameter, assuming it to be spherical, would have to be about 1/2500 m.m. This is of the order of magnitude of the centrosome, a body which is considered by many biologists to play an important part in the process of cell division. With a target of this size, half the cells would be put out of action with an exposure of 12 units, 25 per cent. would survive a dose of 24 units, while 6 per cent. would still be capable of mitosis even if the dose were increased to 48 units. It will be seen how closely these numbers fit the phenomena we have described. It seems possible, to say the least, that the quantum theory must be taken into account in biology as well as in physics, and that a single cell may have a much more direct and painful appreciation of the existence of quanta than is possible to our grosser senses.

The scanty data which we possess on the action of X-rays on living cells indicate that the simple exponential relation which we have suggested is rather exceptional. The curve relating the number of survivors to the dose of X-radiation is generally sigmoid in shape. Practically no effect is produced until the dose exceeds a certain value. After this point is reached the number of cells affected increases rapidly, but there are always a few which survive much larger doses than the average. Curves of this kind are given by Dr. F. C. Wood, as expressing the result of his recent experiments on the effect of X-rays on cancer cells *in vitro*. Theoretically, we get a relation of this kind if we assume that a definite succession of hits is required to produce the result we are aiming at—say, for example, the destruction of the cell. I have given a calculation of the form of the curve on this assumption in a recent paper before the Cambridge Philosophical Society. A very considerable amount of rather tedious work will be necessary before sufficiently experimental results can be obtained to afford a real test of the theory, but the results so far accumulated are distinctly promising.

It need not be emphasised that these attempts to drag the biological action of X-rays into the domain of physics are extremely tentative. It is possible, even probable, that in the ultimate issue we shall find in the living cell something which transcends all physics and chemistry, but this is no legitimate excuse for failing to push our sciences to their extreme limits. Whatever the ultimate result may be, we are sure to find much of interest by the way. The primary effect of the absorption of X-rays by an atom, in fact the only effect of which physicists are aware, is the expulsion of a high-speed electron from the atom. That, it would appear, must be the starting point of any purely physico-chemical theory of the action of X-rays on living matter. What subtle series of changes is thus initiated in the complex chemical compounds which make up the cell is a problem, like that of the song the syrens sang, the answer to which no man knows, but which may not be beyond the wit of man to conceive. Nature, as usual, leaves us guessing. That is precisely why we find her so fascinating.

The Rhynie Crustacean.

By Dr. W. T. CALMAN, F.R.S.

MR. D. J. SCOURFIELD'S memoir "On a new Type of Crustacean from the Old Red Sandstone (Rhynie Chert Bed, Aberdeenshire), *Lepidocaris rhyniensis*, gen. et sp. nov." (*Phil. Trans.* B, 415, 1926), which has already been noticed in NATURE (April 3, 1926, p. 498), is so important a contribution to arthropod morphology that no excuse is needed for directing further attention to some of the problems suggested by it.

In the first place, it should be emphasised that no other fossil crustacean is known with anything approaching the completeness with which Lepidocaris has been described by Mr. Scourfield. The only fossil arthropod, and in fact the only fossil invertebrate, which comes near it in this respect is the well-known *Eurypterus fischeri* as described by Holm. In the second place, in spite of its antiquity, Lepidocaris is far from being a primitive crustacean. In some respects (notably in retaining the biramous swimming antennæ of the nauplius) it is indeed more primitive than the existing Anostraca, but it shares with them many characters that are by no means primitive, such as the simplified mouth-parts, which are much more specialised than those of many Copepods. The development of male claspers, of Anostracan type, from the maxillulæ instead of the antennæ, is a surprising feature, the significance of which remains obscure. It may indicate that Lepidocaris is off the main line of Anostracan descent. It is doubtful also whether the absence of eye-stalks can be regarded as a primitive character.

One of the most difficult problems of crustacean morphology has been the correlation of the biramous type of limb found in so many Crustacea with the 'phyllopod' type seen in the Branchiopoda. Since Ray Lankester, in his classical memoir on Apus, showed that the Branchiopoda (or Phyllopoda) are the most archaic of living Crustacea, it has been generally accepted that the biramous has been derived from the phyllopod type. Lankester argued that the two branches of the biramous limb, the endopod and exopod, were derived from the two distal 'endites' or lobes of the inner edge of the phyllopodium. Huxley had earlier identified the exopod with the 'flabellum' of the Phyllopod and the endopod with the distal part of the stem or 'corm,' and this interpretation has been adopted by others, notably by Dr. Borradaile in a recent paper.[1] Lepidocaris would seem to provide the answer to this question, for while the first three pairs of its trunk appendages are phyllopodia, comparable without much difficulty with those of recent Branchiopoda, the following limbs are biramous; and it is perfectly clear that the exopod of the posterior limbs is equivalent to the flabellum of those in front, the endopod being the distal endite.

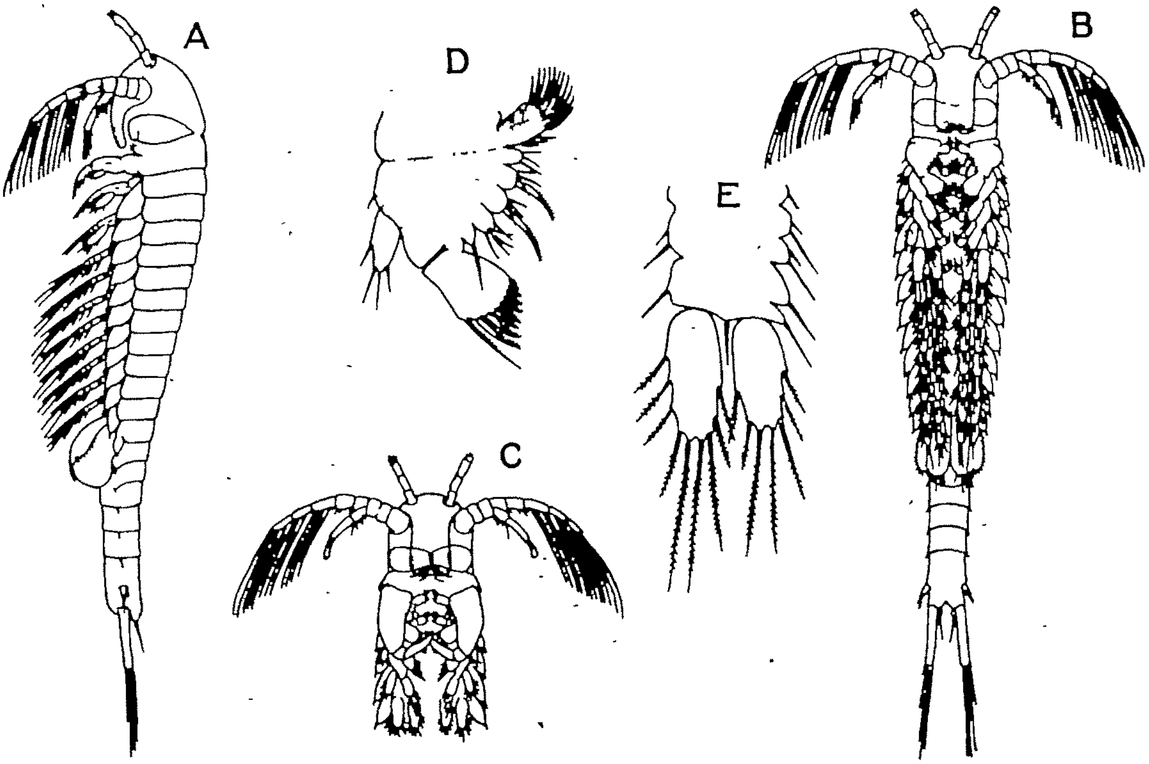


FIG. 1.—Restorations of *Lepidocaris rhyniensis*, Scourfield. A. Female, from the side. B. Female, from below. C. Male, anterior part of body from below. D. One of the first pair of trunk limbs. E. One of the trunk limbs of the posterior (? seventh to eleventh) pairs. Approximate magnification, A, B, and C×27, D×9, E×10. (After Scourfield.)

Dr. Borradaile inclines to the opinion that, in the evolution of the Crustacea, the biramous form of limb has been arrived at more than once by different modifications of the phyllopod type. In view, however, of the simple biramous form of the limbs in the nauplius larva and in the Trilobites (the close relationship of which to the Crustacea cannot now be doubted), and of the persistency with which the same type emerges in the most diverse groups of Crustacea, it seems more reasonable to assume that it represents the deep-seated plan of symmetry on which all crustacean limbs are built. It is indeed possible that the phyllopod type preceded the biramous and that Lepidocaris preserves the transition from one to the other. This would seem to be the view taken by Mr. Scourfield, who, although he gives us little in the way of speculation, does imply that the biramous hinder limbs of Lepidocaris are derived from the phyllopodous type of those in front. It is, however, a very general rule among Arthropoda that specialisation begins anteriorly and works backwards; we should expect the posterior limbs to be the more primitive; and Lepidocaris gives the impression of having had primitively biramous limbs of which the more anterior pairs have been specialised in adaptation, no doubt, for some special method of collecting food.

---

[1] "Notes upon Crustacean Limbs," *Ann. and Mag. Nat. Hist.* (9), 17, p. 193, 1926.

A minor problem is presented by the lateral row of large scales (to which the generic name alludes) covering the bases of the trunk limbs. These suggest the small scales at the base of the outer edge of the limbs in Anostraca which are generally interpreted as the proximal exites of the limbs. In Lepidocaris, however, at the posterior end of the series, the scales are seen to be merely the pinched-off pleura of the somites. It is a matter for further inquiry whether the proximal exites of the Anostraca may not also be of pleural origin.

Perhaps the most unexpected feature of Lepidocaris, however, is the structure of the last segment of the body. In many Crustacea, in the larva if not in the adult, the termination of the body is forked. Very often this fork is nothing more than a notch in the hinder edge of the telson, but sometimes the two prongs of the fork are movable rods jointed to the segment, and in a few cases (Notostraca, Cirripedia) they are long, many-jointed filaments. In Lepidocaris we see clearly, for the first time, that these movable appendages are not, as has been generally supposed, homologous with the two branches of the notched telson. In the earliest larva found the telson is notched, and this notch persists in the adult to form what Mr. Scourfield calls the "primary furca." In the later larvæ, however, a pair of rod-like appendages grow out at the sides of the primary furca and become separated by articulation from the body of the telson, forming a "secondary furca" which is evidently the homologue of the articulated furca of Anostraca, Copepoda and Phyllocarida. In still later larvæ a second smaller pair of appendages appear at the sides of the telson in front of the secondary furca. Just above the articulation of each of these two pairs of appendages is set a small spine. The somites immediately in front of the telson bear no appendages, but each has, on either side, a similar spine, and as these spines are traced forwards they are plainly seen to be in series with the spines which tip the lateral scales already mentioned above the insertion of the limbs.

It seems impossible to avoid the conclusion that the appendages of the telson in Lepidocaris and the furcal rami of the groups mentioned above are serially homologous with the true limbs of the anterior part of the body. Now it is the general rule in the development of Arthropoda that the somites and their appendages appear and become differentiated in regular order from before backwards, new somites being added from a 'formative zone' in front of the telsonic region. In Lepidocaris alone do we find evidence of true appendages on the telson itself, *behind* the formative zone; and, emphasising the singularity of their position, the order of their development is the reverse of that of the pretelsonic appendages, the hinder pair appearing first.

It must be borne in mind that, at the time when Lepidocaris lived, the Crustacea had already behind them a long evolutionary history. It is now known from Walcott's remarkable discoveries that, so early as the Middle Cambrian period, a varied crustacean fauna existed and that several of the forms had at least a superficial resemblance to Anostraca. Unless some chance discovery, as fortunate as that at Rhynie, and an investigator with Mr. Scourfield's indefatigable patience and skill, combine to reveal a great deal more than we know at present about the structure of these early forms, speculations on phylogeny must go very cautiously.

Obituary.

DR. EDWARD J. BLES.

BY the recent death of Edward J. Bles, zoological science has lost a devoted worker whose qualities of mind and character were of the highest. It is the faith of many of his friends that, but for factors of temperament, and health, he would have become a leader of thought in the subject of his choice. His publications, though of high merit, were relatively few; but his intimates know that they were far from representing all that he accomplished, and are aware of the temperamental restraints but for which he could and would have published much more. He was one of those investigators—deserving sympathy from colleagues with easier standards—who would fain allow publication to wait for perfection, and yet realise even better than others that perfection never arrives. In spite of such inhibitions, or perhaps because of them, his published output is of high value and stamped with the quality of absolute reliability.

For elementary teaching, or, at any rate, for the shackles of departmental teaching and organisation, Bles had some distaste. On the other hand, he was the ideal colleague and one of the most educative influences for the young research worker. He would give his time and ingenuity for days to devise methods for another's work; he was a most sincere and painstaking critic and there never was any one with whom it was more delightful to share the joys of discovery or the fruits of victory. Yet he greatly prized independence, and the freedom to work out his own ideas on his own lines. Being possessed of sufficient private means, Bles was therefore finally led to avoid all official posts, and for nearly twenty years he worked, first at Iffley, Oxford, and later, until the end, at Cambridge, in private laboratories equipped by himself. This involved, of course, some degree of isolation, and the additional factor of weak health finally led him to become scientifically somewhat of a recluse. In visits from scientific friends, however, he always took the greatest pleasure, and, to the end of his life, those who had the privilege of paying such visits profited always from contact with a truly philosophic mind and a stimulating personality. His wide learning was at the service of all.

Born in 1864, he was the son of A. J. S Bles of Manchester. When fourteen years old he was sent to a school in Hanover where the teaching of science seems to have been exceptionally good. Family interests led him at the age of eighteen years to start in his father's business at Manchester; but his own interests directed him from the first into scientific company. He joined the Manchester Microscopical Society and became its secretary. Thus arrived the turning-point of his life. He came under the influence of Milnes Marshall, who saw his bent and genius, and for whom Bles then acquired, and ever afterwards retained, great love and admiration. He joined the Owens College, attended Milnes Marshall's classes, and in 1890 became, with his teacher, joint author of papers dealing with the development of amphibia, a subject which for some time remained one of his chief scientific interests. About this time he went to occupy a table at Naples and returned to carry out the duties of junior demonstrator of zoology at the Owens College. From 1892 until 1894 he was Director of the Marine Biological Association's Station at Plymouth. He went up to Cambridge in 1895 and took a research degree in 1898. When Prof. J. Graham Kerr was appointed to the chair of natural history at Glasgow, Bles accompanied him as his assistant and remained at the University until 1907, when he went to live at Iffley, Oxford.

In 1911 Bles removed to Cambridge. Before his last migration his scientific reputation had been made by the publication of important papers; especially by one which appeared in the *Transactions of the Royal Society of Edinburgh* in 1905 on the life-history of *Xenopus Lævis*, and another dealing with the development of certain Anura published in the volume issued by the Cambridge University Press as a memorial to John Samuel Budgett. Of these two papers describing work of fundamental importance, Prof. W. E. Agar writes: "They are very characteristic of Bles' work and scientific attitude. He would take an immense amount of trouble over the smallest detail, lingering over it with a loving care. . . . The plates in these two papers could scarcely be surpassed, either for accuracy of detail or beauty of execution—the result of laborious co-operation between the author and the artist, Mr. A. K. Maxwell. It is worthy of note that these plates contain the first scientific illustrations produced by this artist whose work is now so well known to biologists." The interest of the artist in such work must have been stimulated by his early collaboration with an investigator like Bles, whose own love of accuracy and beauty of execution were so great.

After his Cambridge laboratory was equipped, Bles started to breed various species of rare amphibia, a difficult enterprise in which he had the assistance of his devoted wife. This work was carried out with elaborate care and led to most interesting scientific observations, especially with regard to certain little-studied aspects of metabolism, to the significance of which Bles was keenly alive. The most important work of his Cambridge period had been begun at Oxford. It consisted of an elaborate and highly original study of Arcella by microchemical methods, during which Bles developed a very beautiful technique and obtained results of great importance. Unhappily, the inhibitions to which reference has been made became exaggerated in his latest years, largely because of continued ill-health, and the results of this prolonged research, though known to many, have not yet appeared in print. A paper was practically finished, however, and very fine drawings are available for its illustration. Its publication will be secured in the immediate future under arrangements made in the author's will.

Bles was not merely a scholarly biologist in a very wide sense, he was also a man of fine general culture; music, literature, and the arts all made a vivid appeal to him. He had, moreover, a true sense of values and a very beautiful appreciation of the relative importance of things. His knowledge was of the widest, but so philosophic was the cast of his mind that synthetic thought was essential to him. He endeavoured always to see things as a whole. F. G. HOPKINS.

PROF. V. A. STEKLOV.

PROF. VLADIMIR ANDREJEVICH STEKLOV, member and vice-president of the Russian Academy of Sciences, an eminent and well-known mathematician, died at Ialta (Crimea) on May 30.

Steklov was born in 1863 in the province of Nishni-Novgorod as the son of a country priest. He attended a classical school at Nishni-Novgorod and afterwards entered the University of Moscow to study medicine, but he soon left Moscow and went to Kharkov to study mathematics under Liapunov and became his most gifted pupil and lifelong friend. He graduated at Kharkov, took the usual degrees of magister and doctor of mathematics, and was appointed professor at this University. His first work, "On the Motion of a Rigid Body in a Fluid," was published in Russian in the *Memoirs of the Mathematical Society of Kharkov*. In this paper he found several new 'integrable' cases of this problem. His thesis for his doctorate was "On the Principal Problems of Mathematical Physics." Such problems formed the basis of his subsequent numerous investigations, extending over a period of nearly thirty years. In these investigations he established his "théorème de fermeture," relating to the development of arbitrary functions in infinite series of "fundamental functions" depending on the roots of transcendental equations. Such expansions occur frequently in mathematical physics, the Fourier series being the simplest special case. Steklov introduced the necessary rigorousness into the problems of mathematical physics, in proving the existence of the solutions and the conditions of convergence for the series used. He summarised his researches in a treatise "On the Differential Equations of Mathematical Physics" recently published by the Russian Academy of Sciences in two volumes. The complete list of his scientific papers contains about 120 items. These papers are published mostly in French, in the *Memoirs of the Russian Academy of Sciences*, the *Annales de l'École Normale Supérieure*, the *Annales de l'Académie de Toulouse*, and others.

As a lecturer Steklov was widely known while he was professor in the higher branches of theoretical mechanics and mathematics, first at Kharkov and then at St. Petersburg (now Leningrad).

Steklov was elected a member of the Russian Academy of Sciences in 1910, and in 1919 became vice-president of the Academy. The task of the vice-president was at that time a most difficult one. The vice-president is responsible for all the administrative work of the Academy and of its numerous institutions; he has to control the yearly expenditure and to superintend the proper use of the funds. Steklov proved to be just as able an administrator as a man of science: with open mind, sound judgment and firm hand, he steered the Academy safely through the hardships of the years 1919–22.

A. Kriloff.

We regret to announce the following deaths:

Miss Gertrude Bell, oriental secretary to the High Commissioner of the Iraq, Baghdad, since 1920, and distinguished for her travels in and knowledge of the peoples of Arabia, on July 11.

Mr. A. G. Charleton, past president of the Institution of Mining and Metallurgy, and author of numerous works on ore-mining and treatment, on July 7, aged sixty-eight years.

Mr. W. Temple Franks, C.B., lately H.M. Comptroller-General of Patents, Designs, and Trade Marks, on July 4, aged sixty-three years.

Mr. F. Harrison Glew, M.B.E., a pioneer in the utilisation of radium and its salts for the preparation of luminous paint and other purposes, on July 10, aged sixty-eight years.

Sir Peter Scott Lang, emeritus professor of mathematics in the United College at the University of St. Andrews, on July 5, aged seventy-five years.

Dr. George R. Lyman, dean of the West Virginia College of Agriculture at Morgantown and previously pathologist in the Bureau of Plant Industry at Washington, D.C., on June 7, aged fifty-five years.

Rev. T. R. R. Stebbing, F.R.S., the distinguished naturalist and worker on Crustacea, on July 8, aged ninety-one years.

News and Views.

On July 7, in the presence of a large and representative gathering in a spacious marquee, Mr. Neville Chamberlain laid the foundation stone of the new London School of Hygiene and Tropical Medicine, the result of a gift of 2,000,000 dollars from the trustees of the Rockefeller Foundation. The chairman of the Board of Management, Sir Alfred Mond, in introducing Mr. Neville Chamberlain, reviewed the steps which had led to the foundation of the School. He pointed out that the former Chancellor of the Exchequer, Sir Robert Horne, had recognised the great importance of such an institution and had agreed that the British Government should make itself responsible for its maintenance. As a result of representations made by Mr. Neville Chamberlain to the present Chancellor of the Exchequer the building was being expedited, a grant of 5000*l*. per annum being made by the University Grants Committee and one of 4000*l*. per annum from the Rockefeller trustees for immediate developments. He was able to announce that though Sir Cooper Perry is retiring from the post of Principal Officer of the University of London, his services are being retained on the Board of Management of the School, of which he has consented to be vice-chairman. Mr. Ormsby-Gore, Under-Secretary for the Colonies, in a most lucid and convincing manner, spoke of his recent experiences on a tour of the colonies and his conviction that hygiene and sanitation are the most vital of all the problems connected with the future development of the vast territories under the charge of Great Britain. The importance of a school like that being founded in London could not be overestimated.

Mr. Neville Chamberlain said that the building, the foundation stone of which he was to lay, was a result of co-operation between the two great English-speaking nations. It had been noted that the teaching of public health in London is carried on in a number of separate institutions, and it was realised that its concentration in one school would undoubtedly conduce to greater efficiency in teaching and research work. It was further realised that public health is not only necessary in the British Isles, but is of even greater importance in the tropical possessions of Great Britain. It was this fact which led to the incorporation of the London School of Tropical Medicine, founded in 1899 by Mr. Joseph Chamberlain. The new School would deal with hygiene in its widest applications, and before it lies a future in which it would not only be of national but also of imperial and even world-wide importance. It is probably destined to be famous as the greatest centre in the world for research and instruction on one of the most beneficent of all the activities of the human race. Reviewing the departments of the new School, Mr. Chamberlain said these would comprise: (1) Physiology; (2) chemistry and bio-chemistry; (3) bacteriology and immunology; (4) epidemiology and vital statistics; (5) medical biology; (6) sanitary science and public health in general. The School would be fitted with the latest types of apparatus and equipment, and would develop a great teaching museum in graphic form, intended not only for the student of hygiene but also for those of the general public who would care to visit it. With this programme before it there is every prospect that post-graduate students would gather from all parts of the world, and there can be little question that men and women will receive the best possible instruction in the methods of disease prevention. After the foundation stone had been laid Dr. Andrew Balfour, Director of the School, presented Mr. Neville Chamberlain and Mr. Ormsby-Gore with seals as mementoes of the important occasion, the success of which they had so ably ensured.

AT 29 Great Pulteney Street, Bath, a corporation committee, under the chairmanship of Mr. T. Sturge Cotterell, has erected the forty-second mural tablet in commemoration of distinguished people definitely connected with the city. This last one states that "In this house William Smith, the Father of English Geology, dictated 'The Order of the Strata,' December 11th, 1799." The house was that of the Rev. Joseph Townsend, and it was the Rev. Benjamin Richardson who held the pen. This, the first written statement of Smith's ideas, was distributed in many copies to geologists at home and abroad. The tablet was unveiled on July 10 by the president of the Geological Society of London, Dr. F. A. Bather, in the presence of the mayor and a company that included many leading geologists. The chief guests were entertained to lunch at the Guildhall by the mayor (Mr. Cedric Chivers) and mayoress (Madame Sarah Grand), after which a meeting at the Royal Literary and Scientific Institution was addressed by Dr. Bather.

DR. BATHER showed in his address how the conclusions of William Smith flowed naturally from his surveying work in the neighbourhood of Bath, and how the society of the city afforded a fertile field for their reception. Smith's leading ideas, a revelation to his contemporaries, formed the starting-point and the necessary foundation of all tectonic and all historical geology; they have been the only sure guide in the great industries of coal-mining and oil-getting; and they alone have afforded the proofs without which evolution would have remained an ineffective dream. Prof. W. B. Scott, of Princeton, emphasised some of these thoughts by reminding the company that Hutton himself had not conceived the possibility of an historical geology, and that among those who failed to understand the principles of William Smith even Herbert Spencer could be reckoned. Among other speakers were Profs. S. H. Reynolds and H. L. Hawkins, and the chairman, Mr. P. E. Martineau, who is doing so much to revive the geological museum of the Institution.

MATHEMATICIANS usually look to the British Association only to satisfy their curiosity as to progress in other subjects than their own, but for this year's meeting at Oxford an attempt is being made to provide a broad platform for expression among themselves. On three mornings Section A will divide, mathematics separating from astronomy and physics, and several speakers have undertaken to describe in terms intelligible to mathematicians generally, not merely to experts in one branch or another, recent lines of advance and outstanding problems that are being attacked in mathematics itself. Subjects are found in mathematical logic and in rational dynamics as well as in the central regions of analysis, and every problem is to be expounded by some one who is at work upon it. It rests with the mathematicians of Great Britain, amateur as well as professional, from the schools as well as from the universities, to prove by their attendance that an effort to give in simple language some idea of the present vitality of mathematics appeals to a genuine interest. Only a fraction of the possible subjects can be touched at one meeting, and if this year's experiment is successful, the British Association will have discovered a function which can be continued beyond the circle surrounding its present origin and may even be found to be regular almost everywhere.

THE interesting lecture given by Mr. C. F. Elwell on May 5 to the Royal Society of Arts on the past, present, and future of radio is published in the June number of the Society's journal. He divides the subject into radio telegraphy, telephony, and miscellaneous applications. He points out that it is possible to talk to ships at sea by an ordinary subscriber's telephone. Such relaying of wire line telephony has even been done after the speech has been transmitted 5500 miles. The rapid progress of broadcasting is due to the demand for it. There are already two million receiving sets in use in Great Britain, and five million in the United States. There is a field for the transmission of speech by radio over electric light wires and transmission lines. Considerable progress has already been made in this direction in Italy, Germany, and the United States. It will do much to relieve the overcrowded ether. The three-electrode valve has already cheapened the cost and considerably extended the field of telephony. A few years ago, conductors weighing 150 lb. per mile were necessary for long-distance transmission. Better speech is now possible over greater distances with conductors of only one-fifth the weight. Considering that millions of miles of telephone circuits are in existence and that extensive developments are in progress, the value of the copper that is being saved is very large. A picture of a cheque has been sent across the Atlantic by radio and has been honoured within an hour of its receipt. It is possible that picture films may be sent by radio. In the art of television notable progress is being made by J. L. Baird, and developments may be expected. Many problems in connexion with the prevention of collisions at sea and between aeroplanes in the air still remain to be solved. A solution of one of these problems would probably also be applicable to the other. Even in competition with submarine telegraphy, radio is making progress. Radio telegraphy carries 30 per cent. of the message traffic across the Atlantic.

ACCORDING to a telegram of July 6 from The Hague (printed in the *Times* for July 7), another serious earthquake since June 28 has occurred on the west coast of Sumatra, but the date is not given. The epicentre is said to lie between Fort de Kock and Solok—that is, some miles to the north or north-east of Padang. The brick houses that withstood the earlier shock were destroyed and the number of lives lost is placed at 400. The recent shocks occurred in a district lying many miles to the north-west of that visited by the great earthquake of June 12, 1893, but in a part of the island disturbed from time to time by destructive earthquakes, one of the most important being that of May 17, 1892. This latter earthquake is of interest, as it was the earliest in which crust-movements were measured by a repeated triangulation of the district. Prof. H. F. Reid, from a study of the displacements (*Bull. Seis. Soc. Amer.*, vol. 3, 1913, pp. 72-79), infers that the movements took place horizontally along a N N.W.—S.S E. fault 150 or 200 km. in length, the west side moving to the N.N.W. and the east side to the S.S.E., the total relative slip being 3·5 or 4 metres. The movements, both in nature and amount, bear a close resemblance to those which took place along the San Andreas fault at the time of the Californian earthquake of 1906.

REPLYING to a question in the House of Commons on July 12, Mr. Ormsby-Gore, Under-Secretary for the Colonies, said that arrangements have been made by the Department of Scientific and Industrial Research for communicating regularly published and other information as to the work done under its auspices to Dominion Government research organisations, to the principal unofficial research centres, and to the Governments of India and the Colonies. In return, valuable information is being received by the Department from the oversea parts of the Empire Similar arrangements for the exchange of information on agricultural research are in force; and it is proposed that a conference on the subject of inter-Imperial co-operation in agricultural research shall be held in the autumn of 1927. Invitations to this conference were issued last year to the Governments of the Dominions, Colonies, and Protectorates.

A MEMORIAL tablet has been placed in the Dominion Archives building, Ottawa, in memory of sixteen members of the Canadian Arctic Expedition, 1913–18, who perished during the expedition in widely separated sections of the Arctic. In addition to the inscription "in memory of those who perished, Canadian Arctic Expedition, 1913–18," and the names in alphabetical order with the ranking of each, there is an inscription at the foot of the tablet: "for Canada and for Science—pour la patrie et pour la science." Of the five members of the scientific staff who are thus commemorated, one is a Canadian, son of the late Dr. A. E. Malloch, of Hamilton, Ontario, and a member of the Geological Survey of Canada. Henri Beuchat, anthropologist, was a distinguished writer on American archæology and ethnology from Paris. Bjarne Mamen, topographer of Oslo, Norway, had served on the Norwegian-Spitsbergen Expedition before taking part in the Canadian expedition. James Murray, oceanographer, and Alister Forbes Mackay, surgeon, were from Scotland, and had been with Shackleton in the Antarctic. Peter Bernard, master of the *Mary Sachs*, a native of Prince Edward Island, lost his life, as did Charles Thompson, seaman, while crossing Banks Island in the winter of 1916–17. André Norem, Daniel Wallace Blue and John Jones were buried on the north coast of Alaska, Baillie Island and Victoria Island, N.W.T. After the sinking of the *D. G. S. Karluk*, north of Siberia, in January 1914, four men were lost attempting to reach Wrangel Island over the sea ice: James Murray, Alister Forbes Mackay, Henri Beuchat, and a seaman, Stanley Morris. Another party of four, led by First Mate Alexander Anderson, consisting of Charles Barker, John Brady and Edmund Golightly, seamen, succeeded in reaching Herald Island, but their fate was not known until a whaling vessel calling at the island in 1924 discovered the relics of the party on the beach. George Breddy, seaman, died on Wrangel Island, as the result of an accidental gunshot wound, and George Malloch and Bjarne Mamen, perished from scurvy at Rodger's Harbour, Wrangel Island, in May 1914.

SIR J. C. BOSE, of Calcutta, has been giving lectures and demonstrations recently in Great Britain on plant stimulus and response. This is a subject to which he has devoted his energies for many years, and he has devised various delicate instruments for magnifying the minute responses of the plant to stimuli. Plant physiologists have not hastened to take up the use of such instruments, which would surely by their delicacy yield interesting results in the hands of any skilled experimenter. There is still much to learn about plant response, and Sir Jagadis has done useful work in directing attention to the delicacy of the plant as a responding mechanism. In a recent lecture at the Royal Society of Arts he referred to the sensitiveness of the plant to ether vibrations, not only to visible light but also to the ultra-violet and to octaves of long invisible waves. He also referred to the death spasm accompanied by an electric discharge, which he believes to take place when the plant dies but before it begins to droop and wither.

THE memory of Benjamin Harrison and his life-long devotion to archæology, and particularly to the study of the evidence of man's earliest handiwork in the form of stone implements, will be appropriately preserved as a result of the efforts of the promoters of the "Benjamin Harrison Memorial Fund." On Saturday last, July 10, a tablet to his memory was unveiled in Ightham Church, and as part of the memorial ceremony the title-deeds of the Coldrum Stone Circle at Trottiscliffe, Kent, which has been purchased out of the contributions to the Fund, were handed over to the National Trust. Admirers of Benjamin Harrison, who are many, will be gratified that the preservation of this most interesting relic of early man should be assured, and that it should be associated with the memory of one of the most devoted of the pioneers in archæological studies in England

A LETTER from Lord Onslow appears in the July issue of *Man*, putting forward a plea for the preservation of specimens of ethnographical interest in Great Britain at present in private hands. It is pointed out that the nineteenth century being primarily a century of settlement, as opposed to the two preceding centuries which constituted the age of discovery, it was pre-eminently the century of the collector, and there must remain in private hands a large number of ethnographical objects which were acquired before their use among primitive peoples had been superseded by articles of European manufacture. If immediate steps are taken, it should be possible to preserve a large number of objects of great ethnographical and historic value, and in many cases to record their history and provenance. The Council of the Royal Anthropological Institute has appointed a committee to explore the possibilities of the situation. Lord Onslow has consented to act as chairman of the Committee.

WE are glad to know that it is proposed to establish a memorial to the late Mr. F. S. Spiers, secretary of the Faraday Society and of the Institute of Physics, to remind future generations of his valuable services to science and human welfare It is suggested that a memorial lecture, to be paid for out of the interest on the fund subscribed, shall be instituted under the auspices of the Faraday Society. A committee to promote this appeal has been formed, with Sir William Bragg as chairman, and the sum of about 130*l* has already been subscribed We are sure that many who have been associated with Mr. Spiers in scientific meetings and the preparation of papers and reports will desire to add to this sum. Contributions should be sent to the assistant honorary secretary, Miss M Parsons, of the Faraday Society and the Institute of Physics, at 90 Great Russell Street, W C 1 Cheques should be made payable to Prof. A. W. Porter and crossed " F S Spiers Memorial Fund A/c."

ARRANGEMENTS are being made by the Regional Survey Association to hold a meeting at Richmond, Yorkshire, on September 1-10 next The district, which is rich in historical associations and natural beauty, will be studied from as many points of view as possible—physical, geographical, historical and social. Lectures will be given by specialists in these subjects, and these will be supplemented by practical work and observational excursions in the neighbourhood. The latter will cover Barnard Castle, Muker and Keld, Leyburn in Wensleydale and Catterick Bridge, localities which will afford exceptionally favourable fields for research. Full particulars may be obtained from the Secretary, Leplay House, Belgrave Road, London, S W.1.

THE report on the Health of the Army for the Year 1924 has recently been issued (London: H.M Stationery Office, 1926. 3*s*. 6*d*. net). Efforts have been made to expedite issue, with the result that this report appears within about four months of its predecessor. A melancholy interest attaches to it, for it is signed by the late Sir William B. Leishman, Director-General, A M.S. The improvement in the health of the troops, noted in previous reports, was maintained during 1924, with the exception that the admission ratio shows a fractional increase over 1924, due to influenza Tonsillitis again caused a large number of admissions to hospital, and middle ear disease heads the list of diseases causing the greatest loss of men through invaliding. Interesting details are given both of the medical measures and equipment employed in the army in the treatment of disease and of the hygienic and other measures now taken to prevent disease and to improve the lot of the soldier.

THE technical programme has now been issued of the sectional meeting of the World Power Conference, to be held at Basle on August 31-September 8 in the halls of the International Exhibition for Navigation and Utilisation of Hydraulic Power. Five broad subjects of discussion have been arranged: (*a*) utilisation of water power and inland navigation, (*b*) exchange of electrical energy between countries, (*c*) relation between the hydraulic and thermal methods of generating electricity, (*d*) electricity in agriculture, (*e*) railway electrification. At the conclusion of the meeting, an official tour of Switzerland will be made, lasting from September 9 until September 12. Communications for the British National Committee should be addressed to the Secretary, World Power Conference, 36 Kingsway, London, W.C.2.

ON May 30, Dr. Truman Michelson, of the Bureau of American Ethnology, left Washington for the reservation of the Fox Indians at Tama, Iowa, where he will study the ritual of the religious ceremonies which are held in the spring and autumn. He will afterwards proceed to Wyoming to study the language of the Arapaho, which appears to be a widely divergent derivative of Algonquin. This is the fifteenth consecutive season that Dr. Michelson has spent among the Fox Indians, from whom he has collected a large amount of anthropological material. Some of this material appears in the latest volume published by the Bureau of American Ethnology, but the greater part awaits publication owing to the lack of funds. This is the more to be regretted as the Fox are a reticent people with an interesting history—they contributed materially to the loss of Canada by the French to the British by breaking up the trade route from Louisiana to Canada—and although they suffered some admixture with European blood in the early days of American colonisation, they have since stubbornly maintained their racial purity.

AN announcement has been issued of the fifth competition, for 1926, for the Patxot prize, which was instituted in 1922, primarily to stimulate research in Catalonia in the physical sciences and mathematics, by M. Raphaël Patxot i Jubert. The prize for 1926 will be 5000 pesetas (present value about 160*l*), and the jury of award will consist of two specialists and the founder of the prize, who retains rights of publication. Competing works should be addressed to Rue de la Cucurulla, 1 et 3, Barcelona, and must be received by December 31, 1927. They may be in Catalan, any Latin tongue, or English, and the subject is the meteorology of the western Mediterranean, and more especially of the Catalan coast. One competition for 1924 (10,000 pesetas) for a documented monograph relating to the history of the physical sciences or mathematics in Catalonia in the Middle Ages, closes on December 31, 1928. Another prize for 1924 was not awarded, although three memoirs on physiographic studies of Catalonia were entered, for which minor awards were given. The prize for 1925 (5000 pesetas), which closes on December 31, 1926, is for a monograph in Catalan on atmospheric physics applied to Catalonia.

UPON its title page the *Journal of the Royal Agricultural Society of England* bears the Society's distinctive motto "Practice with Science." In view of the latter epithet it is entitled to notice here. Under the heading "Special Articles" there are in vol. 86 eight papers, of which many of the authors bear well-known names either in 'Practice' or 'Science.' The most arresting contribution is one on the "Use of the Dynamometer in Soil Cultivation Studies" by Dr. Keen, of Rothamsted. This gives a summary of the novel results obtained by the use, for the first time, of an instrument of real precision in measuring the draft of tillage implements, the unexpected result being that draft does not necessarily increase *pro rata* (even in linear dimensions) with speed. In regard to tillage problems, however, one may be permitted to suggest (as Wren Hoskyns believed almost a century ago) that the future of economical tillage lies with a rotary implement rather than with the plough, designed, as the latter is, to suit the slow-moving ox or horse. The Oxford Research Institute in Economics contributes a timely article on the sugar-beet position. For the first time in the rather turgid literature on this subject, attention is directed to the fact that the introduction of this crop on any extensive scale necessarily contracts, in a serious degree, the provision of animal food, and consequently raises questions of fundamental economic importance to British farming, dependent as this is, to a pre-eminent degree, on animal husbandry. The Society has recently established a Research Committee, but judging by its present report its title should be, with greater justice, the Field Investigation Committee; for it is almost wholly concerned with interesting and valuable practical trials in such subjects as green manuring, lucerne-growing, malting barley trials, grassland improvement, and so forth.

PROF. A. F. VON EISELSBERG, professor of surgery in the University of Vienna, has been awarded the Lister medal, given by the Royal College of Surgeons of England, for distinguished contributions to surgical science.

THE Council of the National Institute of Agricultural Botany has awarded the Snell Memorial Medal for the year 1925 to Dr. R. N. Salaman. The medal is given annually to mark distinguished work in the sphere of potato husbandry, and has been awarded to Dr. Salaman in recognition of his eminent services in the study of the problems connected with the breeding and the diseases of potatoes. The medal will be presented to Dr. Salaman at the public inspection of the trials at the Potato Testing Station, Ormskirk, on August 19.

PROF. CARL DIENER, professor of palæontology in the University of Vienna, has been elected a foreign member of the Geological Society. The following have been elected foreign associates of the Society: Dr. A. L. Day, of the Geophysical Laboratory, Washington, D.C.; Prof. Otto Jækel, professor of geology and palæontology in the University of Greifswald; Prof. Maximin Lohest, professor of geology and physical geography in the University of Liége; and Prof. Pierre Pruvost, professor of geology and applied mineralogy in the University of Lille.

THE Vienna Academy of Sciences has elected as honorary member Dr. Ernst Fuchs, emeritus professor of ophthalmology in the University of Vienna, and the following as foreign corresponding members: Prof. G. H. Hardy of Oxford, Dr. C. V. L. Charlier of Lund, Dr. S. Ramon y Cajal of Madrid, Dr. O. Richter of Brünn. Prizes have been awarded to Dr. A. Franke for his work on the formation and transformation of glycols, and to Dr. G. Stetter for his work on the determination of the masses of atomic fragments. The prize offered at the instigation of Dr. Hans Vaihinger, president of the Philosophical Society "As-if," for an essay on "Fictions in Mathematics" has been awarded to Dr. C. Betsch of Kannstatt, and Dr. M. Draeger of Chemnitz has been highly commended.

THE publication of the *British Journal of Experimental Biology* has been undertaken by the Cambridge University Press. It is the organ of the Society for Experimental Biology, but contributions are accepted from other than members of that body. It is edited by Mr. J. Gray, with the assistance of Dr. F. A. E. Crew and others.

MESSRS. Dulau and Co., Ltd., 34 Margaret Street, W.1, have just issued a useful catalogue (No. 143) of some 1200 second-hand books on phytopathology and horticulture. It is conveniently arranged under the headings: phyto-pathology, fungi, mosses and hepatics, lichens, diatoms and desmids, algæ and plankton, ferns and lycopods, cryptogamia, botany, floras, gardening, herbals, etc.; and agriculture and economic botany.

ANOTHER of Messrs H Sotheran and Co.'s well-known catalogues has just reached us. Its number is 800 (or "Catalogue of Science and Technology," No. 111, Part vii.: x. and xi.), and in it are particulars of nearly 4000 second-hand works on chemistry and chemical technology. The classification is as carefully carried out as in earlier parts of the catalogue, and there are the valuable bibliographic details and comments which one looks for in this publication which is of the greatest usefulness to collectors and librarians of scientific publications. Applications for the catalogue should be made to Messrs. H. Sotheran and Co., 140 Strand, W.C.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in the Education Department of the University of Leeds with, preferably, qualifications and experience in teaching science or geography—The Registrar (July 19). A demonstrator in mathematics at the Royal College of Science, and a demonstrator in mathematics at the City and Guilds (Engineering) College—The Secretary, Imperial College of Science and Technology, South Kensington, S.W. 7 (July 26). An assistant librarian at the University College of North Wales, Bangor—The Registrar (July 26). A lecturer in physical chemistry in University College, Dundee—The Secretary and Registrar, The University, St. Andrews (August 16). A lecturer in zoology at Armstrong College, Newcastle-upon-Tyne—The Registrar (August 28). A principal of the University College of North Wales, Bangor—The Registrar (October 1). A chief science mistress at the County School for Girls, Beckenham; or a temporary post until Christmas and a permanent post in September or January—The Head Mistress (marked 'Science Post'). Directors of propaganda for calcium cyanamide in India and in Ceylon respectively—The Director of Propaganda for Calcium Cyanamide, Adelaide House, King William Street, E C 4. An assistant entomologist under the Empire Cotton Growing Corporation for work on cotton pests in the Union of South Africa—The Secretary, Empire Cotton Growing Corporation, 2 Wood Street, Westminster, S.W.1. An assistant master at Soham Grammar School to take charge of practical instruction in Nature study, horticulture, and the elements of agricultural science—The Secretary for Education, County Hall, Cambridge.

ERRATUM.—In the issue of July 10, p. 64, col 1, line 21 of paragraph on "Silver Iodide in Gelatin Iodo-bromide Emulsions": for "440 mm." read "440 $\mu\mu$"

Our Astronomical Column.

FINLAY'S COMET.—Mr. S. Hasunuma, of Tokyo, who has calculated the perturbations of Finlay's comet (*Astr Nach.* 5453), finds that they delay the perihelion passage until August 7, which is some six weeks later than the approximate value assumed in the B A A Handbook The effect is to bring the comet into a more favourable position for observation, so that its detection this summer is now quite probable The following ephemeris for 0^h is based on perihelion August 3·0.

	R A.		N. Decl.	
July 18	3^h	$3{\cdot}7^m$	13°	48′
,, 26	3	40·9	16	38
Aug 3.	4	16·9	18	56

A change of +4 days in perihelion date diminishes the R A by about 10^m and the Decl. by about 90′ The comet must be looked for low in the east just before dawn

THE COMING PERSEIDS.—The earlier meteors of this famous shower have been perceptible since the opening of July, and it is very interesting to trace the development of the display and the motion of its radiant from night to night through the constellations of Andromeda and Perseus.

This year should provide a shower of more than usually prominent character, for the moon will be new on August 8 and practically invisible at the period of the maximum.

The radiant moves E S E. in a line corresponding to 39° north of the ecliptic, and its positions on four dates in July, August, and September are as follow:

		Star near
July 15 . .	15° +47°	Psi Andromedæ
August 1 .	31° +52°	10° N Gamma Andromedæ
August 15 .	49° +57½°	8½° N Alpha Persei.
September 1 .	69° +61½°	2° W. Beta Camelopardalis.

New observations should be applied to test the accuracy of these approximate positions. The Perseids usually leave streaks, and these are occasionally very enduring in the case of the brighter meteors, so that their directions of flight may be recorded with considerable fidelity.

Some hundreds of the Perseids have had their real paths computed, and there seems little necessity for further data of this sort except on nights near the commencement or end of the display, when double observations will give good and certain radiants. It will be interesting, however, to learn more of the minor contemporary showers. Observers, in comparing one year's results with others, should make such allowances as appear to be required respecting the weather, moonlight, etc. The hours of observation are also important as greatly affecting the altitude of the radiant and the number of meteors distributed.

THE SIMEIS OBSERVATORY REFLECTING TELESCOPE.—The report of the Pulkovo Observatory for 1925 has been published. The most important work done during this year is considered to be the erecting of the 40 inch (1 metre) reflecting telescope at the Simeis Observatory in the Crimea, which is affiliated to the Pulkovo Observatory. The reflector was made at the works of Sir Howard Grubb and Sons, Ltd, and a brief description of it is to be found in NATURE of April 12, 1924 (vol. 113, p. 550).

In the report some interesting details are given relating to the erection of the instrument. The masonry was started on June 6, 1925, and at the beginning of November the mechanical parts of the revolving dome were so far ready that the erection of the reflector could be proceeded with Finally the large mirror was inserted in its case with great precautions, and was fixed to the tube.

By the end of the year the reflector was mounted, with the exception of the clock-work. Movement of the instrument by hand is easy, although the total weight is 6½ tons. The mechanical parts of the instrument work perfectly, the construction being the highest type of technical achievement

The programme of research being dependent on the quality of the mirror, a preliminary laboratory test was made during the summer months by Hartmann's method at the centre of curvature of the mirror. The conditions during the test were purposely chosen far from favourable and approximated closely to the average conditions in the dome Quite apart from the mounting, it is very important to have a thorough knowledge of the shape of the mirror. A series of independent photographs were taken on different days and were examined, in order to get an idea of the mirror's shape. The following details are noteworthy. The results of measurements of different photographs taken on the same day give very nearly the same results. The zonal aberration is exceedingly small, of the same order as the errors of measurement. The average departure in different zones is about 0·03 mm. The accuracy of the configuration of the mirror (departure from a paraboloid) is of the order of [illegible] of a wave-length. According to Hartmann's classification, the mirror may be considered as "hervorragend gut" (exceedingly good). The results of the analysis leave no doubt that the mirror has a perfect shape, and in comparison with data published for other big mirrors it certainly ranks among the best.

Research with such an excellent instrument on both the mechanical and the optical sides is expected to give good results in the various interesting problems for which the instrument is intended to be used.

Research Items.

Relative Value of Factors influencing Infant Welfare.—In Parts 3 and 4 of the first volume of *Annals of Eugenics*, Miss Ethel M. Elderton concludes her exhaustive study of data from Rochdale, Bradford, Blackburn, Preston and Salford on infant viability and summarises her conclusions. These, both positive and negative, are of fundamental importance. The factors, which are shown to be more or less closely associated with viability, are the health of the mother, the health of the baby at birth and, of much less significance, the maturity of the mother and the position of the child in the family. The evidence is conflicting, but in some towns there appears to be a rather heavier death-rate among the infants of women under twenty-three years of age. Miss Elderton has also formed the opinion that there is a higher infant death-rate among the first-born which may be concealed during epidemics of diarrhœa. Association with the habits of the parents and the occupation of the father is small; so is that with all other environmental conditions, *e.g.* poverty, whether judged by the income of the family or the wage of the man, and housing; while no evidence is afforded that children born at the end of a large family suffer in vitality, or that bottle-feeding in itself causes a high infant mortality. Nor, so far as infant mortality is concerned, has indoor sanitation any advantage over outdoor sanitation. The whole trend of the evidence is in favour of the view that the infant death-rate is selective. From the point of view of the race, also, the success of health visitation and inspection is in the right quarter, tending to assist chiefly the better portion of the community. Miss Elderton urges very strongly the need for fuller information to decide whether parental health and habits cause environmental conditions or whether these are responsible for parental health and habits. Much of the available evidence favours the first of these alternatives.

Tears.—Prof. Maurice Canney, in the *Journal of the Manchester Egyptian and Oriental Society*, No. 12, points out that there is a curious resemblance in birth and death ceremonies which may be due to the fact that birth, marriage, and death all mark a change of state, and the ceremony may be one of initiation into new life. Though it may be natural to express grief by howling, wailing, and weeping, much depends upon how things are done. Though black is sometimes stated always to have been a symbol of death, it seems frequently to have been of life-giving significance, as, for example, in the use of antimony and henna as applied to new-born babes in Egypt. In the case of tears, two ideas have intermingled, but in a civilised community tears are almost exclusively connected with grief and pain, excluding the idea of life-giving, which is really the more primitive. The ceremonial weeping and bawling, which is a feature of mourning ritual in, for example, China, Africa, and elsewhere, clearly has a special significance, its object being not to express grief, but to awaken and reanimate the dead. Tears may be compared to the shedding of blood. The ceremony of cutting oneself for the dead renewed the bond of union with the living. Further, tears being creative, they are potent to produce fertility and ensure good crops. Hence in a number of instances in human sacrifices, the victims are frequently tortured to make them shed tears.

Prehistoric Earthworks in North Cardiganshire.—A regional survey of the prehistoric earthworks of North Cardiganshire by Mr. I. T. Hughes in vol. 4 of the *Transactions of the Cardiganshire Antiquarian Society* gives a summary description, with plans, of 28 earthworks which can be classified as true 'hill-top' camps. They are confined to a region north of a line drawn from the sea near Llanrhystyd along the Wyre Valley to Trawscoed, then towards Ystrad Meurig and along the valley of the Upper Teifi. There is, however, an important group along the Aeron Valley. North of the Wyre—Upper Teifi line they are isolated from the camps of western Montgomeryshire by the Plynlimon Range. No camp is below the 300 ft. contour and four are above the 1000 ft. range. The upward limit of camps coincides with that of cultivation and modern habitation. Some of the camps are situated in proximity to the sea and defend inland routes, and the distribution suggests that Llanrhystyd was a port of some importance, probably connected with the south coast of England by the conjectural Bronze Age route Southampton—Harlech with a branch from Evesham, "aiming probably at Aberystwyth or some port south of that town." The chief metalliferous areas of Cardiganshire are characterised by groups of camps. Place names associated with the camps near the sea, the valleys and the mining areas suggest Irish affinities which are supported by finds of a halberd, a flat celt, and a palstave of Irish design. The camps, therefore, would appear to be the centres of a community of Goidelic lead lords with close connexions with Ireland. Without the evidence of the spade it would be unwise to offer an opinion as to their age.

Soil Problems in Cotton-growing in the Sudan.—The Sudan Government has published (Khartoum, January 1926) the report of a meeting of the chemical section of the Wellcome Tropical Research Laboratories, held at Wad Medani, in which the problems of cotton-growing in the Sudan Gezira were passed in review from the point of view of chemist, physicist, and biologist. This review is particularly noteworthy on account of Dr. E. M. Crowther's discussion of the effect of the nitrogen supply. It appears that, after the water supply, the most important soil factor in the Gezira is the nitrogen supply. Cotton cultivation in the Gezira in this respect shows an essential difference from the conditions prevailing in Egypt.

Oxygen Requirements of Fish.—Data have been presented concerning the oxygen requirements of different kinds of fish at various temperatures by J. A. Gardner (Min. of Agric. and Fisheries Fishery Invest., Ser. I, vol. 3, No. 1, 1926: Report on the Respiratory Exchange in Freshwater Fish, with Suggestions as to Further Investigations. Pp. 17. London: H.M. Stationery Office, 1926. 2*s.* net). At ordinary limits of temperature, the respiratory quotient varies between 0·6 and 1, but the majority lie round 0·8. Trout appear to be more sensitive to rise in temperature than the coarse fish examined. Even 25° C. proved fatal to a large trout, though smaller specimens could be acclimatised to stand 25° for some hours. Goldfish can endure 30° C., but not 35° C.

Asiatic and American Elements in the Lepidopteran Fauna of Polar Europe.—The well-known Russian lepidopterist Prof. N. I. Kuznecov has been working for many years on the problem of the distribution of lepidoptera in the Polar regions. While a comprehensive work on the subject is in preparation, he publishes some preliminary results of outstanding interest (*Comptes rendus Acad. Scien.*, Leningrad, 1925). Many species of butterflies are characterised by a discontinuous distribution, being present in polar Europe and in eastern Siberia, but not occurring in the wide area between the Yenisei and the Ural Mountains. This area, corresponding to the West Siberian plain, can only be explained by the West Siberian Sea, which existed in the Oligocene and extended as far southwards as the Aral Sea. This means that the age of the European circumpolar faunal elements, as well as of the Holarctic ones, must be estimated in any case as pre-glacial, or, more precisely, as pre-oligocenic. These pre-oligocænic circumpolar elements are probably autochtonous, which leads to the conclusion that the Arctic faunistic region may be considered as independent of the Palæarctic region. On the problem of possible origin of these ancestral Holarctic elements, which since the Palæogenic times have populated the whole northern zone of both Eurasia and America, Prof. Kuznecov is of the opinion that they originated in the Angaro-American continent, which embraced eastern Siberia and north-western America down to Colorado and the Great Lakes, stretching westwards across northern Siberia to the White Sea.

Mediterranean Sternoptychidæ.—Messrs. P. Jesperson and A. V. Tåning ("Report on the Danish Oceanographical Expeditions, 1908–1910, to the Mediterranean and Adjacent Seas." No. 9, Vol. 2 (Biology). A. 12: "Mediterranean Sternoptychidæ," by P. Jespersen and Å. Vedel Tåning. Copenhagen: Andr. Fred. Høst and Søn, 1926. 35s.) continue the systematic account of the fishes belonging to the Sternoptychidæ taken by the Danish Oceanographical Expedition in 1908–1910 under the leadership of Dr. Schmidt. Together with Jesperson's previous report in this series on the genera Argyropelecus and Sternoptyx (Reports, vol 2, A. 2), it forms a valuable account of the post-larval, adolescent, and where necessary, of the adult stages belonging to the species of this family occurring in the Mediterranean. Many cases of doubtful synonymy are cleared up and a new species of the genus Cyclothone described. Much attention is given to the comparison and identification of the species, and numerous clearly executed figures accompany the text; maps are also given showing the horizontal distribution for each species. The information relating to seasonal, diurnal, and ontogenetic vertical migrations, as well as that relating to the horizontal distribution, is interesting and important. Very young larval forms seem not to have been found except in isolated cases; this being due in the authors' opinion to their small size and delicate nature, and to their destruction by the net. Post-larval forms are generally taken close to the surface, whilst typical metamorphosis stages are found in much deeper water, mainly from 500 to 1200 m.w., depending upon season and geographical locality, and varying for each species; it seems, moreover, that the change in depth of living takes place suddenly, as intermediate stages have not been found at intermediate depths. Diurnal vertical migrations are undertaken by most of the adults, and, generally speaking, they are higher in the water in the summer than in the winter.

Biometric Work on Variability.—The *Izvestia Buro po Genetik i Eugenik*, No. 4, recently issued by the Russian Bureau of Genetics and Eugenics, contains five biometrical studies on variability, with short summaries in English or German. The longest paper, by Prof. J. Philiptschenko, on the variability of quantitative characters in twelve pure lines of soft wheats, considers the conditions under which relative values or indices are more suitable than absolute values for certain measurements. The resulting correlations are classified as (1) intrabiotypic, depending on reaction-norms within a biotype; and (2) intrapopulative, depending on the relations of the biotypes within a population. T. Liepin, in a study of variability in a Chrysomelid beetle, *Phædon cochleariæ*, finds by measuring larval stages that the variability gradually decreases with age, this decrease being due to internal factors, while unfavourable conditions are shown unexpectedly to cause increased variability. G. Pchakadze finds in *Daphnia pulex* that the young from fertilised eggs are nearly twice as variable as those from parthenogenetic eggs. He also claims that adult parthenogenetic Daphniæ are more variable than adults from fertilised eggs, and that while variability decreases with age in Daphniæ from fertilised eggs, it increases with age in parthenogenetic individuals. D. Diakonov shows briefly that bimodal variation need not necessarily mean genetic dimorphism. A Zuitin deals with similar problems of variability in the grasshopper, *Dixippus morosus*, which is also parthenogenetic He finds a decrease of variability during post-embryonic development, but concludes that if environmental conditions overbalance the internal regulatory processes within the animal, an increase of variability with age may result.

Some Periods in Australian Weather.—A discussion, by Dr. Edward Kidson, Assistant Director, Commonwealth Bureau of Meteorology, is published by the Bureau of Meteorology, Melbourne, Commonwealth of Australia, as Paper 1—extract from Bulletin No. 17. Mr. Hunt, the Commonwealth Meteorologist, in the introductory note states that Dr. Kidson has put into more precise form much that has for many years been common knowledge to Australian meteorologists, and he considers the discussion should lead to an advance in our knowledge of meteorological processes in the Australian region. The author has dealt with weather charts for more than thirty years. The close relationship shown between the annual latitude range of anticyclones and the Wolfer sunspot numbers is one of the results.

Early Polarisation Apparatus.—The issue of *Die Naturwissenschaften* for May 28 contains over the signature Kpl. an illustrated account of an apparatus for investigating the polarisation of light by reflection shown by J. Tobias Mayer to the Gesellschaft der Wissenschaften of Göttingen on November 21, 1812. It consisted of two parallel glass plates the back surfaces of which were blackened; the upper one received sunlight and reflected it vertically downwards to the second, which could be rotated about a vertical axis. It was, therefore, the apparatus now known as Norremberg's, although there appears to be no record of Norremberg having constructed his apparatus before 1842. Mayer's paper will be found in *Commentationes Soc. reg. scien. Göttingen*, 1813, No. 9.

The Atomic Nucleus—The most recent of the suggestions as to the constitution of the atomic nucleus is that made by S. Ono in the April issue of the *Proceedings of the Physico-Mathematical Society of Japan* He suggests that the nucleus consists of two parts, an inner and an outer. In the inner portion each proton or positively charged elementary particle is accompanied by an electron, while in the outer part each pair of protons has an electron. The volume occupied by the outer combination is on the average 1·1 times that occupied by the inner, and the combinations are uniformly distributed, the inner through the volume of a sphere, the outer through the shell surrounding the sphere, its outer radius being on the average 0·6 times the diameter of an outer combination greater than that of the sphere. On this supposition the relation between the atomic numbers and the atomic weights of the heavier elements comes out in close agreement with the facts, but the number of possible isotopes is in excess of those found. Two groups projected from the outer nucleus constitute an α-ray, and the disturbance of the equilibrium of the atom results in the emission of two electrons from the rings outside the nucleus —the β-rays, which it is known are emitted in pairs.

PROTECTION AGAINST IGNITION BY PERFORATED PLATES.—It is rather astonishing to read of and more astonishing to see red flames—several inches in height—emerging through perforations in a metal plate into an explosive mixture of gases without igniting the mixture. Nevertheless this may be seen in the laboratories of the Safety in Mines Research Board at Sheffield, and the description of the experiments may be read in the second report on flameproof electrical apparatus with perforated-plate protection (Mines Department: Safety in Mines Research Board. Paper No. 21: Flameproof Electrical Apparatus for use in Coal Mines. Second Report: Perforated Plate Protection. London: H.M. Stationery Office, 1926. 1*s.* 3*d.* net). Messrs. Wheeler and Grice have shown experimentally that by allowing the escape of burning gases (produced by the explosion of fire-damp and air in a bomb) through suitably spaced holes in a metal plate, the escaping gases—still visibly burning—may be so cooled down by conduction and expansion as to be incapable of igniting a 10 per cent. methane-air mixture surrounding the bomb. When two suitably perforated brass sheets, such as are manufactured commercially, are superposed—with a small interval between them—as part of the cover of a switch-box, an explosive methane mixture can be fired inside the box without igniting a similar mixture outside.

COMBUSTION UNDER DIRECT ELECTRICAL DISCHARGE. — In an interesting paper published in a recent number of the *Proceedings of the Royal Society*, Messrs G. I. Finch and L. G. Cowen describe their experiments on the combustion taking place when a direct discharge is maintained between metallic electrodes in electrolytic gas at pressures between 20 mm. and 100 mm. of mercury. In the inflammation of gases there is a pre-flame period of slow combustion when chemical combination begins; this process usually increases automatically in intensity until the normal flame appears. But it is possible to maintain the flameless regime under special conditions. Some twenty years ago, Kirkby found that when a direct discharge was maintained in electrolytic gas under low pressures, the water formed (without flame) was proportional to the quantity of electricity passed, and that the combustion was independent of the nature of the electrodes and occurred at all points of the discharge. Later workers have chiefly studied ignitions by high-tension discharges from a coil or by capacity-discharges from a condenser. The present authors have sought to eliminate so far as possible all 'capacity' effects, and to maintain a perfectly steady discharge with a glow free from striations and flickering—so that the combination might be related only to ionisation and not be due to high temperature. Under the conditions maintained by the authors, the rate of formation of water was found to be directly proportional to the current. By limiting the current, the combination may be confined to the glow round the cathode, when it is independent of the gas temperature and pressure, but varies with the nature of the electrodes.

DIRECTION FINDING BY RADIO.—The Department of Scientific and Industrial Research has just issued the third part of the report on the variations of the apparent bearings of radio transmitting stations. This report gives the results of observations carried out by Dr. Smith-Rose between November 1922 and March 1924 on ship and shore transmitting stations. (Department of Scientific and Industrial Research. Radio Research. Special Report No. 4: Variations of Apparent Bearings of Radio Transmitting Stations. Part 3: Observations on Ship and Shore Transmitting Stations, November 1922-March 1924. London. H.M. Stationery Office, 1926. 2*s.* 6*d.* net.) The previous report describes observations using wave-lengths varying from 2000 to 9000 metres. In the experiments now described, special attention was given to a wave-length of 450 metres as this was the length in general use for every day direction finding during this period. Two land stations were mainly used for the test, the Admiralty station at Orford on the east coast of England and the Radio Research Board's station at Slough. Tests were also made on board ship. It was observed that with the short wave-length of 450 metres there was a tendency for the occurrence of 'blurred' minima which annoy observers. From the point of view of navigation an important result was proved. It was found that the existence of fog had little or no effect in producing errors. On one occasion in particular, although the fog was spread over Great Britain and a large portion of western Europe, yet the directional effects showed only the usual day and night variations. As it is chiefly during foggy weather that direction finding stations are called into action, this result is most satisfactory. Again, when the weather was cloudy and overcast, no special phenomena were noticed. It seems probable therefore that the cause of the variations is not due to any effects produced by solar radiation on the lower strata of the earth's atmosphere. The report concludes by reference to two recent papers communicated by the author and Mr. Barfield to the Royal Society. In one of these a direct determination of the effective conductivity of the earth is made at radio frequencies. This result is of importance in the general study of wave propagation. In the other and later paper, it is stated that some of the radio waves have travelled through the upper regions of the earth's atmosphere before reaching the detector.

TRANSLUCENCY OF PORCELAINS.—With the view of the improvement of the ceramic industry in the United States, an investigation of the causes of translucency has been carried out by Messrs. C. W. Parmelee, professor of ceramic engineering, and P. W. Ketchum, research assistant in the University of Illinois, and the results are given in Bulletin 154 of the Engineering Experimental Station. The measurements of translucency were made by eye with the aid of a Lummer-Brodhun photometer or by the use of a photo-electric cell, the current from which when illuminated was measured by the change of deflexion of an electrometer. The two methods give relative values in fair agreement with each other, although owing to the reddish colour of the transmitted light the absolute value of the translucency by the cell method is less than that obtained by photometer. Increase of thickness of the specimen decreases the transmitted light in the usual exponential way. High felspar content produces high translucency, while flint has a less marked effect in the same direction. High clay content diminishes translucency. Fine grinding of the constituents raises the translucency in a striking way, and increase of firing temperature produces a further improvement.

Studies in Eugenics and Human Heredity in South Africa.[1]

THESE two papers by Dr. Fantham are welcome evidence of the earnestness with which he is pressing home the social applications of biology in the country in which his lot is cast. Whilst they reiterate to a large extent principles that are well known to readers of NATURE, these principles are exemplified by some interesting original observations made by Dr. Fantham since he began residence in South Africa

The ultimate aim of zoological science is of course a thorough knowledge of the inner nature of animal life The intense interest of this aim provides the spur which urges to zoological research in old countries like Great Britain, in which Nature has been thoroughly dominated and tamed, and in which we have to be up and doing if any traces of really wild Nature are to be allowed to persist But in newer countries like the outlying portions of the British Empire the battle with circumambient wild Nature is at its height, and the ultimate victory is by no means assured, and so the light which zoology (and other sciences) can throw on the conditions which are likely to lead to success in this struggle contitutes their main passport to popular favour.

Now there are two main problems for eugenists which emerge from the study of human heredity; one of these may be described as the problem of the Mendelian recessive; this problem is ubiquitous, and it is this question which especially faces social workers in Great Britain. The other is the problem of the crossing of different races: this, usually denominated miscegenation, is the really burning question in countries like South Africa and the United States of America. It would constitute a problem in Australia, also, had not the Australians adopted one particular solution of it which certainly is effective so long as it is maintained, but their power to maintain it for an indefinite period of time is, to say the least of it, exceedingly doubtful It seems to us that Dr. Fantham has not kept these two problems sufficiently distinct in his mind, for we are convinced that they are entirely different in their nature. The term "Mendelian recessive" is meant to denote those defective individuals, constantly turning up amongst modern civilised men, whose defective characteristics are transmitted to posterity in a way which suggests that their inheritance follows the laws of Mendel

The defects are, however, by no means always recessive. In fact, it seems to us that the importance of the contrast between dominant and recessive characters has been greatly exaggerated by Mendelian writers. What is usually termed a 'mutation,' that is, a sudden divergence from the type, almost always shows a peculiar character which bestows on these 'mutations' a family likeness wherever they may occur. This character is a constitutional weakness as compared with the type, and the question of dominance and recessiveness is merely the question of whether the weakness is or is not sufficiently marked to make itself felt in the F_1 generation where it enters the germ from one side only of the house These defects show themselves in external marks of the most varied kind, such as brachydactyly (the shortening of the digits accompanied by the fusion of two of the joints), polydactyly (extra toes and fingers), hæmophilia (inability of the blood to clot), night-blindness (loss of the power to see in the dusk), and, most important of all, defective development of the brain or feeble-mindedness. Dr. Fantham quotes some well-known pedigrees, but he also gives examples from his own observations of the inheritance through three generations of such defects as 'stiff fingers' (orthodactyly), permanently bent little finger, premature baldness on the crown of the head, white forelock, and supernumerary thumbs. The inheritance of this last case is very instructive, for the trait was first noted on the left hand and it appeared in the next generation on the right hand. This shows that the character was not due to a 'gene' or 'factor' which initiated an extra growth at a particular place, but to an interference with the normal processes of growth, and there is a strong suspicion that this interference was a too tightly-constricting amnion in the latest stages of development which impinged on and split the thumb rudiment into two

The social detriment due to the breeding of the feeble-minded of course far outweighs in importance the minor detriments due to the transmission of the slighter constitutional defects. The more extreme cases are confined in asylums, but the less marked cases are at liberty and constitute the lowest stratum in society. They have just sufficient intelligence to secure intermittent employment in the least skilled occupations, though they are in frequent need of poor law relief; they often marry improvidently and reproduce recklessly, for they have no foresight or control of their passions. They give birth to numerous illegitimate offspring, and their children inherit their defects. In former times these children, defective in nature and badly cared for, died like flies; now modern philanthropy steps in to preserve them, they increase in numbers, contaminate the race, and are a danger to future generations. Dr. Fantham relies implicitly on this point on the results of the American workers Davenport and Goddard, Estabrook and others. Whilst these results in broad outline will doubtless prove to be correct, it is fair to add that they have been severely criticised. Feeble-mindedness is not a definite thing due to a 'factor'; it is a varying grade of germ-damage the origin of which is due to definite causes which ought to be more closely investigated It is instructive to note that Tredgold has found that feeble-mindedness in a given generation is often preceded in the parental generation by milder symptoms such as epilepsy or even merely nervous instability.

Turning now to the question of miscegenation, we find that the hybrids between two different races such as the Kaffir and the Dutch show no evidence of clear and sharp segregation such as is found when a mutation is crossed with the type These hybrids show combinations of the qualities of the parental races in every conceivable proportion, but the attempt to analyse these qualities into factors, when pushed into details, reveals itself as impossible, as we have previously pointed out in the pages of NATURE The qualities of races are acquisitions won in the struggle with the environment, and they constitute an epitome of the evolutionary history of the race. Dr. Fantham points out that the negro race, left to itself, shows no tendency to produce a civilisation or indeed to undergo any progressive evolution whatever that it is deficient in foresight and providence, and exhibits lack of persistence and initiative The negro is in fact a tropical animal, evolved amidst the teeming life of the warmer and more fertile zones of the earth's surface; clothing is a superfluity, and the means to satisfy hunger are comparatively easily procured, and his qualities correspond with this environment The Dutch and English are offshoots of the white Nordic race, which grew up under the cloudy skies and cold raw climate of the shores of the North Sea in post-glacial times. The members of this race had to develop boldness and perseverance to survive at all, and they won their food as a result of terrific struggles with the elements, and to this struggle they owe their good and forceful qualities Dr. Fantham points out that hybrids between the two races lose the admirable qualities of the white and yet are not controlled by the tribal conventions of the negro. Further, as children of the same family differ in the colour of their skins, the whiter consider themselves European and despise their darker brothers and sisters as negroes. Dr Fantham traced one such hybrid family through five generations A joint meeting of the Eugenic and Anthropological Societies of London was told last spring that miscegenation was far more wide-spread than one would gather from Dr. Fantham's papers, and was slowly undermining the moral stamina of the whole of the white population of South Africa What are known as 'coloured people,' that is, hybrids of the second and third generation, are increasing in number, and the whiter individuals are intermarrying freely with the pure white population. We can only say that we trust that this view is an exaggerated one.

---

[1] "Heredity in Man Its Importance both Biologically and Educationally," and "Some Factors in Eugenics, together with Notes in some South African Cases." By Prof. H. B. Fantham, University of Witwatersrand, Johannesburg. *South African Journal of Science*, vol. 21, 1924, and vol. 22, 1925.

Dr. Fantham alludes to another matter of great importance, namely, the exhausting and weakening results of too frequent pregnancies not only on the mother but also on the children. We ourselves believe that the most fertile cause of human 'mutations' is to be found here. Dr. Fantham gives an example of the results of such pregnancies traced through three generations. In all three 'Mongolian idiots' appeared; this defect appears to be due to amniotic pressure on the developing brain.

Dr. Fantham's final conclusion is one which we can heartily endorse; it is that "the principles of animal [including human] biology put forward in simple interesting language and illustrated by living examples should form an essential short course in the curriculum of every University student as well as of every school child." This proposal has been pressed on our own Ministry of Education by the Council of the Eugenics Education Society, and when population and cognate problems in Great Britain become sufficiently acute to cause widespread discomfort, it will doubtless be given official attention. E. W. M.

Research in Illumination.

A SURVEY of the work of the Illumination Research Committee of the Department of Scientific and Industrial Research is given in a report issued recently by the Department. These investigations were also reviewed in a paper read by Mr. J. W. T. Walsh before the Illuminating Engineering Society on June 1. In the introduction to the Report the events leading to the formation of this committee are recalled, and attention is directed to the demand for information on lighting matters that has arisen since the formation of the Illuminating Engineering Society in 1909. On the Illumination Research Committee the medical and architectural professions are represented, and there are several members who are experts on illumination and also members of the Illuminating Engineering Society, the various British Engineering Standards Association committees, and other bodies concerned in research on illumination. Co-ordination of effort is thus facilitated and overlapping of work avoided.

The representation of the Medical Research Council on the committee is of special importance, as numerous problems before the committee have a physiological basis. This applies particularly to the study of 'glare,' and of the relation between intensity of illumination and speed and accuracy of fine work. Such fundamental researches necessarily require time. In connexion with the second problem, attention has first been devoted to printing as an example of 'fine work' readily adapted to investigations of relations between illumination and output In this investigation valuable aid has been rendered by the Joint Industrial Council for the Printing Trades of the United Kingdom. The results are to be presented in a detailed report, but it appears that the relation between illumination and quality of work has been fully substantiated. This investigation will be extended to other forms of 'fine work.'

Other fundamental researches include a comprehensive record of daylight-intensities, now being made at the National Physical Laboratory, Teddington.

Among the 'special problems of urgency' may be mentioned the investigations of enamelled iron reflectors, which have contributed greatly to the framing of the recent British Engineering Standards Association's specification for reflectors used in industrial lighting. The design of picture galleries with the view of the avoidance of troublesome reflections in the glazed surfaces of pictures has also been studied. Another series of researches deals with the effect of flickering illumination on vision and the brightness of glassware used in various lighting fittings (the latter another problem with which a B.E.S.A. committee is concerned). A series of experiments is in progress with the object of studying the effect of colour and distribution on the degree of comfortable illumination required for clerical work The systems examined include: (*a*) Semi-indirect lighting with vacuum lamps; (*b*) Semi-indirect lighting with artificial daylight (blue bulb) lamps; (*c*) Artificial window lighting with vacuum lamps; and (*d*) Artificial window lighting with artificial daylight lamps. Numerous other investigations include the examination of transmission of light through window-glass, the effect of window size and the reflecting power of walls and ceilings, the relation between glare and visibility in street lighting, and the distribution of temperature in the glass and other parts of lighting fittings.

Mr. Walsh, in the concluding portion of his paper, mentioned that these investigations would be the subject of individual reports, to be issued by the Department in the near future At the meeting on June 1, general recognition of the importance of the work being done by the committee was expressed. Mr. C. C. Paterson (chairman of the Illumination Research Committee), in opening the discussion, alluded to the services rendered by the Illuminating Engineering Society and its hon. secretary (Mr. L. Gaster) in paving the way for the creation of the committee and initiating these researches. Sir John Herbert Parsons, who presided, emphasised the important field presented for physiological study by artificial lighting, and commended the subject to the notice of ophthalmologists. Miss Wiggins mentioned examples of the valuable aid which the committee has rendered to the British Engineering Standards Association in connexion with its various investigations. Mr. J. S. Dow, in commenting on the relation between illumination and ease of work, pointed out that discretion is necessary in attempting to derive standards on the basis of natural illumination, and suggested that investigations should be directed to the effect on vision of the differences in the spectra of artificial illuminants and daylight. Mr. W. C.

Raffé suggested various inquiries bearing on the effect of colour, and the influence of light on certain metals. Mr. A. Cunnington referred to problems arising in connexion with the passage of railway trains through short tunnels, as illustrating the liability of temporary dazzling of the eyes to cause accidents. Mr. P. J. Waldram discussed the problem of avoiding troublesome reflections in picture galleries, referring particularly to the effect of badly placed skylights.

At the end of the discussion Mr. L. Gaster explained the interlinking of the Illumination Research Committee with the various other organisations interested in research on illumination, and pointed out that the Illuminating Engineering Society is performing valuable service by acting as a 'liaison officer' and as a clearing-house for information. The recent discussion before the Society of the specifications of the various B.E.S.A. committees (see Nature, March 13, p. 397) proved valuable in making them more widely known, and it is hoped that the discussion of this preliminary report of the Illumination Research Committee would be equally useful. It is of obvious importance that reports of such work should receive the widest publicity and should be thoroughly discussed, and he hoped that the forthcoming reports on individual researches would be likewise presented at meetings of the Society for full consideration.

Primitive Time Reckoning and the Calendar.

THE stages by which the Julian calendar as a method of time reckoning was attained are demonstrated by Dr. Martin P. Nilsson in a contribution to vol. 39, pt. 6 of *Scientia*, which surveys the various methods of measuring time employed by primitive and early peoples, and shows how the conception of a continuum in time, which is the essence of a calendar, has gradually developed.

The mind of primitive man, being essentially interested in the concrete, expresses time in terms of action, such as the time it takes to cook a bowl of rice, or the duration of a journey, the double hour of the Babylonians being an example of the latter. In the early stages certain recurrent natural phenomena are regarded, not as units of time of a certain duration, but as indications of time. The conception of continuity is absent at this stage. Thus time of day is indicated by the natural divisions—dawn, twilight, sunrise, or the position of the sun. Night is regarded as a whole. The crow of the cock is employed generally, but few make use of the stars as did the South American Indians and the Homeric Greeks. The conception of a 24 hours' day is late

In the same way, the season of the year is indicated by natural phenomena, winter, summer, the season of snow, rain, drought. Neither the duration of the season nor, more remarkable, their number, is uniform While we have four seasons, other peoples have two, three, five, or six. The unity of the year is established only slowly, and that empirically. As among the Banyankole, the reckoning may be from rains to rains. An agricultural people employs the agricultural operations, reckoning from sowing to harvest, the vacant period following the latter not counting.

The year is recorded and identified by some striking happening such as the "year of the meteorites." The Roman method of identifying it by the Consuls is another example.

The observation of the stars and constellations, and especially their heliacal rising, gives a more exact method of time reckoning These observations are brought into relation with agricultural operations. This leads to the observation of the solar year, which in Egypt was fixed so far back as the prehistoric period through observation of the heliacal rising of Sirius; but the conception of units of time and time as a continuum arose from observation of the moon's phases, which gave the lunar month and the divisions of the lunar month as a record of time within the month. These months were named from the appropriate activities or natural phenomena. Owing to the disparity of the lunar month and the solar year in this luni-solar year, which was known to the Greeks, Babylonians, and Jews, it became necessary, whether the cycle consisted of 12 or 13 lunar months, to employ the principle of inter- or extra-calation, either at irregular intervals or periodically, as was done in Greece in the 7th century B.C. It was this last type of calendar which was superseded by Cæsar's reform, which based the Julian calendar solely on the solar year, recognising the impossibility of equating it with the lunar year.

The Need for Precision in Botanical Terminology.

IN his presidential address to the Linnean Society on May 27, Dr A. B. Rendle referred to the work of the Society during the year. An interesting feature of certain of the discussions has been the tendency to get back to first principles or definitions and to discover that that which we had regarded as definite is after all vague. For example, in one of the discussions various authorities were quoted in support of different ideas as to the conception of the term carpel. Morphological terms originate in a desire to express certain conceptions, limited or general, and morphologists are apt to find themselves in the same position as the present-day systematist in typifying species. In the matter of definitions a meaning may be attached to a term which the originator never meant to convey; moreover, a vague use of terms may engender vague ideas of relationship. The advisability of the inclusion of the seed-like organs of Pteridosperms under the definition of seeds was also questioned. What is the degree of importance of the differences between the modern seed, which has priority for the use of the term, and the organ characteristic of Pteridosperms? Has the latter advanced beyond the gametophyte stage? Does the fact that postponement of embryo-formation until after the freeing of the seed occurs, for example in Cycads, meet the objection? This absence of an embryo may be called negative evidence, but is it not rather the absence of the criterion of the normal seed, which is an arrangement for the protection of the new sporophyte during a period of rest or transport? The phases in the life-history preceding and accompanying germination must have been widely different in the two great groups.

Until the Caytoniales were described we were clear as to what we understood by Angiosperms. We know nothing of the contents of the seed-like bodies in this primitive group, but we recognise the Angiosperm idea and associated with it the generally considered advanced character of wind-pollination.

Are we clear as to our ideas of what constitutes a Gymnosperm? The tendency is to include here everything with a seed or seed-like structure which is not angiospermic; that is, everything from Pteridosperms to Conifers—an aggregate of widely differing groups. We are in danger of introducing merely a physiological or biological character into our systematics and of recognising a mixed group which is not comparable with the well-defined group of Angiosperms.

The relationship of Monocotyledons to Dicotyledons has been the subject of many discussions in recent years. Henslow derived Monocotyledons from Dicotyledons as a result of adaptation to an aquatic habit, and Miss Sargent similarly derived them, but looked to the geophytic habit for the explanation. Neither view will withstand criticism, and it is more in accordance with our present knowledge to admit that there is no evidence of the derivation of one from the other. The problem of the origin of these two great subdivisions of Angiosperms, like that of the Angiosperms themselves, and even of modern seed-plants, still awaits solution. We need more spade-work and more facts before we are able satisfactorily to solve these problems of phylogeny.

University and Educational Intelligence.

ABERDEEN.—At the summer graduation the honorary degree of LL.D. was conferred, among others, on Prof. F. W. Oliver and Prof. T. B. Wood.

The degree of D.Sc. has been conferred on J. E. Humphries for a thesis on "Studies in Phenylhydrazones"

CAMBRIDGE.—The Frank Smart Prizes for botany and zoology have been awarded to D. J. Watson, Downing College, and to H. P. Hutchinson, St. John's College, respectively. At King's College, E. T. S. Appleyard, G. P. Hudson, and J. M. Stephens have been elected to research studentships.

MANCHESTER.—On July 8, on the occasion of his retirement from the Beyer chair of zoology in the Victoria University, Prof. Sydney J. Hickson was presented with a cheque by Sir William Boyd Dawkins, on behalf of a number of his former students, colleagues, and friends. In eloquent terms Sir William Boyd Dawkins referred to Prof. Hickson's services to science, to the work which he has done for the University, and for the cause of education in natural science A dinner has been arranged in his honour at the University Refectory on Friday, October 29, when his friends will have an opportunity of meeting him.

MR. GEORGE PATCHIN has been appointed Principal of the Sir John Cass Technical Institute in succession to Dr. C. A. Keane, who has retired.

MR. P. L. ROBINSON, lecturer in chemistry in Armstrong College, Newcastle-upon-Tyne, University of Durham, has been awarded the degree of D.Sc in the University of Durham for a thesis entitled "A Comparison of the Atomic Weights of Silicon from Various Sources."

ON Thursday, July 8, H.R.H. The Prince of Wales visited Merchant Taylors' School to lay the foundation stone of a new science building on the north side of the School quadrangle and opposite the opening from Charterhouse Square The Prince referred to the long and illustrious history of the School and to the great munificence of the Merchant Taylors' Company in fostering its many activities. After the ceremony, Mr. G. N. Pingriff (chief mathematical and science master), Mr. L H. Hutton (chief modern languages master), and three senior boys were presented to the Prince. The new building will provide for a very complete extension of the science teaching. The old science block contains an exceptionally well equipped, though somewhat cramped, physics laboratory as well as a rather old-fashioned chemical laboratory and biological department. The new building will comprise, on the ground-floor, a large lecture room, a preparation room, and a laboratory workshop; on the first floor, a good laboratory for mechanics and elementary science, as well as a form-room for the 'Special' Fifth; and on the second floor, a new biological department consisting of laboratory and museum This will enable the old building to be devoted almost exclusively to chemistry and more advanced physics, but the 'Special' Sixth form-room will remain here. Provision will be made for the projection of kinematograph films and a complete electrical installation consisting of an ordinary alternating current lighting circuit, a power circuit for heating and motors, and a 24-volt direct-current circuit for electrolytic and other work.

MANCHESTER was the earliest of the modern universities successfully to adopt the idea of residential halls, and the oldest of these, Dalton Hall, was founded by the Society of Friends in Manchester in 1876, being named after John Dalton, for forty years a prominent Manchester citizen and member of the Friends' Meeting. On July 9 a jubilee dinner was held at the Hall, at which was present a large and distinguished company. The toast of Dalton Hall was proposed by Sir William Boyd Dawkins, who paid a warm tribute to the part played by the institution in the general educational system of Manchester and the breadth of view which inspired its founders and had characterised its life In the great work accomplished by the University, the Society of Friends has rendered inestimable service. They had introduced into Manchester a non-sectarian spirit and a sturdy uprightness the value of which was incalculable. Two old Principals of the Hall were present as well as the present Principal, Mr. G. A. Sutherland, until recently senior lecturer in physics at University College, London, all of whom replied to the toast Reference was made to the number of eminent men of science and letters who have passed through the Hall as students. These include Prof. A. S. Eddington, Dr. G. C. Simpson, Dr. Gilbert Fowler, Prof. W. A. Bone, Prof. W. B. Anderson, Dr. Bevan Lean, Sir Michael Sadler, who resided at the Hall when on the University staff; Prof J. F. Thorpe and Prof. Andrew Robertson, old Hall tutors; and Mr. W. H. Moberley, the Vice-Chancellor elect of the University. The Hall has now accommodation for 65 students and a staff of twelve tutors, most of whom hold or have held appointments on the University staff.

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to Senior Studentships and Overseas Scholarships for 1926:—*Senior Studentships:* Dr. A. J. Bradley (University of Manchester—crystallography); Dr. H. J. Emeléus (Imperial College of Science and Technology—inorganic chemistry); Mr. R G. J. Fraser (University of Aberdeen—physics and chemistry); Dr. C. W. Shoppee (University of Leeds—organic chemistry); Mr. W L. Webster (University of Cambridge—physics). *Overseas Scholarships:* Mr. R. C. Robb (Dalhousie University, Halifax, Nova Scotia—biology); Mr. F. H. Yorston (McGill University, Montreal—organic chemistry); Mr. H. M. Cave (Queen's University, Kingston, Ontario—physics); Mr. J. R. Vickery (University of Melbourne—bio-chemistry); Mr. F. P. Bowden (University of Tasmania—physics); Mr. E. R. Roux (University of the Witwatersrand—botany); Mr R. R. Nimmo (University of New Zealand—physics).

Contemporary Birthdays.

July 16, 1872. Capt Roald Amundsen.
July 18, 1853. Prof H A Lorentz, For Mem. R S
July 21, 1873. Sir Walter Morley Fletcher, K B E., F R S
July 21, 1873. Prof. Howard T Barnes, F.R S
July 22, 1865. Sir Richard Redmayne, K C.B
July 24, 1856. M Charles Émile Picard, For. Mem. R S.
July 24, 1853. M. Henri A Deslandres, For Mem R S.
July 25, 1854. Mr. Alfred Barnard Basset, F.R S

Prof Lorentz, an alumnus of the University of Leyden, was born at Arnheim. He was elected to the chair of theoretical physics in that University in 1875, and among his former pupils was Prof Zeeman The Nobel prize in physics was allotted to both of them in 1902. Rumford medallist of the Royal Society in 1908, Prof. Lorentz was awarded the Copley medal in 1918. While his researches as a mathematical physicist of the first order have covered many fields of investigation, his principal work has dealt with the theory of electrons and the constitution of matter considered as an electrodynamic problem

Sir Walter Fletcher, who was born at Liverpool, is a graduate of Trinity College, Cambridge He is Secretary of the Medical Research Council

Prof. Howard T Barnes was born at Woburn, Mass, and educated at Montreal Academy and McGill University. Originally a demonstrator in the chemistry department of McGill, he became in 1908 Macdonald professor of physics there, and, soon after, director of the Physics Building. For long he was ice engineer of the Hydro-Electrical Power Commission of Ontario. Prof Barnes invented the micro-thermometer ice preventive method. He has written many memoirs concerning ice formation, specific heats, and radioactivity.

Sir Richard Redmayne, consulting mining engineer, was born at Gateshead-upon-Tyne. Following private tuition he attended Durham College of Science, and afterwards he became a mining apprentice at Hetton Collieries Sir Richard was H M. Chief Inspector of Mines, 1908–20. A member of many Royal Commissions on mining operations, he has been responsible in the main for the respective official reports. Sir Richard is a chevalier of the Legion of Honour

M Picard, eminent as a mathematician, was born in Paris and educated there at the École Normale Supérieure. From 1879 until 1881 he held a professorial chair in the University of Toulouse One of the permanent secretaries of the Paris Academy of Sciences, he is a commander of the Legion of Honour. M Picard is an honorary member of the Royal Society of Edinburgh

M Deslandres, the distinguished director of the Astronomical and Physical Observatory at Meudon, was born in Paris and educated at the École Polytechnique An active member of the International Astronomical Union, M. Deslandres is an officer of the Legion of Honour. He has many written memoirs on general and physical astronomy.

Mr. Basset, a Londoner, graduated at Trinity College, Cambridge, as 13th wrangler He is the author of a treatise on physical optics, and other works

Societies and Academies.

London.

Mineralogical Society, June 15 —**S I. Tomkeieff**: On some chloritic minerals associated with the basaltic Carboniferous rocks of Derbyshire Certain leptochlorites occurring as vesicular infillings in the Carboniferous lavas (' toadstones ') of the North Derbyshire area are described The chemical analysis of a finely spherulitic chlorite from Calton Hill places it definitely in the delessite-diabantite series Some other chlorites from Miller's Dale are less crystalline and show a peculiar development of bacteria-like aggregates, similar to those observed in the chlorophæite of Dalmahoy Hill, near Edinburgh All these chlorites can be compared with the chloritic palagonite occurring in the mesostasis of the non-vesicular basalt of the same lava flow, and it is suggested that both varieties of chlorite are primary, and were formed during the final stages of the solidification of the magma (autopneumatolitic) —**F L. Stillwell**. On the nature of berthierite A chemical analysis of berthierite from Nullamanna, near Inverell, New South Wales, gave the formula $3FeS\ 4Sb_2S_3$ Microscopical examination of polished and etched sections of the material shows an intergrowth of about 18 per cent of stibnite. Deducting this from the results of the chemical analysis, the formula of berthierite becomes $FeS\ Sb_2S_3$.—**L J Spencer**: A sperrylite crystal from the Transvaal Crystals of sperrylite (the rare platinum arsenide, $PtAs_2$) up to half-an inch across have recently been found in the Potgietersrust platinum fields, Transvaal The crystal examined measures 5·0–5·5 mm across and weighs 1·294 gm It is a brilliant cubo-octahedron developed on all sides and with the corners and edges much rounded. The rounded areas give a profusion of scattered reflected images, few of which lie in the principal zones on the crystal The only forms identified with certainty are (100), (111), (110), (210), (211) —**H E. Buckley**: The anomalous optical properties of some new series of isomorphous double tartrates In addition to the mixed crystals $\{m\ NaK,\ n\ Na(NH_4)\}\ C_4H_4O_6\ 4H_2O$, previously examined, optical anomalies of the same kind have now been determined for the series $\{m\ KNa,\ n\ K(NH_4)\}\ C_4H_4O_6\ 4H_2O$ and $\{m\ (NH_4)Na,\ n\ (NH_4)K\}\ C_4H_4O_6 . 4H_2O$. All these crystals are orthorhombic and isomorphous, but when freshly prepared they show crossed dispersion characteristic of monoclinic crystals (borax type) On standing, the crystals show a slow change in the size of the optic axial angles and in the position of the optic axial planes for different colours; and finally, after a lapse of some time, they settle down with all the optic axial planes lying in the plane (100) or (010) or in both, giving in the latter case crossed axial-plane dispersion of the orthorhombic (brookite) type This change is hastened by rise in temperature and retarded by pressure. Sections from the outer and inner portions of the crystals showed a difference, evidently due to the time taken for growth; but in the final state they are identical, suggesting that the crystals are homogeneous Other isomorphous series of mixed crystals containing only two of the three bases, namely $\{m\ Na_2,\ n\ Na(NH_4)\}$, $\{m\ (NH_4)_2,\ n\ (NH_4)Na\}$, $\{m\ Na_2,\ n\ NaK\}$, and $\{m\ K_2,\ n\ KNa\}$, showed, in the range of the visible spectrum, the optic axial planes all in one plane, but with wide differences in optic axial angle —**G T Prior** On the South African meteorites, Vaalbult, Witklip, and Queen's Mercy. The Vaalbult meteoric iron is a very deeply and broadly pitted mass weighing about

26 lb. which was found on a farm in the Prieska Division, Cape Province. It is a coarse octahedrite having a percentage of nickel of about 7. The Witklip meteoric stone fell on May 26, 1918, at about 9.40 A.M., after the appearance of a luminous meteor and loud explosions, on the farm Witklip in the Carolina District, Transvaal. Fragments weighing together only about 22 gm. appear to have been preserved. It is a grey chondrite closely resembling the Cronstad meteoric stone. Of the Queen's Mercy meteorite a large stone, a foot and a half long, fell, on April 30, 1925, at Queen's Mercy, about twenty miles from Matatiele, and was broken into small pieces by the natives. A second complete smaller stone, weighing about 950 gm., which fell about fifteen miles from Matatiele, was obtained from Chief Jeremiah Moshesh and is now in the Natal Museum at Pietermaritzburg. The meteorite is a veined grey bronzite-chondrite containing about 15·5 per cent. of nickel-iron, in which the ratio of iron to nickel is about 10·5, and about 5·5 per cent. troilite, and having a ratio of magnesia to ferrous oxide in the pyroxene of about 5.

Royal Meteorological Society, June 16.—J. E. **Clark**, I. D. **Margary** and R. **Marshall**: Report on the phenological observations in the British Isles, 1925. This year illustrated strikingly how easily extreme conditions may cancel out each other if the year is taken as a whole. December 1924 and November 1925 stand out, one as the mildest for many years, the other among the coldest. May gave extremes of warmth and cold and was very wet. June drought and heat were extreme. Yet the year was exactly normal in temperature, and so too the mean date of flowering. Migrants were only a day late. The tree fruit was doubly hit. Early blooming after the warm winter exposed it to the inclemency of late April and May, while the June drought was fatal to young fruit set badly, and also to later-sown crops. Hay, early sown grain, roots including potatoes, did pretty well where weather permitted fair harvesting, but sunshine after mid-July was lacking. Normal plant progress was uneven in various districts, lines of equal unseasonableness showing some districts very early, others as much late. The spread over the British Isles of the cuckoo compared to the swallow shows that passing westward to Ireland from S.E. England its lag behind increases from two to ten days. But northwards to Berwick it loses only three days and then begins to catch up, finally reaching north Scotland a day early on the average of thirty-five years. Twelve organisations are now collaborating in Europe, extending north to Scandinavia, south to Italy, and east to Russia.—S. Morris **Bower**: Report on winter thunderstorms in the British Islands, Jan. 1 to Mar. 31, 1925. February was the stormiest month in England and Wales, while January was most disturbed in Scotland and Ireland. For England and Wales the stormiest areas were mainly on or near the south coast, the southern parts of Sussex and Surrey being heavily visited.—Edward **Kidson**: Abnormal rates of ascent of pilot balloons in the lower levels of the atmosphere at Melbourne. Observations extending from 1922 until 1925 are discussed, and tables given showing respectively (1) rapid ascending currents in the atmosphere, and (2) low rates of ascent. Rapid ascending currents and low rates of ascent most frequently occur in the months of September to February inclusive, that is, in the months when the land is warmer than the air and sea. The rapid ascending currents are encountered with the greatest relative frequency at 11.00 hr. and the least at 9.30 hr. With the low rates of ascent the greatest and least relative frequencies are at the same hours. The low rates of ascent seem to be largely the product of turbulence, the balloon being caught in the ascending portions of eddy currents.

Royal Anthropological Institute, June 22.—V. Gordon **Childe**: The first colonisation of Central Europe. The first food-producing civilisation was introduced into Belgium and northern France through the gradual spread of Danubian cultivators. These may be traced back to Moravia; and it is clear that in their migration they lost elements of culture. The origin of their civilisation must be sought farther south, immediately in 'Hungary,' though not on the Danube-Tiszá plain, which in the warm, wet, early neolithic period would have been uninhabitable. On the loess terraces of Serbia and the Banat a rich civilisation has been discovered from which the Moravian might be derived by degradation. The sites are located where open ridges of loess are cut by the Danube or the Tisza, just where people coming up the Danube would be likely to halt, and often in the vicinity of ores or on auriferous streams. The remains, notably remarkable clay statuettes, and the costume these illustrate, suggest that their makers came up the river bringing with them elements of Ægean and Egyptian civilisation. In the formation of Danubian civilisation, survivals of palæolithic elements and influences from the vase-painters of Transylvania can be detected, and its spread may ultimately have been accelerated by the pressure of nomadic steppe-folk from south Russia.

PARIS

Academy of Sciences, June 7.—L. **Lecornu**: The problem of the grindstone.—Léon **Guillet**: The tempering of lead-antimony, lead-tin, and lead-antimony-tin alloys. Referring to the recent work of Dean, Zicheick and Nix on the tempering properties of white-metal alloys, the author directs attention to earlier work by Dubosc and by himself on the same subject.—Léon **Guillet**: The cementation of copper, nickel and their alloys by tin. The cementation was produced by heating with a bronze powder (tin 25 per cent.), and results are given for copper, nickel and some alloys. The thickness of the cementation layer varied considerably, 1 mm. being the maximum. The object of the work was to produce a surface with low friction with the minimum proportion of tin.—Victor **Grignard** was elected a non-resident member in succession to the late W. Kilian.—Michel **Petrovitch**: A remarkable property of a series of double integrals.—A. **Véronnet**: Extension of the vectorial calculus to analysis and to the absolute differential calculus.— — **Noaillon**: The determination without ambiguity of the solution of the problem of Dirichlet for functions capable of summation.—Mlle N. **Bary** and D. **Menchoff**: The integral of Lebesgue-Stieltjes and absolutely continuous functions of absolutely continuous functions.—Henry **Bénard**: The frequency laws of detached alternating vortices behind an obstacle.—P. **Dumanois**: The possibility of realising high compressions without antidetonants. By a modification of the shape of the piston of an internal combustion engine it has proved possible to obtain the same results as were obtained by the introduction of lead tetraethyl into the petrol. The comparisons were made in a car on the road.—Th. de **Donder**: The application of relativity to atomic and molecular systems.—R. **Chambaud**: A particular class of solutions of the problem of the circular ring. Application to the theory of thick circular arches.—M. **Samsoen**: The expansion of commercial glasses. Seventeen kinds of glass were prepared, cast into rods, and the coefficients of expansion measured with the Chevenard differential dilatometer. The complexity of the problem prevents any theoretical conclusions being safely drawn from the data obtained It was found, however, that the additive rule of Winkelmann and Schott is not valid.—Salomon **Rosenblum**: α-rays with single charge.—— **Chevenard**: The course of the isotherms representing the resistance and thermoelectric power of the reversible ferro-nickels in the interval −200° C to 1000° C The experimental results, shown in diagram form, do not clearly indicate the existence of the compound Fe_2Ni, but are not definitely opposed to the possibility of its existence Further experiments at temperatures between −195° C. and the absolute zero are required.—T. **Karantassis**: Double decompositions between the halogenides of phosphorus, tin, arsenic, antimony, lead, bismuth, silicon, titanium, zirconium and thorium From the experiments described the conclusion is drawn that in the trivalent metalloid group the iodide of an element of low atomic weight exchanges its iodine for chlorine or bromine from the halogenide of an element of higher atomic weight.—N **Maxim**: The action of the organo-magnesium compounds on some aromatic dialkylamides.—Em. de **Martonne**: Dryness and the index of aridity.—**Jacquet**. New radioactive springs in the Puy-de-Dôme.—L. **Eblé**. Magnetic measurements in the north-east of France.—Aug **Chevalier**: The cinchonas of tropical Africa.—Mlle. G **Bonne**: The constitution of the gynæceum in the Chrysobalaneæ.—X. **Chahovitch**. The energy metabolism in the course of experimental scurvy. Study of the metabolic quotient It is suggested that the increase in the basic metabolism in experimental scurvy may be due to increased secretions of the suprarenal capsules and of the thyroid gland.—Mme. L. **Randoin** and R **Lecoq**: The inequality of the proportion of water-soluble vitamins (B) in yeast extracts of different origin. It is generally accepted that yeasts and yeast extracts are substances exceptionally rich in the water soluble vitamins. Experiments on pigeons are described which prove that all yeast extracts have not the same biological value An extract from beer yeast appeared to contain two factors, one securing the maintenance of the animal, the other essentially curative as regards polyneuritis On the other hand, an extract of distillery yeast contained only the first factor and, tested biologically, was markedly inferior to the extract of beer yeast.—Claude **Fromageot**. The oxidation of pyruvic acid by ceric ions. On oxidation of pyruvic acid with ceric salts the solution containing the enol form behaved differently from that containing the keto form, the former taking up more oxygen. The enol form is more rapidly oxidised than the keto form.—Raymond **Petit** The action of a solution of basic chlorhydrate of quinine and of urethane on the blood.—Henri **Marcelet**. Studies of the oils extracted from the head of a dolphin (*Delphinus Delphis*). Oils extracted from the maxillary glands, from the nose, and from the fat surrounding the skull were submitted to complete physical and chemical examination. Large differences were observed, showing that earlier analyses of oil described as dolphin head oil must give misleading figures.—H **Barthelemy** The influence of the dilution of the sperm on the duration of survival of the spermatozoids of *Rana fusca* in aqueous or saline media.—Ch **Porcher**: The alteration of the micelles of the caseinate in the calcium caseinate—calcium phosphate complex and its consequences in the action of rennet on this complex.—— **Boulard**. A method permitting fermentations to be arrested at will, especially liquids containing sugar and alcohol, and rendering these unfermentable The method is based on the fact that a second culture does not develop in a medium which has previously served for the cultivation of the same ferment The method is capable of industrial applications.—E. **Lesné** and S **Simon**: New observations on the anti-rickets factor of cod-liver oil Vegetable oils neither prevent nor cure experimental rickets, whereas certain cod-liver oils both prevent and cure It is shown that whilst certain oils are more or less active, others are absolutely inert, even although the latter fulfil all the requirements of the Codex It is suggested that these results prove the necessity for a biological test of cod-liver oil.—A. **Nanta**: A myxobacterial splenomegaly.—P. E **Pinoy** A synbacterium isolated from cases of splenomegaly

Rome

Royal National Academy of the Lincei, May 2.—P **Burgatti**: Elastic distortions.—U **Cisotti**: Dynamic effects of a fluid circulating between any number of thin cylinders with parallel axes.—Ferruccio **Zambonini** and Luca **Coniglio**. The presence of marked proportions of cæsium compounds in certain products of the present-day activity of Vesuvius.—M **Cantone** Reply to a criticism. Bemporad's criticism of the author's communication on a new method of studying experimental results.—Achille **Russo** Absence of agamous period and individual development in *Cryptochilum echini* Maupas.—Luigi **Fantappiè**: Non-linear analytical functionals.—Francesco **Tricomi**: Inversion formula of the order of two double integrals " with asterisk."—Vladimiro **Bernstein** Singularity of interpolar functions satisfying certain asymptotic conditions.—E. **Cartan**: Riemann's spaces in which transport by parallelism maintains the curvature.—G **Vranceanu**. A class of anolonomous systems.—U. **Bordoni**. The transmission of heat by radiation.—E **Persico**. Magnetic-rotatory polarisation in an alternating field. The rotatory polarisation of light in an alternating magnetic field follows the variations in the field almost exactly.—Giorgio **Piccardi**: The affinity of the neutral bromine atom for the electron.

Vienna.

Academy of Sciences, May 20.—F. **Schuster**: On vapour pressure curves.—A **Wegener**: Observations of the twilight arch and of the zodiacal light in Greenland.—Z. **Dische** and D **Laszlo**: The influence of carcinoma on the glycolysis of organs, especially liver and kidney.—F. **Heritsch**: The " window " of Fischbach, a vault of Semmering rocks, limestone and quartzite under the massive gneiss.—H **Handel-Mazzetti**: New Chinese plants (fortieth and last communication), including 12 species of Gentiana.

Official Publications Received.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions, Vol. 39 Report of the North-Western Area Committee for 1924 and 1925 (Rapport Atlantique, Secteur Nord-Ouest, 1924–1925) By Prof. Johs. Schmidt Pp. 103 Publications de Circonstance, No. 91. On a New Repeating Current-Meter. By V. Walfrid Ekman. Pp 27 (Copenhague: Andr Fred. Høst et fils.)

Transactions of the Royal Society of Edinburgh Vol 54, Part 3, No 11: The Anatomy of the Head of a Fœtal African Elephant, Elephas africanus (Loxodonta africana). By Dr Nellie B. Eales. Pp 491-551+12 plates. 12s Vol. 54, Part 3, No 12: The Old Red Sandstone of Shetland. Part 1. South-Eastern Area By Dr T. M Finlay; with an Account of the Fossil Fishes of the Old Red Sandstone of the Shetland Islands, by Sir Arthur Smith Woodward and Errol Ivor White. Pp 553-572+3 plates. 4s 6d. (Edinburgh. Robert Grant and Son, London: Williams and Norgate, Ltd.)

Department of the Interior: Bureau of Education. Bulletin, 1926, No. 3: Recent Progress in Legal Education. By Alfred Z. Reed. Pp. 30. (Washington, D.C.: Government Printing Office.) 5 cents.

Berichte der Naturforschenden Gesellschaft zu Freiburg i. Br. Herausgegeben von Prof. Dr. J. L. Wilser. Sechsundzwanzigster Band, Erstes Heft. Pp. 120+46. (Freiburg i. Br.: Speyer und Kaerner.)

Empire Cotton Growing Corporation. Report of the Fifth Annual General Meeting. Pp. 12. (London: Millbank House, Millbank, S.W.1.)

Proceedings of the South London Entomological and Natural History Society, 1925–26. Pp. xviii+112+9 plates. (London: Hibernia Chambers, London Bridge, S.E.1.)

Cardiganshire Antiquarian Society. Transactions, Vol. 4. Pp. 96. (Aberystwyth.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 78: Veronicellidae from British Guiana, by H. Burrington Baker; Anatomical Notes on American Helicinidae, by H. Burrington Baker. Pp. 19-56. Some additional Faunal Remains from the Trias of York County, Pennsylvania. By H. E. Wanner. Pp. 21-28. (Philadelphia, Pa.)

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 8: Drainage Waters at Cawnpore. By H. N. Batham. Pp. 127-152. 10 annas; 1s. Entomological Series, Vol. 9, No. 4: The Red Pumpkin Beetle, Aulacophora abdominalis, Fb., and its Control; with a Short Note on A. atripennis, Fb. By Mohammad Afzal Husain and Syed Abdullah Shah. Pp. 31-57+plates 12-14. 1 rupee; 1s. 9d. (Calcutta: Government of India Central Publication Branch.)

City of Norwich. The Report of the Castle Museum Committee to the Council, 1925. Pp. 25. (Norwich.)

Catalogue of Products illustrating the Tardenoisian and other Microlithic Industries exhibited at the Rooms of the Royal Anthropological Institute of Great Britain and Ireland, 52 Upper Bedford Place, June 8th to June 22nd, 1926. Pp. 8. (London.) 9d.

Empire Cotton Growing Corporation. Report on the Cotton-growing Industry of Nigeria, 1926. By Col. C. N. French. Pp. 48. (London: Millbank House, Millbank, S.W.1.) 1s.

Smithsonian Institution: the National Gallery of Art. Catalogue of Collections, II. By William H. Holmes. Pp. vi+118+45 plates. (Washington, D.C.: Government Printing Office.) 1.65 dollars.

Smithsonian Institution: United States National Museum. Bulletin 131: The Minerals of Idaho. By Earl V. Shannon. Pp. vii+484. (Washington, D.C.: Government Printing Office.) 75 cents.

Smithsonian Miscellaneous Collections. Vol. 77, No. 11: Music of the Tule Indians of Panama. By Frances Densmore. (Publication 2864.) Pp. 39+5 plates. Vol. 78, No. 1: Explorations and Field-Work of the Smithsonian Institution in 1925. (Publication 2865.) Pp. iii+132. (Washington, D.C.: Smithsonian Institution.)

United States Department of Agriculture. Department Circular No. 363: The Japanese Beetle. By Loren B. Smith and Charles H. Hadley. Pp. 66. 25 cents. Department Circular No. 380: Calcium Cyanide as a Fumigant for Ornamental Greenhouse Plants. By C. A. Weigel. Pp. 16. 5 cents. Farmers' Bulletin No. 1461: The Common Cabbage Worm and its Control. By F. H. Chittenden. Pp. ii+14. 5 cents. Farmers' Bulletin No. 1462: The Potato Leafhopper and How to Control it. By J. E. Dudley, Jr. Pp. ii+12. 5 cents. Farmers' Bulletin No. 1472: Preventing Damage by Termites or White Ants. By T. E. Snyder. Pp. ii+22. 5 cents. Department Bulletin No. 1364: Effects on Honeybees of Spraying Fruit Trees with Arsenicals. By N. E. McIndoo and G. S. Demuth. Pp. 33. 5 cents. Department Bulletin No. 1369: The Cattle Grubs or Ox Warbles, their Biologies and Suggestions for Control. By F. C. Bishopp, E. W. Laake and H. M. Brundrett, and R. W. Wells. Pp. 119. 25 cents. (Washington, D.C.: Government Printing Office.)

Diary of Societies.

SATURDAY, JULY 17.

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Natural History, University of Edinburgh), at 10 A.M.—Dr. F. A. E. Crew: The Developmental Capon and Poulard.—E. A. Spaul: The Metamorphic Principle of the Anterior Lobe of the Pituitary.—W. P. Kennedy: Diet and Reproduction in the Rat.—Prof. J. H. Priestley: The Perception and Transmission of Stimulus in the Coleoptile of the Grass Seedling.—L. A. Harvey: The Relation of Cell Inclusions to Cell Metabolism.

MONDAY, JULY 19.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at the Botanical Gardens, Edinburgh), at 10 A.M.—J. Gray: The Growth of Fish.—E. Philip Smith: The Effect of Acidity on Regeneration in Coleus.—J. W. Gregor: The Influence of Environment on the Formation of definite Habitat Types.—K. B. Blackburn: Some Observations on Sex and Chromosomes in Plants.—(In Department of Natural History, University of Edinburgh), at 2.30.—A. Walton: The Survival of Fertilising Capacity of Rabbit Spermatozoa *in vitro*.—A. D. Hobson: The Formation of the Fertilisation Membrane in *Echinus esculentus*.—E. Ponder: The Kinetics of Hæmolytic and Bacteriolytic Reactions.—T. Rettie: Demonstration of a Histological Method for the Early Stages of Cell Injury.

WEDNESDAY, JULY 21.

CORRELATIVE SCIENCE SOCIETY (at Royal Botanic Society of London, Regent's Park), at 3.—Waves and Vibrations—The Spectra of Nebulæ, of Temporary, Variable and Normal Stars.

CONFERENCES.

JULY 15 TO 19.

JOURNÉES MÉDICALES DE PARIS (at Paris).

JULY 19 TO 23.

BRITISH MEDICAL ASSOCIATION (at Nottingham).

SOCIETY OF CHEMICAL INDUSTRY (Annual Meeting) and CONGRESS OF CHEMISTS.

Monday, July 19.—Institution of Chemical Engineers (Annual Corporate Meeting) (at Central Hall, Westminster), at 10 A.M.—Sir Frederic L. Nathan: Industrial Efficiency and the Elimination of Waste (Presidential Address).—At 11.30 A.M.—Exhibition of Chemical Plant (at Central Hall, Westminster).—At 2.30.—(At Mansion House).—Presentation of the Society's Messel Medal to the Earl of Balfour, and Delivery of the Messel Memorial Lecture by Lord Balfour.

Tuesday, July 20.—Society of Chemical Industry (Annual Meeting) (at Hotel Great Central), at 10 A.M.—W. J. U. Woolcock: Presidential Address.—Joint Meeting of the British Chemical Plant Manufacturers' Association, the Institute of Metals, the Institution of Chemical Engineers, and the Chemical Engineering Group for a Symposium on 'Corrosion' (at Hotel Great Central), at 10.30 A.M.—Ulick R. Evans: Fundamental Principles of Corrosion.—Dr. W. H. Hatfield: Chemically Resistant Steels for Chemical Engineering.—P. Parrish: Corrosion and Erosion.—T. G. Elliot and G. B. Willey: Chemically Resistant Steels, with special reference to Very High and Very Low Temperatures.—Joint Meeting of the Bio-Chemical Society with the London Section of the Society of Chemical Industry (at Hotel Great Central), at 11 A.M.—The Scientific and Industrial Problems presented by the Hormones—the Natural Drugs of the Body:—Dr. H. H. Dale: The Experimental Study and Use of Hormones.—Dr. H. W. Dudley: The Chemistry of the Pituitary Gland and of Insulin.—F. H. Carr: The Commercial Production of Hormones.—Dr. H. A. D. Jowett: The History of Adrenalin.—Prof. G. Barger: Recent Progress in the Chemistry of Thyroxine.—Dr. J. W. Trevan: Biological Assay of Hormones.—British Chemical Plant Manufacturers' Association (Annual Meeting) (at 166 Piccadilly), at 2.30.—British Association of Chemists (at Hotel Great Central), at 2.—Dr. Stephen Miall and others: Discussion on Chemistry House.

Wednesday, July 21.—Society of Chemical Industry (Annual Meeting) (at Hotel Great Central), at 10.30 A.M.—Addresses by Sir Josiah Stamp and Sir Max Muspratt, Bart.

Thursday, July 22.—Society of Chemical Industry (Annual Meeting) (at Hotel Great Central), at 10.30 A.M.—Joint Meeting arranged by the Chemical Engineering Group with the Institution of Petroleum Technologists, and the Institution of Chemical Engineers on Power Alcohol.—Dr. W. R. Ormandy: Sugar from Wood.—D. Ross and Dr. W. R. Ormandy: Experiences with Alcohol Motor Fuels.—Joint Meeting of the Institution of the Rubber Industry and the Oil and Colour Chemists' Association (at Hotel Great Central), at 10.30 A.M.—Discussion on The Influence of Particle Size in the Paint and Rubber Industries:—Dr. D. F. Twiss: The Importance of Particle Properties in the Rubber Industry.—G. A. Klein: The Importance of Particle Properties in the Paint Industry.—Dr. S. S. Pickles: Carbon Black.—H. Green: The Necessity for a Direct Measurement of Particle Size.—B. D. Porritt and G. Gallie: An Apparatus for the Estimation of Grit in Pigments.—E. A. Murphy: The Detection of Grit in Rubber Compounding Ingredients.—A. de Waele: The Different Types of Dispersion and some Factors Determining Same.—Dr. P. Schidrowitz: Note on the Influence of Particle Shape.—N. Heaton: The Influence and Elimination of Coarse Particles.

Friday, July 23.—Institution of Chemical Engineers and the Oil and Colour Chemists' Association (at Hotel Great Central), at 10.30 A.M.—L. J. Simon and Prof. J. W. Hinchley: Discussion on Fat Extraction by Solvents.—Fuel Section (at Hotel Great Central), at 10.30 A.M.—Dr. E. W. Smith: Summary of the Symposia at Leeds and Sheffield on Solid Smokeless Fuel.

JULY 22 TO 26.

INTERNATIONAL CONGRESS ON ALCOHOLISM (at Dorpat).

JULY 26 TO 31.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Lyons).

AUGUST 3 TO 6.

INTERNATIONAL PHYSIOLOGICAL CONGRESS (at Stockholm).

AUGUST 16 TO 23.

INTERNATIONAL BOTANICAL CONGRESS (at Cornell University).

AUGUST 23 TO 28.

AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Perth, Western Australia).—Prof. E. H. Rennie: The Chemical Exploitation, Past, Present and Future, of Australian Plants (Presidential Address).—The Presidents of Sections and the Titles of their Addresses are as follow: *A* (*Astronomy, Mathematics and Physics*), Prof. K. Grant, Atomic Transformation; *B* (*Chemistry*), Prof. J. Kenner, Some Aspects of the Problem of Molecular Structure; *B* 2 (*Pharmacy*), A. T. S. Sissons, The Indebtedness of Pharmacy to Organic Chemistry; *C* (*Geology and Mineralogy*), Sir Douglas Mawson, The Igneous Rocks of South Australia—a brief Survey of Present Knowledge relating thereto; *D* (*Zoology*), Prof. L. Harrison, The Composition and Origins of the Australian Fauna, with special reference to the Wegener Hypothesis; *E* (*Geography and History*), Prof. E. Scott, The Discoveries of the Western Australian Coast, with especial reference to Dampier and D'Entrecasteaux; *F* (*Ethnology and Anthropology*), Prof. F. Wood Jones, The Claims of the Australian Aboriginal; *G* (*Social and Statistical Science*), Major L. F. Giblin, Federation and Finance—an Examination of the Financial Relations of States to a Federal Commonwealth; *H* (*Engineering and Architecture*), Sir John Sulman, Town Planning; *I* (*Sanitary Science and Hygiene*), F. S. Hone; *J* (*Mental Science and Education*), P. Board, Social and Economic Values in Education; *K* (*Agriculture and Forestry*), C. E. Lane Poole, Forestry and Land Settlement; *L* (*Veterinary Science*), Prof. J. D. Stewart, The Relationship of Veterinary Science to the Prosperity of the State; *M* (*Botany*), Prof. A. J. Ewart, Past and Future Development of Botanical Science; *N* (*Physiology and Experimental Biology*), Prof. W. A. Osborne, The Study of the Reflex.

AUGUST 20.

MEDICAL WOMEN'S INTERNATIONAL ASSOCIATION (at Prague): Discussions on Tuberculosis and Pregnancy, Women Police-surgeons.

SATURDAY, JULY 24, 1926.

CONTENTS.

PAGE
Truth and Tradition. By Prof. H. Wildon Carr . 109
Ice-Domes and the Atmosphere. Dr. G C Simpson, C.B , F.R.S. 111
Infinite Series. By J. C. B. 112
The Chemistry of Drugs and Perfumes By T. A H 113
Our Bookshelf 114
Letters to the Editor:
  The Secondary Hydrogen Spectrum —Prof O. W. Richardson, F.R S. 116
  Imperfect Crystallisation of Common Camphor.—W. G. Burgers 116
  Influence of Temperature on Biological Processes.—Dr. J. Bělehrádek 117
  Migrations of Butterflies —C. B. Williams . . 118
  Series Spectra of the First Long Period.—Dr. R. J. Lang 119
  Technical and Intellectual Values.—A. E. Evans . 119
  Natural History of the New Hebrides.—John R. Baker 119
The Imperfect Crystallisation of Common Things. By Sir William Bragg, K.B.E., F.R.S. . . 120
The Passing of Finsbury Technical College. By C. R. D. 122
The Oxford Meeting of the British Association. By F. A. D. 123
The Ross Institute and Hospital. OPENING BY THE PRINCE OF WALES. 124
News and Views 126
Our Astronomical Column 131
Research Items 132
Oxford Meeting of the British Association. PROVISIONAL PROGRAMMES OF SECTIONS . . . 135
Universities of the British Empire 138
University and Educational Intelligence . . . 140
Contemporary Birthdays 141
Societies and Academies 141
Official Publications Received 144
Diary of Societies and Conferences . . . 144

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Truth and Tradition.

A CURIOUS change is apparent in contemporary thought. The scientific revolution, with its subversive principle of relativity and its paradoxical quantum theory, invaded the calm and secluded groves of philosophy and caused a strange disturbance. The positivity of science, at least in the form which it had assumed in the nineteenth century, seems to disappear; accepted principles and methods suddenly became suspect; old controversies lost their meaning; new worlds were being discovered. The reception of the new mathematical relativity by philosophers was at first decidedly hostile. An attitude of incredulity was followed by amazement and dismay. When the results of the eclipse observations of May 1919 were made known, and the principle of relativity, which had been formulated fourteen years before by Einstein, was found to be actually verified and confirmed, the interest was no longer confined to academic circles; popular expositions in journals and scientific manuals flooded the book market and every one was eager to be informed. A few mathematicians and many philosophers thought the whole excitement would prove to be a nine days' wonder and hoped, somewhat impatiently, that all would be explained away and that physics would again free itself from metaphysics. The principle of relativity has not been explained away; on the contrary, in an almost incredibly rapid time, it has established itself as orthodoxy. A revolution in ideas which a few centuries ago would have occupied generations now seems to take place between night and morning and while we sleep. At the beginning of the sixteenth century it was discovered by intrepid navigators that our earth is a sphere. It was not until past the middle of that century that a daring thinker suggested that the earth moves, and it was not until a century later than that, and after bitter persecution, that the revolution of ideas which it implied was accomplished.

The extraordinary thing in the present world of ideas is not the scientific revolution, but the fact that it is accepted and that no one expects it to be upset. This does not mean that the spirit of scientific inquiry has ceased its quest and is resting satisfied with its discovery. It does mean that whatever new revolutions are in the future, there is no return to the old ideas. It is the recognition of this fact which is eloquently and forcibly expressed in the two lectures before us—The Fison Memorial Lecture at Guy's Hospital delivered by Dean Inge on March 25,[1] and the Herbert Spencer Lecture given at Oxford by Prof. Sorley on May 19.[2]

---

[1] Science and Ultimate Truth: Fison Memorial Lecture, 1926, delivered at Guy's Hospital Medical School, March 25, 1926 By the Very Rev W R. Inge. Pp. 32. (London: Longmans, Green and Co., Ltd., 1926) Paper, 1s. net; cloth, 2s. net.

Dr. Inge points out that there are only three periods of history when knowledge has advanced by leaps and bounds—the time of the ancient Greeks, the Renaissance, and our own age—and of these the greatest accession of positive knowledge has come in our own time. He passes the brilliant pageant in review, and very impressive it is. Yet the philosopher's interest is in the conception of value, and he asks himself, what is the relation of values as they enter as factors into ethical, religious, and æsthetic experience to scientific truth, and especially to the reality which is the ultimate goal of scientific research? The profounder consciousness of contemporary science is not content to detach or dismiss these universal aspects of human experience, the ideals of beauty, truth, and goodness, as epiphenomenal existences, imparting an apparitional glow to cold mechanical order and to which our epiphenomenal minds respond with an emotional thrill. If the real nature of things is to be found in the atom of the physicists, then, as Dr. Inge points out to us, a microbe is nearer to reality than a man. We are, however, still far from the complete philosophy which would show how the different valuations which physics, history, and religion apply to experience supplement each other. This ideal consummation is yet to be attained. The formulation of such an ideal, however, shows that we are on a higher plane of thought. The reproach which has been and still is levelled at religion, that it is ever retreating from one position to another before the victorious advance of science, and that it is now preparing to die in its last ditch, is not undeserved, nor is it entirely untrue. It is the materialism of religion which has constituted its weakness. It is the "garish promises and terrifying threats" which have failed.

Prof. Sorley also is impressed with the consciousness of its own strength which is the outcome of the triumph of the new ideas in physics and biology. The same kind of confidence which Bacon and the leaders of the scientific renaissance expressed when they represented the modern inquirer, not as the patient interpreter of the old learning, but rising on the shoulders of the past, belonging not to the infancy but to the adult stage of our race. He sees to-day a revival of the same spirit which led the young Descartes to choose a military career, not influenced by desire for glory and for worldly success, or by chivalry, but by the opportunity it offered of gaining first-hand knowledge of man and Nature. All the great periods in which there has been a notable advance in science and a revolution in ideas have witnessed a break with tradition, an emancipation from authority. We are going through such a period to-day, and no more profitable subject of self-reflection can be suggested than to take stock of our traditions, their significance, their value, and the nature of the authority they impose. Is tradition a dead hand throttling the living effort? Prof. Sorley shows us the sense in which it is a vital force necessary for the carrying on of original work. "Unless the solitary thinker emerge from his solitude and sow his seed in good soil, his ideas will not fructify." "It is seldom that a second chance comes to the innovator, as it did to Mendel when his work was rediscovered and became the inspiration of a school of biologists."

The two lectures suggest important reflections on the relation of human science to human nature and individual experience. A strange phenomenon is the apparition of man! When we view him as a form of material organisation, the outcome of a biological evolution, and then compare his activity with that of other forms in the hierarchical series, there is presented a phenomenon paradoxical and unique. The unique thing in the human attainment is the power which has come to man alone (it may be by virtue of the erect position, the visual convergence, and the co-ordination of the sense of hearing with the muscles of articulation) of superposing an artificial life on his natural life. There is nothing resembling it or approaching it in the other forms of living activity. Man by reason of his emancipation from environmental conditions has undergone and is undergoing a cultural as well as a natural evolution. The conditions of this cultural evolution are very strange—opposed to, rather than in line with, the conditions of biological evolution. The mind of the ape is moulded on the environment and responds to it as it were automatically. The mind of the man is educable. The culture which a man acquires by education does not modify his nature: it is super-added to it. Man's wisdom is not the wisdom of the bee or the ant. It is artificial. We may grow daily in grace and wisdom, transforming our natural cravings into social virtues, but we do not change the natural man. We cannot transmit our culture as a heritage to the succeeding generation. If we have the gift of expression and leave behind the works which follow us, all we leave is records which set a task for those who will enter into communion with us. Every individual must tread again painfully the path we have had to tread. The flattering notion that an Oliver Twist, born in a workhouse and brought up among thieves, can retain the gentle nature which cultured parents have bestowed on him is a romantic fiction.

It is this which constitutes the real problem of the genesis, the nature, and the authority of tradition. The new generations must start their education not where the old left off, but where the old started. Our generations overlap. It might have been otherwise. Evolution might have produced forms of activity which can retain and preserve individual attainments across a complete breach of continuity. This is the normal case in the insects, but the reverse is the rule in the vertebrates, and in the human form we meet with the formation and growth of an ideal environment, cultural and adventitious. The musician cannot bequeath his acquired skill, the painter cannot impart his acquired technique, the student his erudition. Each individual starts *de novo*, and yet he can only develop under the guidance and influence of the overlapping generation. Hence there grows up around him a tradition and an authority which appear external and seem to restrain him, but which in truth he is himself creating in the very activity of the life which bursts his bondage.

---

[2] Tradition the Herbert Spencer Lecture delivered at Oxford, May 19, 1926 By Prof. W. R. Sorley. Pp 24 (Oxford: Clarendon Press, London Oxford University Press, 1926) 1s. net.

H. WILDON CARR.

Ice-Domes and the Atmosphere.

The Glacial Anticyclones: the Poles of the Atmospheric Circulation. By William Herbert Hobbs. (University of Michigan Studies, Scientific Series, Vol. 4.) Pp. xxiv+198+3 plates. (New York: The Macmillan Co., 1926.) 2.75 dollars.

IN his study of the great ice masses which form the continental glaciers of Greenland and the Antarctic, Prof. Hobbs was impressed with the dome-like shape of their ice-covered surfaces. He also noticed that the predominating wind direction along their coasts had a marked outward component as though the air were sliding off the domes. It was not difficult to find a reason why air should slide off the domes in this way, for meteorologists had long been familiar with the flow of cold air down hill-sides and valleys which occurs when the surface layers of air become abnormally cold owing to intense outward radiation. Sir Napier Shaw has given the name katabatic wind to the winds formed in this way.

Starting, then, with the idea that the air is flowing off the domes outwards in all directions, Prof. Hobbs naturally concludes that it must be replaced by air which is 'pulled down' over the central parts of the dome. But this is the sort of circulation which is described in the old text-books of meteorology as anticyclonic, so Prof. Hobbs assumes that there must be an anticyclone over every dome-shaped ice-covered land. He gives the name glacial anticyclone to such anticyclones; but he categorically states "the domed ice-surface, not the snow-covered land, is the direct cause of the anticyclone" (p. 126).

The outward flow of air, however, is not steady, but takes place in what Prof. Hobbs calls "strophs." Each stroph commences with a calm, then the air starts to move outwards, slowly at first, but acquiring velocity "to accord with the law of acceleration of gravity"; when the velocity has reached full blizzard proportions the motion is suddenly arrested because of adiabatic heating, and the stroph is at an end. Thus the whole regime of the air circulations over the Antarctic Continent and Greenland with their calms, blizzards, fohns and high winds is brought under the dominion of the glacial anticyclones.

The difficulty with all such theories is that the author never knows when to stop, so Prof. Hobbs extends his theory still further. As is well known, the Bjerknes theory of cyclones and the polar front is based on the interaction between polar air and equatorial air. But Prof. Hobbs says that the air in the north polar regions is not suited for such a purpose; in fact, Bjerknes' polar air "is quite different from that encountered by explorers within the north polar region of frozen sea"; what Bjerknes' cyclones want is a dose of air from a glacial anticyclone, so Prof. Hobbs concludes that "the cold air which rejuvenates the dying cyclones on their approach to the coast of Europe from the west, instead of having polar origin, issues from the Greenland Continent during a stroph of the anticyclone" (p. 155). Prof. Hobbs also casts longing eyes on Bjerknes' families of cyclones, but it is not clear whether he claims them entirely as the product of the anticyclone; he does say, however, "when a new stroph is inaugurated a new family of cyclones is generated" (p. 153).

Not content with bringing the cyclones of the northern and southern hemispheres under the dominion of the strophs of his glacial anticyclones, Prof. Hobbs goes still further and claims that the terrestrial climatic zones owe their existence to the glacial anticyclones, and that if there were no iced domes in Greenland and the Antarctic, the world would enjoy the uniform climate which certain geologists consider existed in previous ages. Finally, it is claimed that "these northern and southern glacial anticyclones fixed in position, function as the loci of drainage from the upper wind currents and are therefore the reversing position within the general cycle of air movement—they and not the geographic poles are the wind poles of our planet" (p. 155).

Thus, by a series of plausible steps, Prof. Hobbs has brought practically the whole of the meteorological conditions of the globe and the general circulation of the atmosphere under the dominion of two relatively small ice-domes. We have not the space to criticise this elaborate theory in detail, so a few remarks must suffice. It is now generally agreed that true anticyclones exist over the Antarctic and Greenland, but these are due to the effect of the snow surface on radiation, and would be there whether the surface were domed or not. In the clear calm air of these anticyclones katabatic winds are often highly developed, and as their direction is practically constant, being always down slope, they produce well marked sastrugi, which can frequently be seen cutting across the sastrugi caused by the blizzards. Katabatic winds, however, need very special meteorological conditions for their existence, the chief of which is that radiation from the surface layers must exceed the radiation received. This is not the case when the sun is high or when the sky is cloudy, as it generally is before and during blizzards. It is possible that the high winds in Adelie Land described by Mawson may be katabatic winds, but until the meteorological data of this expedition are published it is impossible to be certain. We can at least say that the blizzards of the Ross Sea area are not katabatic winds.

That some air from Greenland is drawn into cyclones which pass near to the Greenland coast is clear from the familiar föhn effect which is definitely associated with passing cyclones, but that the cyclonic regime over the North Atlantic would be materially modified if Greenland were reduced to sea-level we cannot accept. The old idea of ascending currents at the equator and descending currents at the poles, in the crude way in which it was formerly stated, has now completely gone. Air cannot be 'pulled down' anywhere; the thermal structure of the atmosphere entirely prevents such motion, and this is as true in Greenland and the Antarctic as it is anywhere else. G. C. SIMPSON.

Infinite Series.

(1) *The Theory of Functions of a Real Variable and the Theory of Fourier's Series.* By Prof. E. W. Hobson. Second edition, revised throughout and enlarged. Vol. 2. Pp. x+780. (Cambridge: At the University Press, 1926.) 50s. net.

(2) *An Introduction to the Theory of Infinite Series.* By Dr. T. J. I'a. Bromwich. Second edition, revised with the assistance of Dr. T. M. MacRobert. Pp. xv+535. (London: Macmillan and Co., Ltd., 1926.) 30s. net.

(1) THE second volume of Prof. Hobson's book completes a great contribution to the literature of mathematics. The second edition is double the size of the first, and is really a new book. Less than half of the present volume is devoted to Fourier series. The rest of it contains an exhaustive account of sequences and series in general.

Of the first part of the book, Chap. vii. is worthy of special remark. In it Prof. Hobson expounds a theorem of his own which states properties common to a very wide class of representations of functions—including Fourier series as a particular case. (We regret that in this chapter and elsewhere the author has continued to use the word *summable* as meaning integrable in the sense of Lebesgue and—a still more trifling criticism—that he has not adopted the arrow notation for passage to a limit.)

It may be held that among all its branches pure mathematics appears at its best in the theory of Fourier series. There is a peculiar sharpness which has been attained in many propositions (and remains to be attained in others), and there is a peculiar cleanness in the arguments which prove these propositions. To take an example at random, let the reader refer to the ten pages of Prof. Hobson's book in which he expounds the theory of Fourier transforms developed in the last three years by Titchmarsh.

This may explain the feeling one has that if there is any part of the book better than another, it is the part dealing with Fourier series. There is a unity in this chapter (scarcely possible in the earlier, more encyclopædic part of the book) which can only have been attained by great pains in fitting the work of many writers into the author's development of the subject. One source of this unification has already been mentioned in Prof. Hobson's convergence theorem.

One wishes that the author could have woven into his general scheme some of the work published since the chapter was written, which could only be referred to, such as the solution by Hardy and Littlewood of the Cesàro summability problem and the beautiful theorems of M. Riesz on the allied series. But, after all, an account of a rapidly growing subject can only be complete—as Prof. Hobson's is—at the time of writing.

The modern theory of trigonometrical series is largely due to Englishmen—one need only mention Prof. Hobson himself, Young, Hardy, Littlewood, and lately Titchmarsh. It is particularly fitting that one of them has written this book.

(2) We welcome very heartily the reappearance of Dr. Bromwich's book, the first edition of which has been out-of-print for many years, to the great loss of the post-War generation of students. Much excellent new matter has been introduced into the second edition. The most substantial additions deal with the solutions of linear differential equations of the second order, elliptic functions, asymptotic expansions, and trigonometrical series.

To make room, the section in the first edition on summability has been omitted. We cannot help feeling that in a book on infinite series *something* should be included about summability, whatever else may have to go. It would be ungracious to urge that a discussion of Cesàro's method is more germane to the theory of infinite series than an account of Napier's invention of logarithms or of constructions for trisecting an angle, for much that is valuable and delightful in the way of miscellaneous matter has been included. It would indeed have been impossible to give an extended treatment of summability—for that one must go to Prof. Hobson's book—but we wish that the *idea* had been explained. In twenty pages one could prove theorems which show the importance of conventional methods of summation—say, in dealing with Fourier series—and we think that such a sketch would have enhanced the value of the book.

In making this comment on the choice of matter, we had in mind the advanced student: concern for the beginner now suggests a remark. We fear that the early use of the notation $a_n \rightarrow b_n + l$ for $a_n - b_n \rightarrow l$ may leave him with free and easy notions of what a limit is. Most of the advantages of the new notation seem to be covered by the symbol $\sim$, which is less dangerous.

Prominence is given to those limit-problems which present themselves naturally and at every turn in analysis. Not only to the mathematician is the book indispensable; it is also the best possible guide to any one who encounters mathematical analysis in his work. The second edition will increase the very high reputation gained by the first.

J. C. B.

The Chemistry of Drugs and Perfumes.

(1) *A Text-Book of Pharmaceutical Chemistry.* By Arthur Owen Bentley and John Edmund Driver. Pp. xi+456. (London: Oxford University Press, 1925.) 18*s*. net.

(2) *The Chemistry of Drugs.* By Norman Evers. Pp. 247. (London: Ernest Benn, Ltd., 1926.) 32*s*. 6*d*. net.

(3) *Perfumes, Cosmetics and Soaps, with Especial Reference to Synthetics.* By William A. Poucher. Vol. 1: Being a Dictionary of Raw Materials. Second edition. Pp. ix+304+21 plates. 16*s*. net. Vol. 2: Being a Treatise on Practical Perfumery. Second edition. Pp. xvi+406+42 plates. 21*s*. net. (London: Chapman and Hall, Ltd., 1926.)

THE issue of elementary text-books for particular groups of chemical students is usually a proceeding to be deprecated, but there is something to be said for it in the case of students intending to qualify as pharmacists, for they need special information regarding chemicals used in medicine, and they must know something about such substances as alkaloids and glucosides and the methods by which they are estimated; subjects which are outside the scope of ordinary text-books. Messrs. Bentley and Driver's book (1) meets these and other needs of pharmaceutical students, and the authors wisely point out that it must be regarded as supplementary to a general course in elementary chemistry. For use in this way the book can be cordially recommended. The few errors noted are of minor importance, such as the representation of prulaurasin as a diglucoside on p. 4 and as a monoglucoside on p. 383. It is curious that there is no reference to the digitalis glucosides or to the alkaloid emetine, both drugs of great importance in modern medicine with which pharmacists ought to be familiar.

Any one who has used such a book as Fränkel's "Arzneimittel Synthese," or skimmed through one of those formidable 'Dispensatories' published in the United States, must be appalled at the number and variety of substances which exhibit physiological action and are potential drugs. Mr. Evers's book (2) serves the purpose of picking out the valuable drugs from this mass of material, and is at least usefully suggestive as regards the lines on which progress in chemotherapy is being made. The chapters on such familiar subjects as hypnotics, antipyretics, anæsthetics, and antiseptics are well done, being neither overloaded with unimportant materials nor neglectful of essential points.

It is interesting to find that out of 218 pages of text, synthetic drugs occupy only 66 pages, the rest being required for the discussion of natural drugs containing alkaloids, glucosides, etc. It is sometimes forgotten, especially by chemists, that medicine still depends so largely as this on drugs of natural origin. The work of compilation has been carefully done, and the only points noticed as requiring attention are of minor importance, such as the implication that chenopodium oil is produced in the West Indies and Central America, whereas it is only distilled in the United States. The statement that "though numerous derivatives of such drugs as atropine, cocaine, quinine, adrenalin, and emetine have been prepared and tested, not one of the derivatives has surpassed the natural drug in maximum effect" is true only in a Chestertonian sense, for the author himself mentions quinine derivatives which surpass the parent alkaloid in activity as anæsthetics and antiseptics. Appendix I., in which this statement occurs, is a too brief summary of current information on the relationship of chemical constitution to physiological action, a subject of great importance, which merits much more elaborate treatment than it receives.

It is typical of the difficulty of keeping books like this up-to-date that Kendall's views on the properties and constitution of thyroxine, which are given in considerable detail, have been superseded by the results of the recent admirable work of Harington. Interest in the chemistry of drugs is steadily increasing, and Mr. Evers has performed a useful service in providing students with this survey of present knowledge on this subject.

(3) A mere chemist is interested to learn from Mr. Poucher's two volumes that so many chemicals have properties which enable them to be applied to the preparation of toilet requisites, but the reader must be more than a chemist to appreciate at its full value such information as the following. "Alloxan, or mesoxalylurea, is used in the preparation of 'blush' creams on account of the fact that it will impart to the skin a delicate pink tint, if used in a very dilute form." "If too high a percentage of alloxan is employed a purple colour is produced, which may be removed by treatment with dilute nitric acid." Clearly, the modern woman may yet be driven into taking a course in chemistry in the interests of her complexion. The author is naturally not always at this high level, and the bulk of the two volumes is occupied with more prosaic information regarding the sources, production, and uses of the immense variety of materials now used in the manufacture of perfumes, cosmetics, and soap, and the recipes beloved of the practical man are abundant. The book no doubt thoroughly deserves the popularity it has obviously secured from those for whose instruction it was written.

T. A. H.

Our Bookshelf.

Handbuch der Zoologie: eine Naturgeschichte der Stamme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. (1) Dritter Band: *Tardigrada, Pentastomida, Myzostomida, Arthropoda: Allgemeines, Crustacea, Arachnoidea.* Erste Lieferung. Pp. 128. 12 gold marks. Zweite Lieferung. Pp. 129-272. 15 gold marks. (2) Fünfter Band: *Solenogastres, Mollusca, Echinodermata.* Erste Lieferung. Pp. 96. 10 gold marks. Zweite Lieferung. Pp. 97-176. 8·40 gold marks. (Berlin und Leipzig: Walter de Gruyter und Co., 1925-1926.)

(1) THE section on the Tardigrada, which was finished by the late Prof. F. Richters in 1914, has been revised by the editor. It is an altogether admirable account in 61 pages of the structure, biology (including the remarkable powers of recovery after drying), development, distribution, affinities and systematics of the order, and is illustrated by 68 excellent figures, many of which are original. The editor has appended a list of about 130 memoirs on tardigrades. The Pentastomida are described in about 60 pages by Prof. R. Heymons, and this account also is praiseworthy for the adequate and well-balanced treatment of the subject. The author would place the Pentastomida between the Annelida and the Arthropoda, and near the other short-footed arthropod-like forms such as Tardigrada and Onychophora. In the section on the Myzostomida (about 80 pp.), by Prof. von Stummer-Traunfels, we find again adequate consideration of structure, biology and life-history, together with excellent figures, for the most part from recent memoirs. The effects of the presence of Myzostoma upon the respective crinoid hosts are clearly set forth. We can thoroughly recommend these three sections to the attention of teachers of advanced zoology. The remainder of the second part is occupied by a general introduction to the morphology and phylogeny of the Arthropoda, written by Dr. Anton Handlirsch.

(2) Prof. Johannes Thiele, the author of these two parts, prefers to regard the Solenogastres as separate from the Mollusca. In the account of the order (14 pp.) more might have been given on the development, and figures to illustrate the more important stages should have been provided. The part on the Mollusca contains a brief general introduction, and accounts of the classes Loricata (Chiton, etc.), Gastropoda, Scaphopoda and Bivalvia, this last to be concluded in the third part. The best of these accounts is that of the Loricata, but here again the author does not provide figures of the developmental stages or of the excretory organs.

While we admit that it is difficult to give adequate consideration to the several systems of organs of the Prosobranchia, we cannot help feeling some disappointment in looking over the account of the sense organs and nervous system (which together receive the same space as the radula), and surely it would have been more helpful to have figures of egg capsules of known origin rather than those of unknown parentage which are given on p. 67. The classification of the Prosobranchia is well done, but some of the subdivisions, *e.g.* Heteropoda, deserve fuller treatment on account of their special interest. Certain aspects of molluscan morphology, *e.g.* torsion, have not received adequate consideration. The account of the Scaphopoda occupies less than 5 pp., and the only illustrations represent the shell, the animal removed from the shell, and three of the radular teeth; there are no figures of the internal anatomy or of the developmental stages.

The systematic part of this work is satisfactory, but the descriptions of structure and development leave much to be desired. As compared with the third volume, the present volume is far less adequate in both text and illustrations.

Volatile Solvents and Thinners used in the Paint and Varnish Industries. By Noël Heaton. (Oil and Colour Chemistry Monographs.) Pp. 158. (London: Ernest Benn, Ltd., 1925.) 15*s.* net.

IN less than 140 pages of text the author has attempted the task of compiling "for reference and comparison detailed information as to the nature, preparation and properties of every solvent of industrial importance in the paint and allied industries." His sixty-odd substances are broadly classified under the heading of petroleum and coal-tar hydrocarbons, hydrocarbon chlorides, terpenes, alcohols, ketones, ethers, esters, and in addition, carbon disulphide. His claim that his list of individual solvents includes every one of the type indicated is scarcely correct, especially in the United States, where the lacquer trade has made enormous strides in recent years. There is a final short chapter on the general significance of the tests for solvents, with some theoretical considerations involved in their use.

A large proportion of the material in this book can be found in many theoretical organic chemistry books, and in view of the comparatively high price of the volume it might be advisable to have restricted such matter and to have dealt more with the technical application of the solvents. Some typographical errors and a fair number of obscure or slightly inaccurate statements occur, but in spite of these and the author's disclaimer to literary style in dealing with technical data, the book is exceptionally well written. It collects together a large amount of useful information on a special type of organic substances, and it should be of great use not only to the technical man but also to the organic chemist generally. J. REILLY.

Castles. By Sir Charles Oman. Pp. xii + 232 + 100 plates. (London: Great Western Railway, Paddington, 1926.) 5*s*. net.

To the two delightful volumes, "Cathedrals" and "Abbeys," the Great Western Railway has now added a third dealing with the castles on or accessible from its system. Eighty castles in the south and south-west of England and in Wales are here described in full and illustrated by many photographic plates of great beauty and a number of equally pleasing sketches in the text. All the castles with the exception of six have been carefully inspected by the author, while his son was responsible for about half the illustrations. In addition to the description of each building and the notes on its history, Sir Charles Oman has provided an introduction in which he gives the history of the castle, royal and baronial, in England, and sketches its development as well as the development in methods of attack which took place *pari passu*—a subject on which so distinguished an authority on military history is peculiarly competent to speak. Sir Charles discusses at some length what constitutes a castle, and finally defines it as a military structure used for residential purposes which is a unit as itself. It is interesting to note that the author attributes the fact that castle building virtually ceased in the fourteenth century, not so much to the development of artillery, though that was no doubt a contributory cause, as to the realisation by that time that war in the open had come to be the only form of decisive action, and it was consequently more effective to spend money on the maintenance of men-at-arms rather than in buildings.

The Chemical Analysis of Foods: a Practical Treatise on the Examination of Foodstuffs and the Detection of Adulterants. By Dr. H. E. Cox. Pp. vii + 323. (London: J. and A. Churchill, 1925.) 18*s*. net.

THE aim of the author has been to write a text-book of food analysis for the general requirements of chemists who have no special experience in the analysis of foods. On the whole he has produced a compact and readable volume which contains a large amount of useful information. In eleven chapters the subjects dealt with include carbohydrates, baking-powder, fruits, tea, coffee, cocoa, mustard, pepper, wines and other alcoholic liquors, flesh foods, milk and related products, and various oils. In an appendix the Public Health (Preservatives, etc.) Regulations of 1925 are given.

Methods are often too briefly described to be of real value to the inexperienced, and the details given are not always strictly accurate. In some cases definite alterations in standard existing procedure is indicated without comment or reference to original sources. The expert analyst is certain to be disappointed in many sections of the book, for in several instances where information is required, even on common controversial problems, little help is given. There is possibly some justification for this, as the author indicates that he is not writing for the specialist, and has endeavoured only to present the elements of the subject. The book is therefore more useful in initial training than as an aid in discussing special isolated points. In a second edition with a fair amount of revision and correction a very useful text-book should result.

Economic Geography of South America. By Prof. R. H. Whitbeck. Pp. vii + 430. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 17*s*. 6*d*. net.

THERE has long been need for a text-book on South American economic geography, since much that has been written on this subject is not free from bias and is far from trustworthy. In this volume, Prof. Whitbeck, who has the necessary qualification of personal experience of South America and a wide outlook, has largely supplied the want. The physical background is merely sketched and there is little explanation of climatic processes. These are the weak sides of the book. But the economic problems are ably handled, and the human element, which is of great significance, is kept well in the foreground. States are selected as geographical entities, but within the larger States natural regions are recognised. National boundaries, traditions, and even prejudice, play too important a part in the economic life of any State to be neglected, as must happen if natural or geographical regions are chosen as the larger units for treatment. The Falkland Islands may be of small importance, but they merit more than one casual reference, at least if the book is to be used in Great Britain. There are admirable illustrations and sketch-maps and copious bibliographies, while the text shows a pleasing absence of New World phraseology.

The Human Body. By Dr. Marie Carmichael Stopes. Pp. v + 224 + 7 plates. (London: The Gill Publishing Co., Ltd., 1926.) 6*s*. 6*d*. net.

FEW will venture to deny that some elementary knowledge of the structure and working of the human body should be included in the education of every child. To further that object, Dr. Marie Stopes offers this book to adolescents and to all who missed this knowledge when they were young. In general, it is eminently suitable for the purpose; it is simple in expression, clear and accurate in detail, and easily readable by any youth of average intelligence. There are, however, certain features of anatomy and physiology which cannot adequately be explained in print; they are best left to the tact and common sense of the parent or guardian, and their omission from this book would certainly have increased its sphere of use, to those, at least, who are passing from childhood to youth. The only other criticism we have to offer is that technical terms, such as 'omos,' 'lumbus' and 'natis,' are unnecessary even in the diagrams of a book intended for lay readers.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Secondary Hydrogen Spectrum.

The further examination of the secondary spectrum of hydrogen has led to a number of interesting discoveries since my last publication (*Roy. Soc. Proc.* A, vol. 111, p. 714, 1926). It appears that the green and red bands have the same electron jump but correspond to different sets of vibrational transitions, those for the green bands being 0→0, 1→1, 2→2, 3→3, and 4→4, and those for the red bands 1→0, 2→1, 3→2, 4→3, 5→3, and 6→5. In addition, there are five other less well developed sets of bands with the same electron jump, two in the infra-red with vibrational transitions 2→0, 3→1, 4→2 and 3→0, 4→1 respectively, and three on the violet side of the green with the respective sets of vibrational transitions 0→1, 1→2, 2→3, 3→4 and 0→2, 1→3 and 0→3. There is an intercombination between the lines of all the above bands and indications of a further combination in the members of the P R branches, which, however, are less well developed than the Q branches. The second differences of the Q branches form a square array with a common vertical difference = 2·4 and a common horizontal difference = 2·8 wave number.

The blue bands have a different electron jump from the foregoing. It appears that there are less well developed bands on the violet side of these, which are connected with them and with the red bands by means of a Rydberg formula. Thus if the first element on the violet side of each band is indicated as usual by the letter A, the frequencies of the successive lines AQ (1) are given by the formula

$$\nu = 109678\ 3 \times \left\{ \frac{1}{(2-\mu_1)^2} - \frac{1}{(m-\mu_2)^2} \right\}.$$

The value of μ_1 is approximately 0·067 and μ_2 falls steadily from about 0 063 to 0 058 as m increases from 3 to 7. Evidence of the bands can be found for each of the values $m = 3, 4, 5, 6, 7$. When $m = 3$ we get one of Fulcher's red S_3 lines, the one, in fact, nearest the violet end, and when $m = 4$ we get the first line at the violet end of Dieke's blue bands. There is also evidence of the existence of a similar lot of bands connected by a Rydberg formula with the green bands. There can be little doubt, in view of the above equation, that this system constitutes the band analogue of Balmer's series.

O. W. Richardson.

King's College, University of London,
July 11.

Imperfect Crystallisation of Common Camphor.

Quite recently (Nature, May 22, p. 721) A. Müller described the imperfect crystallisation of behenolic acid. The crystals of this substance proved to be built up of small crystal elements which have one direction in common and a random orientation perpendicular to this direction. This seems to be the case with many long-chain compounds.

As another example of such an imperfect crystallisation where, however, the imperfection is still greater, I should like to mention common d-camphor (Japan camphor). This substance, which, according to Traube, crystallises in the trigonal-trapezohedral class, was studied in the course of an investigation of the space-groups of some optically active crystals. The rotatory dispersion of camphor crystals is practically the same as the rotatory dispersion of the substance in the melted, gaseous and dissolved states (L. Longchambon, Thèse, Paris, 1923; *C.R.*, 182 (1926), 769). It was therefore supposed that the crystals might prove to possess no trigonal screw-axes, and thus owe little or none of their rotatory power to the molecular arrangement within them.

Assuming that the crystals are truly trigonal or hexagonal, their tabular form is in favour of this hypothesis. Indeed, the best developed planes in any crystal (here {0001}) are generally those which are the most closely packed with molecules. The presence of a threefold screw-axis would reduce the molecular density of the basal plane to one-third of the value which would hold in the case of a threefold rotation axis.

The crystals used were found in a bottle in which they had been produced by slow sublimation, apparently over a number of years, at room temperature. They consisted of thin hexagonal plates. The X-ray investigation showed, however, that the external form of the crystals is deceiving.

With the Bragg spectrometer never more than three reflections were observed, corresponding to the planes which occur on the crystals. From them the following spacings were deduced: $d_{0001} = 5·80$ Å.U., $d_{10\bar{1}1} = 5·42$ Å.U., $d_{10\bar{1}0} = 6·06$ Å.U. (indices according to Traube). Actually, d_{0001} must be multiplied by 2 to make these spacings consistent. They give for the axial ratio 1·656 (Traube, 1·685). The hexagonal unit calculated from them contains two chemical molecules (1 95). Strange to say, a reflection from {11$\bar{2}$0} was never observed on the spectrometer. Many rotation- and oscillation-photographs were taken with different settings of the crystals (with regard to the outer form). None of these photographs showed the typical hyperbolæ of spots that would be expected. All of them showed only a relatively small number of spots, more or less distributed in a circle round the centre. Although the spots corresponding to the three planes mentioned above were generally found in positions where they would be expected, still no spot that could be definitely identified with {11$\bar{2}$0} was ever found. On the other hand, there were always spots in positions which bore no definite relations to the setting of the crystal. As a consequence it was practically impossible to deduce trustworthy conclusions from the *positions* of the spots on the plates. Clearly, what are apparently good crystals are in reality no more than conglomerations. Laue photographs seem to confirm this view. Several of them were taken in a direction perpendicular to the basal plane, but a hexagonal or trigonal distribution of spots was never obtained. There were a number of broad spots which appeared to correspond to a more correctly orientated larger part; but mostly the spots were drawn out into lines and located in circles round the centre. It should be noted that no definite indication of a larger constituent could be deduced from the rotation- and oscillation-photographs. The sharp spots must correspond to small crystals having a random orientation.

A small number of spacings were obtained from the oscillation-photographs. Attempts were made to increase this number by taking powder photographs, but a real powder could not be obtained. Rubbing camphor in a mortar effects an orientation of the crystal elements with the basal planes more or less parallel to the surface of the pressed substance. An oscillation photograph of this surface gave a strong reflection corresponding to the spacing of the basal plane. Subliming quickly on a cold surface produced crystals which were too big to be considered as a powder.

The spacings obtained are not sufficient to determine definitely the crystal unit. When a hexagonal or trigonal unit was assumed, it was only possible to account for the spacings by taking a much larger unit than would follow from the spectrometer measurements and assuming a number of accidental halvings, etc. In the course of the investigation there were also indications which seemed to point to the possibility that the crystals are not truly hexagonal but intergrowths of biaxial lamellæ. For example, on several photographs double spots were present, and once a very fine stratification of lines making angles of 60° with each other was observed on a thin layer of camphor which crystallised on the surface of a solution of camphor in aqueous methyl-alcohol. If the crystals are really biaxial, an artificial spiral of lamellæ must be present to account for the uniaxial nature of the composite crystals.

The imperfection of the crystals is probably due to the changes in temperature during the long time which is necessary for their growth. With rising temperature crystal elements resublime, whereas at lower temperatures new crystal elements are deposited. It is possible that the orientations of these latter are variable.

It is hoped that crystals will be grown from a solution later, and that better results will be obtained with them.

W. G. BURGERS,
Ramsay Memorial Fellow.

Davy Faraday Research Laboratory,
Royal Institution, W.1.

Influence of Temperature on Biological Processes.

THE study of Van 't Hoff's law in biology has led to the following main conclusions:

1. Biological reactions showing a $Q_{10} = \pm 1$ are of a photochemical nature.

2. Biological reactions with a negative Q_{10} are based upon surface forces.

3. In the remaining cases the Q_{10} lies between 1·3 and 6·0, but usually this value depends much less on the nature of the reaction involved than on the temperature itself, the Q_{10} of one and the same reaction being higher at low than at high temperatures. Thus in these cases the Q_{10} is not a true constant, and Van 't Hoff's formula does not fully hold. It might be noted here that even in many chemical reactions the Q_{10} is not absolutely constant but that it varies slightly with the temperature. In the overwhelming majority of biological processes, however, this variation is much more considerable.

For that reason some investigators have introduced the Arrhenius formula $\left(\frac{v_2}{v_1}=e^{\frac{\mu}{2}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)}\right)$ into biology. Ch Snyder[1] was the first to do so, and has been followed, in recent years, chiefly by W. J. Crozier.[2] The latter author, however, finds that the coefficient μ of the above-mentioned formula of Arrhenius is not always uniform for one and the same reaction, but that it has in many cases at least two, and according to Cole[3] even three, different values for different ranges of temperature. Thus the Arrhenius formula should not be generally used in biology (see Heilbrunn's criticism[4]).

Many biological observations unfortunately are not sufficiently accurate to serve as the basis for a quantitative law. However, after trying various mathematical formulæ for a large number of cases recorded in the literature, I have found that the following equation usually represents the relation between the temperature (x) and the time (y) necessary to accomplish a given reaction:

$$y=\frac{a}{x^b}, \qquad (1)$$

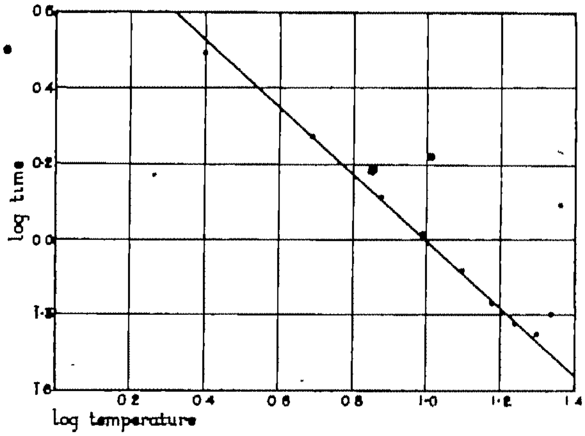


FIG. 1.—Effect of temperature on the locomotion of marine amœbæ (Pantin's experimental data).

a and b being constants. In logarithmic form the formula becomes:

$$\log y=\log a-b\log x, \qquad (2)$$

which means that the logarithm of time plotted against the logarithm of temperature gives a straight line. The following examples, which give good lines, show that the formula is very general.

Reaction.	Species.	Author.	a.	b.
Pulsation of the vacuole	Paramæcium	Cole[3]	5460·0	1·87
Amœboid movement	Marine amœbæ	Pantin[5]	7·76	0·90
Growth	*Scirpus Kisoor*	Bose[6]	$346 \cdot 10^{12}$	9·50
Oxygen consumption	*Tenebrio molitor chrysalids*	Krogh[7]	2819·0	2·10
Vasomotor effect n. ischiadicus	Cat	Howell[8]	3802·0	2·02
Regeneration	Tubularia	Moore[9]	5012·0	1·70

Figs. 1 and 2 show the curves obtained in two of the above reactions.

The constant a expresses the time at ±1°, as it may be calculated in putting $x=1$. It is evident that the value of a varies according to the unit of time used. The value of b is independent of the actual velocity and of the unit of time employed, because b represents an acceleration.

If $b=1$, the formula becomes

$$y=\frac{a}{x}, \qquad (3)$$

which is the general equation of a rectangular hyperbola. Some entomologists have put forward the hypothesis that the product of temperature and time in the embryonic development of insects is a constant for one and the same species. This hypothesis may be written mathematically in the form given above (3), and is therefore only a special case of the more general equation (1).

Krogh,[10] Warburg,[11] and others have shown that some biological reactions are affected by the temperature in such a way that the velocities themselves plotted against temperature (*not* their logarithms) give a straight line instead of the exponential curve of Van 't Hoff. Expressed mathematically, this fact may be written (v = velocity, x = temperature):

---

[1] Snyder, *Arch. für Anat. und Physiol.*, 1907, p. 113.
[2] Crozier, *Journ. Gen. Physiol.*, 7, 1924; *Proc. Nat. Acad. Sci.*, 10, 1924.
[3] Cole, *Journ. Gen. Physiol.*, 7, 1925.
[4] Heilbrunn, *Science*, 62, 1925.
[5] Pantin, *Brit. Jour. Exper. Biol.*, 1, 1924.
[6] Bose, *Trans. Bose Res. Inst. Calcutta*, 1, 1918.
[7] Cf. Robertson, "Principles of Biochemistry," 1920.
[8] Howell, Budgett and Leonard, *Journ. of Physiol.*, 16, 1894.
[9] Moore, *Roux's Archiv*, 30, 1910.
[10] Krogh, *Zeitschr. fur allg. Physiol.*, 16, 1914.
[11] Warburg, *Bioch. Zeits.*, 100, 1919; 103, 1920. Yabusoe, *ibid.*, 152, 1924.

$$v = kx, \quad . \quad . \quad . \quad . \quad (4)$$

and if we take time y instead of velocity ($y = 1/v$) and if we put $k = 1/a$, we may write:

$$y = \frac{a}{x},$$

which is the same as the equation (3). Thus the linear relation between time and temperature is true when b in the general formula (1) becomes $= 1$.

If we construct a curve based on any arbitrary case of the general formula (1) and then calculate the Q_{10} of that curve in the same way as is usually done in biology, we find that the value of Q_{10} decreases with rise of temperature in the same manner as in the majority of actual biographical reactions, provided always that b is greater than 1.

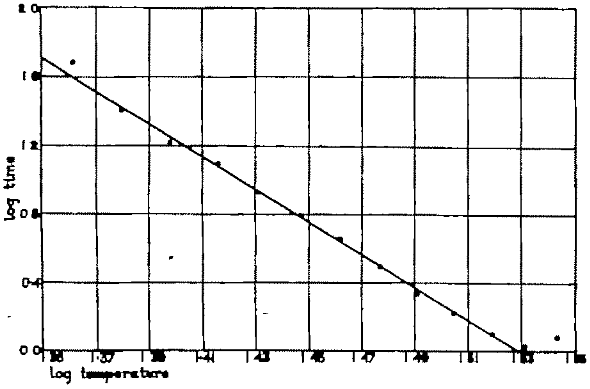


FIG. 2.—Effect of temperature on growth of *Scirpus Kisoor* (Bose's experiments)

At high temperatures (near and above the optimum) the formula of course does not hold, because of changes occurring in the protoplasmic equilibrium. Sometimes it may also be observed that at very low temperatures (in the neighbourhood of 0° C.) the calculated and actual values do not correspond; this is due to the fact that in the previous calculations the possible difference between the physical zero (0° C.) and the biological zero has been neglected. If the biological zero is below 0° C., the calculated points possess somewhat higher values than the points observed, and vice versa. When the temperature is measured from the biological zero (which may be expected to lie not very far from 0° C.), these divergences at low temperatures disappear.

Variations in the constant b in formula (1) appear to have considerable biological significance. I hope to show in a later note that, for the same reaction in one and the same species, b increases with age; also that it is larger in homothermic than in poikilothermic animals, and in tropical than in temperate plants.

J. BĚLEHRÁDEK.

King's College, London, June 11.

Migrations of Butterflies.

IN NATURE of April 11, 1925, p. 535, I gave an account of certain annual movements of the Painted Lady Butterfly (*Pyrameis cardui*) and ascribed them to a deliberate migratory effort on the part of the insect.

In NATURE, September 5, 1925, p. 365, and again on May 29, 1926, p. 754, Dr. E. P. Felt has suggested that this interpretation of the facts is wrong and that in reality we are dealing only with another form of the more general phenomenon of the involuntary distribution of insects by means of overpowering wind currents along the surface of the earth, or upwards by convection, and then along at high altitudes.

No one will disagree with Dr. Felt as to the frequence of involuntary distribution. On the other hand, the evidence that the seasonal movements of such butterflies as *P. cardui*, *Anosia plexippus* and various species of *Catopsilia*, etc., is an entirely different phenomenon, is too long to give in detail in a short letter. I have prepared a fuller statement of the arguments for and against, which will be published elsewhere.

However, one or two points might be summarised here.

(1) The evidence that enormous unidirectional flights of butterflies takes place at ground level, apparently independent of wind direction, or at least more often against or across the wind than with it, is overwhelming. I have more than five hundred references to flights of more than one hundred species in my bibliography for Lepidoptera alone, and the records are multiplying almost daily. The point in dispute seems to be to what distance such flights extend.

(2) In the Pulney Hills in South India, Mr. Evershed has observed for more than ten years a regular stream of butterflies of four families going to the south in November and December almost every year, and a northerly stream of Pieridæ in the earlier months of the year about March. He is convinced that these flights are independent of wind direction.

(3) In the Argentine, Hayward (*Entomologist*, 1925, pp. 147 and 162) records numerous butterflies 'migrating' to the north and flying near the ground when the wind was against them and high up when it was favourable, *i.e.* making use of the wind when possible but not in any way dependent on it or driven by it.

(4) Dr. Felt suggests that as the north and north-west movement of *P. cardui* between March and June over N. Africa and Europe is against the prevailing ground winds, it must therefore be due to upper air currents. I have collected information about the upper air currents in Egypt and the Mediterranean basin, and find that it is necessary to go up from two to four kilometres to get from the ground winds (prevailing north) to a permanent steady westerly upper current. At no height is there any wind current that would account for the migration. The most favourable conditions for the northerly drift of unresisting objects would be with a southerly wind. When there is such at the surface in Egypt, it has veered to south-west at a height of one kilometre and to the permanent west current between two and three kilometres. It should also be emphasised that it is not when there is a south wind, but when there is a north or north-west wind, that thousands of Painted Ladies pass steadily to the north or north-west through the Cairo district.

(5) Practically the same conditions apply with the southerly migration of the Monarch Butterfly in the eastern U.S.A. in the autumn. Neither at the surface nor at any height above it are there prevailing winds to account for the movement.

(6) If the great spread of these insects is due to involuntary drift at high altitudes, why do they continue to move, over many miles at least, in a set direction, often against the wind, when they come to the surface again? (or is it before they go up?). The mad, untiring unidirectional flight of butterflies is a thing apart from their normal flight and cannot

be accounted for except by profound physiological disturbances such as are found in birds during migration.

It is difficult not to add, although it is not argument, that if Dr. Felt had once seen a hundred thousand butterflies going headlong against the wind, or coming out of the bare desert like a thin haze, or flying out to sea without taking any other interest in a steamer than that necessary to avoid it, he would realise the complete lack of identity between this and the willy-nilly drift that carries aphids to Spitsbergen or mosquitoes and house-flies to the Rebecca Shoal Lighthouse. C. B. WILLIAMS.

Ministry of Agriculture,
Cairo, Egypt, June 10.

Series Spectra of the First Long Period.

THE regular and irregular doublet laws have been applied to some lines which appear in the high-potential spark of scandium, titanium, vanadium, and chromium, and those listed in the table appear to be the first members of the *P* doublets of Sc III to Cr VI. For convenience, those of K I and Ca II have been included from Fowler's "Series in Line Spectra."

Element.	λ.	*I*.	ν.	Δν.
K I .	7664·94 7699·01	10 *R* 10 *R*	13042·8 12985·1	57·7
Ca II .	3933·7 3968·5	10 *R* 10 *R*	25414·4 25191·6	222·8
Sc III .	2699·9 2734·9	10 9	37038·4 36564·4	474
Ti IV .	2067·6 2103·4	9 8	48363 47542	821
V V .	1680·4 1722·7	5 3	59510 58048	1462
Cr VI .	1446·7 1498·0	4 2	69123 66756	2367

The wave-lengths were measured *in vacuo* on a two-metre grating having 30,000 lines per inch, giving an average dispersion of 4·5 Å.U. per mm.

There is no doubt that from scandium onward the intensity of these pairs falls steadily as indicated, but there is no direct comparison intended between these and potassium or calcium. It may be said, however, that calcium and scandium were taken on the same plates in some cases, and the calcium doublet was strongly reversed and apparently very much more intense than that for scandium.

When the intensity ratio of the two lines of each pair is considered, it is found that the shorter line is always the more intense of the two

The corresponding doublet for Mn VII falls in a region having many strong lines, mostly due to silicon, and so no definite conclusion could be arrived at regarding its existence.

The origin of these pairs seems unexplained, since each of these elements from calcium onward is supposed to have but two electrons in the *N* levels, unless we assume that when these are removed some of the *M* electrons move out to take their places in a manner similar to that discussed by Catalán (*Phil. Trans.*, A, vol. 223, p. 166). Some such assumption seems necessary to explain chemical and magnetic results. It seems possible, also, that there may be some connexion between this and the decreasing intensity of the pairs.

The doublet for Sc III was arrived at independently by Mr. S Smith, who spent considerable time looking for further series relations for this system, but while several pairs having the same separation are known, no certain results have been found. R. J. LANG.

University of Alberta,
Edmonton, Canada,
May 25.

Technical and Intellectual Values.

IN the leading article in NATURE of June 12, the Association of Teachers in Technical Institutions is invited to publish the philosophy of that branch of education in which its members are specialists. A series of principles is urgently required, and this the Association has formulated, partly philosophical, partly scientific. Control experiments to check our hypotheses are now in the process of performance through the medium of Lord Emmott's Committee of Inquiry into Technical Education, which was suggested, and the preliminary work undertaken by the A.T.T.I., but which is now under the control of an executive committee representative of industry, local education authorities, learned institutions, and technical teachers, with Mr. J. Wickham Murray as its honorary secretary. The guiding principles which are asked for will soon be in a form suitable for publication, and will then be submitted to the reading public for criticism and suggestion.

The urgent need for their formulation and publication is shown by recent speeches of the president of the Board of Education. In his opinion, secondary education is the preparation for a university education destined to provide the 'governing classes'—to use his words as reported in the press. Such a typically constricted outlook must be widened. The function of a government does not end with the manipulation of Emergency Powers Acts. Industry and commerce must be encouraged and fostered. Whether governmental philosophy be individualist or collectivist, we shall require men with technological training and capable of the application of science to the industrial world. Education must include education for service as well as for government, and this service must be intelligent: not a clumsy translation of good intentions into feeble practice.

A. E. EVANS, President.

Association of Teachers in
Technical Institutions,
29 Gordon Square,
London, W.C.1.

Natural History of the New Hebrides.

IN a few months my brother and I are going to the New Hebrides, in the Pacific Ocean, to explore the interior of the largest island, to collect the fauna, to study animal reproduction in a climate that is almost constant throughout the year, and to undertake other work of a more special nature. Particular interest attaches to a large lake on one of the islands, said to be almost the only lake in Melanesia. We are financed in part by the Trustees of the Percy Sladen Memorial Fund.

If any reader of NATURE who is a specialist in any group of terrestrial or fresh-water animals or their parasites would care to communicate with me, I should be glad to make a particular point of collecting that group and of sending the specimens to him on our return, provided that he will undertake to work out the collection and subject to the approval of the Percy Sladen Trustees. JOHN R. BAKER.

Department of Zoology and
Comparative Anatomy,
University Museum, Oxford.

The Imperfect Crystallisation of Common Things.[1]

By Sir WILLIAM BRAGG, K.B.E., F.R.S.

MANY things consist of, or contain, agglomerations of small crystals which are plain to the eye or may be made evident by the use of the microscope. Many more are only discovered to be of similar composition when they are examined with the aid of X-rays, as for example, fats, cotton and silk. In some cases the small crystals are in complete disorder. In others there is a partial arrangement; some one direction related similarly to each crystal has a tendency to orient itself more or less in a certain direction related to the body of which the crystals form part. When this happens there must necessarily be a cause for it. The body may have been subjected to strain or mechanical treatment of some sort, as when a metal sheet is hammered or rolled, or when a metal wire is drawn. Or again the body may have been formed under conditions which favour orientation, as when a substance is deposited electrolytically. Yet another case of great interest is that of animal or vegetable structure; the general orientation of the crystallites in cotton, silk, animal scales and spines, teeth and the like, has features which are clearly associated with growth.[2]

It is most probable, in some cases it is already certain, that the presence of the small crystals and their arrangement affects the properties of the body which contains them. We know that the strength of a wire depends on the arrangement of its constituent crystals; the strength of a cotton fibre, or of a bone, is most probably affected in the same way. It is part of Nature's scheme to produce this partial orientation in living things, so that a knowledge of it may be essential to the understanding of the structures which contain it. To this knowledge the X-ray diffraction figures, which are formed on the photographic plate in the customary ways, are able to contribute materially. These figures are of various types. One of them is the original Laue diagram which is obtained when a beam of heterogeneous X-rays falls on a single crystal. The lattice points in the crystal can be imagined as all lying on sets of parallel and equally spaced planes; there are an infinite number of such sets, but only a moderate number of them are sufficiently widely spaced to reflect X-rays of ordinary wave-lengths. Whenever a reflection takes place the relation $n\lambda = 2d \sin \theta$ must be satisfied, where λ is the wave-length, d the spacing of the set of planes, n is an integer, and θ the angle between any plane of the set and either the incident or reflected ray. The well-known Laue photograph is formed by the reflections from the various sets of planes, each set reflecting that particular wave-length which it is able to reflect, according to the above equation. The arrangement of the spots on the photographic plate is closely connected with the symmetry of the crystal.

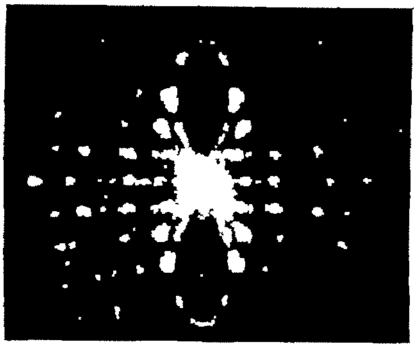


FIG. 1.—Cane sugar. Crystal rotating, homogeneous rays.

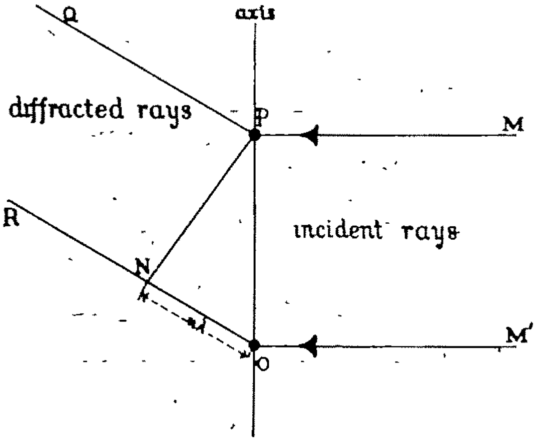


FIG. 2.

A second well-known type consists of a series of concentric rings; it is formed by reflections of rays of one wave-length—not mixed rays as in the previous case—which are incident on a mass of small similar crystals oriented in all directions. The explanation is that the reflection from a set of planes of given spacing must make a certain angle with the incident rays, but otherwise there is no condition which its direction must satisfy. Each ring is the aggregate of reflections from one such set. These ring photographs were introduced independently by Debye and Scherrer and by Hull, about ten years ago.

There is a third type which has been much used in recent years and is particularly important in view of the researches now under consideration. A small crystal is made to revolve about an axis perpendicular to a pencil of incident rays of one wave-length. The resulting photograph when the plate is also normal to the rays is of the character shown in Fig. 1, which is due to a sugar crystal. Each set of planes has its chance of reflecting during the revolution, provided that its spacing lies within certain limits. The spot which the reflection produces must lie on a certain circle concentric with the spot where the incident rays strike the plate; the same circle as that which was fully represented in the previous case when there was no limitation on the orientation of the crystal. But there is now a further condition; each spot must lie on one of a series of hyperbolas, such as are clearly shown in the sugar photograph. This point is readily explained with the help of Fig. 2, which shows incident rays falling on two lattice points O and P, and diffracted rays passing away from these points. It is to be remembered that OP is extremely small in comparison with the size of the crystal, and this again is small in comparison with the distance from the crystal to the photographic plate. The incident and reflected rays are 'fine pencils,' though they contain an enormous number of such lines as MP, M'O. When there is a diffracted or reflected ray from the crystal the contributions from any two such points must be in the same phase. Hence ON must be equal to $n\lambda$ where n is zero or an integer. If O and P lie on the axis of rotation, every diffracted ray must make with OP an angle $\cos^{-1} n\lambda/\mathrm{OP}$. Thus all such rays must lie on one or other of a series of cones having OP as axis, and these cones cut the plate in a series of hyperbolas. If O and P are consecutive lattice points along OP, the first hyperbola is given by $\theta = \cos^{-1} \lambda/\mathrm{OP}$. If θ is measured, OP can be calculated; and in this way the geometry of the lattice can be found.

---

[1] Abstract of lectures delivered by the author at the Royal Institution on April 29 and May 6. The lectures were abbreviated on account of the industrial disarrangements of the time. It is proposed to give the lectures in full next November.

[2] The researches in this direction have been primarily carried out in the Kaiser Wilhelm-Institut fur Faserstoffchemie in Berlin-Dahlem by Herzog, Gonell, Mark, Weissenberg, and other workers. The photographic illustrations of this article are due to Mr. W. T. Astbury.

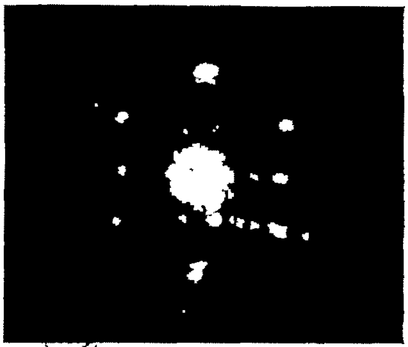


FIG. 3.—Asbestos. Bundle of fibres held steady. Homogeneous rays.

A substance containing a number of small crystals having one direction in common, but otherwise oriented in a haphazard manner, gives the same photograph as a single crystal rotated about that direction during the exposure. Such a photograph is, for example, given by asbestos as shown in Fig. 3; the fibres have been set normal to the rays.

It is not often that a substance shows this arrangement in perfection, and gives a photograph like that of a single revolving crystal. Sometimes it is a spot photograph from which a number of spots are missing; it is like that of a single crystal which has not been turned through a full revolution. A bent flake of maleic acid (Müller, NATURE, May 22, p. 721) gives a photograph of this kind; if it could be bent so as to make a cylinder the tale of spots would be complete.

More often the spots are opened out into arcs of the circles on which they lie. A spot cannot move off its circle so long as the wave-length remains the same; but if there is any variability in the common direction of the crystals, the positions and spacings of the set of hyperbolæ are also variable, so that the spot broadens out along the circle on which it lies. The same effect would be obtained from a rotating photograph of a single crystal, if the axis of revolution were given some motion of its own, regular or irregular. The amount of extension of each spot into an arc varies from plane to plane, and much information can be obtained from a study of the photograph as to the possible variation in the orientation of each plane.

If there is complete uncertainty as to the orientation of the small crystals, that is to say, if there is nothing like a common direction, then a spot may lie anywhere on its circle, and we have again the ring photographs which Debye and Scherrer and Hull obtained independently.

Thus the type of photograph obtained by passing monochromatic rays through a substance shows the extent of the crystallisation. A single crystal gives no picture unless rotated. A substance containing many crystals, all having one direction in common, gives a photograph of spots, arranged in a series of hyperbolæ. The picture has symmetry about the projection of the axis on the plate; and if the incident ray is perpendicular to the axis and the plate, there is also symmetry about a line perpendicular to the projection. If there is only an approach to a common direction, the spots are drawn out into arcs of circles. If there is no approach at all, the circles are complete.

A spot never moves off its circle no matter how the crystals are oriented, so long as the rays are monochromatic. But if the rays are heterogeneous, the spot is drawn out to form part of a closed curve of a lemniscate form which crosses the circle. Photographs (Figs. 1 and 3) show traces of these curves, when the rays employed are not quite monochromatic.

The photographs of structures from several sources composed partly, sometimes almost wholly, of cellulose, all show the existence of crystals having the same lattice. Ramie (Fig. 4) gives quite a good spot photograph when the fibres are perpendicular to the rays; from which it can be concluded that one direction of the minute crystals is for all of them very nearly parallel to the fibre axis. It is possible, in fact, to calculate the size and form of the unit cell; the size turns out to be comparable with that of cells of ordinary organic substances. Clearly the unit of pattern does not contain the substance of many molecules, nor does each molecule contain many atoms (Herzog, *Naturwiss.*, 1924, p. 958). Cotton-wool, in the form of a small pad, gives rings, showing that its crystallites are in this case arranged entirely at random; but when a number of fibres are stretched parallel to one another there is some approach to a common axis. That the arrangement is not more complete has been ascribed to the fact that cotton fibres have a spiral structure.

FIG. 4.—Ramie fibre. Homogeneous rays. Bundle of fibres held steady. The original photograph shows some thirty or forty spots, many of which are too faint to appear in the reproduction.

It is of course no new idea that woollen, cotton and other fibres are two-phase systems at least. The elastic properties [3] point directly to such a supposition.

Mercerisation makes changes in the X-ray picture; the spots move perceptibly, but very little, and the relative intensities of some of them alter. It would appear that the general form of the lattice remains much the same, but there is some slight rearrangement of the atoms in the unit cell, perhaps an addition to them. (The cellulose photograph shows, too, that there is more than one crystalline substance present.)

Artificial silks show the structure of cellulose, as might be expected; though there are small differences in the intensities of different spots, depending on the method of manufacture. Brill has examined a number of natural silks from different sources and found the same structure in all of them.

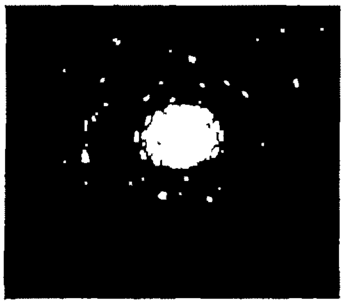


FIG. 5.—Spine of Arbacia. Laue photograph: rays heterogeneous, object held steady.

Herzog has examined chitin from various snails and insects, and found the same structure in them all. A very good spot diagram was obtained from a layer separated from the wing case of the Goliath beetle; the whole case, containing many layers, gave a blurred picture because the crystallites are not oriented the same way in the different layers.

In some cases the X-rays have confirmed previous suppositions, as, for example, that the spines of the sea-urchin consist of single crystals, or at least of aggregates of single crystals all similarly oriented in all respects, not merely in one direction (Fig. 5).

These will serve as examples of the application of the X-ray methods to various substances in the living organism. They are but a beginning, relatively few in number, and imperfectly understood.

In metallurgy the methods have been largely employed in the study of the gradual changes that take place during mechanical treatment. Rolling and drawing tend to give special orientations to the metal crystals. It has been shown by Wever, and by Owen and Preston, that in rolled aluminium foils the crystals finally arrange themselves so that (112) planes lie in the surface, a (111) direction being the direction of rolling (Fig. 6). The cube diagonals of the small cubic crystals lie in the surface; this condition is satisfied by two positions of the cubes, which are images of each other in the surface.

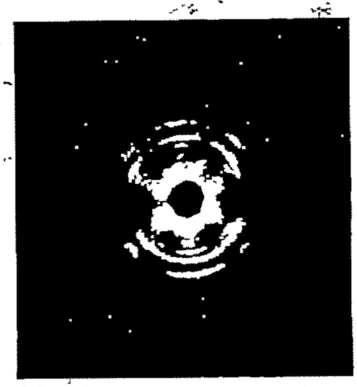


FIG. 6.—Aluminium foil rotated about an axis parallel to the direction of rolling [111] Homogeneous rays.

The interesting point is that a certain tendency to orientation is a consequence of treatment which may be due either to mechanical handling or to some process of life. Absolutely irregular orientation cannot be generally consistent with purpose or design. Whenever small crystals exist in organic substances—and they are far more common than we have supposed—their arrangement is connected with growth, and they may be essential to it, or illustrate it, or be connected with it in some way or other which may be important to know. The X-rays show simply and conveniently the amount of any such regularity, and it is for that reason that it is interesting to apply them to a wide study of natural structures of all kinds.

---

[3] Shorter, *Journal of the Textile Institute*, 15, 4, p. 207.

The Passing of Finsbury Technical College.

THE closing of Finsbury Technical College—familiarly known as "Finsbury"—on July 26, after an existence of nearly half a century, is an event which will be generally regretted. The College was founded in 1878 by the City and Guilds of London Institute, its object being specifically to train students in the principles of science as applied to industry. In this respect it was a new departure in English education, and great interest in its future was aroused both in academic and industrial circles. The courses of instruction were in applied physics, mechanical engineering (to which civil engineering was added later), and applied chemistry, the first professors being W. E. Ayrton, J. Perry, and H. E. Armstrong. A department of applied art, under the direction of Mr. A. Brophy, was attached, and from the beginning both day and evening classes were held in all subjects. The experiment was immediately successful, and in 1885 the Central Technical College at South Kensington—also founded by the City and Guilds of London Institute—was opened. Profs. Ayrton and Armstrong were transferred to the new establishment, and were succeeded by Silvanus P. Thompson and R. Meldola, both of whom held office for more than thirty years.

Thompson on joining the staff was made principal of the College, and threw all his energy into the work. Under his direction the reputation of the College rapidly grew, and students were attracted not only from different parts of the British Isles, but also from all over the world. The day students attended for two years, and received the College certificate on passing the prescribed examinations. Special lecture and laboratory courses were arranged for evening students, many of whom made long train journeys to take advantage of the facilities afforded. No outside examinations were held, and within wide limits each member of the staff was permitted to teach what he thought best and most useful, instead of being tied down to an examination syllabus. Under this system Finsbury flourished, and the number of students increased to such an extent that further accommodation became necessary, and a new wing was added to the College in 1904, which included a large engineering laboratory equipped with modern machinery and commodious drawing-offices. It appeared at this date that Finsbury was firmly and permanently established; but in the ensuing years various difficulties arose which threatened this seeming security, and ultimately led to the closing of the College.

The first troubles were financial. The amount available for Finsbury depended mainly upon voluntary subscriptions to the Institute from the City Companies, which were in some cases reduced in order to provide for special activities on the part of the companies concerned. The development of the College was greatly impeded by the absence of much-needed funds at a time when competitive establishments, often financed from public sources, were being organised in London and other parts of England. Temporary relief was afforded by the closing of the Art Department; but Finsbury was unable to keep so far ahead of its rivals as to attract a full complement of students from all quarters, and about 1910 a notable fall in the number of entrants, both day and evening, occurred. A contributory cause, in the case of day students, was the extension of the course to three years in order to conform with new regulations for admission to membership of the professional institutions.

At this stage the College also began to suffer from the increasing importance attached by public bodies, and even commercial companies, to the possession of a university degree, for which no provision could be made without fundamentally changing the character of the instruction. The War, with the greatly increased cost of upkeep which supervened, added further to the financial difficulties, and a great loss was sustained by the deaths of Profs. Meldola and Thompson during the War. In 1920 it was announced that the College was to be closed, and no new students were admitted in that year. As the result of a widespread agitation the London County Council offered financial aid for a period of five years, and in 1921 new students were again enrolled. The numbers joining, however, were not considered sufficient by the County Council to justify a continuation of the grant, and as the necessary sum was not forthcoming from any other source the closing of the College became inevitable.

Such, in brief, is the life-history of Finsbury; but a few words are needed to explain why it became well known all over the world. The two chief causes were an efficient and enthusiastic staff, from the principal down to the laboratory boys, and a true research atmosphere which infected the students and contributed largely to the great success they achieved in all branches of applied science. Amongst members of the staff who attained to the distinction of F.R.S. were the five early professors already named and Profs. Dalby, Coker, Morgan, and Eccles. Many important researches in applied science were carried out at Finsbury, such as the early work of Mrs. Ayrton on the electric arc; of Ayrton and Perry on electrical measuring instruments; Thompson on X-ray targets, cathode rays, and various electrical and optical devices; Meldola on dye-stuffs; Dalby on the balancing of engines; Coker and Scoble on the optical method of investigating stresses in materials and on the temperatures prevailing in the cylinders of internal-combustion engines; and Eccles on various radio devices, including the valve-controlled tuning-fork.

All these researches were fundamental, and will in themselves preserve the name of Finsbury; but a much longer list could be compiled dealing with researches in many branches of physics, engineering, and chemistry conducted by other members of the staff. It will no doubt be possible easily to distribute the students who would have attended Finsbury among other institutions, but it will not be easy to establish everywhere they may go the atmosphere of enthusiastic work and inquiry which characterised the College and brought out the best that was in the students. It has been said that the usual fate of successful reformers is to render themselves superfluous; and Finsbury, which set out to reform technical education and succeeded, has had this fate forced upon it by adverse circumstances. Whilst its demise must be deplored, it will be a satisfaction to all who have been connected with the College in any capacity that it has made for itself a lasting name in the annals of British education.

C. R. D.

The Oxford Meeting of the British Association.

OXFORD is in many respects a centre well-suited for meetings of the British Association for the Advancement of Science. It is easy of access from most parts of the country; it is well provided with accommodation for persons with moderate requirements; it is situated in a neighbourhood full of interest both historical and natural; and lastly, in its University lecture-rooms and laboratories it is able to furnish most of the conditions needed for the scientific business of the various sections.

In one particular Oxford is at a disadvantage compared with many of the places which have extended their hospitality to the Association—it is deficient in buildings large enough to collect all the members attending the meeting under one roof. It will not be possible in Oxford for even half of those who wish to do so to see and hear the Prince of Wales deliver his presidential address in his own person. The largest hall in the University—the Sheldonian Theatre—will not accommodate more than about 1500, and of these the large majority will have to submit to the discomfort of seats without backs. Conditions in the Town Hall, which has been put at the disposal of the Association by the civic authorities, are somewhat better adapted for an audience with present-day notions of comfort; though it will accommodate no larger number than the

Theatre where the address will be actually given. It is hoped that the Prince, at the conclusion of the business in the Sheldonian, will be able to visit the Town Hall, to which building his address will have been relayed. A further relay has been arranged to the debating hall of the Union Society, and in this way provision will have been secured for every one to hear the words of the president, and for nearly every one to see him.

The fact of the meeting taking place in Oxford will recall to the minds of many the records that exist of the famous meeting of 1860, which was especially signalised by the caustic reply of T. H. Huxley to the criticism passed by Samuel Wilberforce, then Bishop of Oxford, on the Darwinian theory of evolution—at that time a startling, and to the majority an unpleasant novelty. The scene of this memorable encounter was the northern section of the first-floor room in the front of the University Museum, part of which room is now occupied by the Hope Department of Entomology. To those who, like the present writer, heard the presidential address of the late Marquis of Salisbury at Oxford in 1894, there was something peculiarly impressive in the calm and measured language in which one of the former protagonists, Huxley himself, commented on an address which contained the words, "[Darwin] has, as a matter of fact, disposed of the doctrine of the immutability of species." The stage on which this latter development of the drama was played was the same as that which will witness the address of this year's president, namely, the Sheldonian Theatre. It was here, also, that the Marquis of Salisbury, on the occasion referred to, as Chancellor of the University, imparted a pleasantly light touch to the proceedings by introducing and welcoming himself as president of the British Association.

Oxford has, however, scientific associations of an earlier date. It will doubtless be remembered by many of the visitors that it was the scene in the thirteenth century of the labours and researches of Roger Bacon, the great Franciscan who, as the unflinching advocate of experimental science as against authority, was held by Humboldt to be "the most important phenomenon of the Middle Ages."[1] Perhaps some of the members of the Association will be able to find time to visit the traditional site of Roger's workshop at Folly Bridge, and the memorial tablet lately affixed to the old City Wall in close proximity to the spot where he is known to have been buried.

In Sir Archibald Geikie's happy phrase, "if Oxford was not present at the birth of the Royal Society, it at anyrate rocked the cradle of the infant." In these words he was referring to the account published in 1667 by Dr. Thomas Spratt of the meetings held "in *Dr. Wilkins* his Lodgings, in *Wadham College* (1648–59), which was then the place of Resort for Vertuous, and Learned Men." These meetings, says Spratt, in his History of the Royal Society, "laid the foundation of all this that follow'd." "By this means," he adds, "there was a race of yong Men provided, against the next Age, whose minds receiving from them [*i.e.* the men who met under Wilkins's auspices], their first Impressions of *sober* and *generous Knowledge*, were invincibly arm'd against all the inchantments of *Enthusiasm*."[2]

It need scarcely be said that the last word cited did not bear for the men of that time precisely the same meaning that belongs to it at the present day. Among the "principal and most constant of those who met at Wadham," Spratt enumerates the names of Seth Ward, the astronomer; Willis, the instructor of Lower and Mayow; Hooke, Robert Boyle, Sir William Petty, and "that miracle of a youth," as Evelyn calls him, Christopher Wren. The earliest experiments on transfusion were carried out in Oxford by Lower at the suggestion of Wren; and it is worthy of note that Sydenham, the great physician, and Mayow, the actual discoverer of oxygen and of the chemical and physiological explanation of combustion and bodily heat, were, besides Wren, all members of Wadham College, the institution presided over by the scientifically-minded brother-in-law of the Protector, spoken of by Evelyn as "that most obliging and universally-curious Dr. Wilkins."

The interest in 'natural knowledge' thus set going in the middle of the seventeenth century finds no abatement to-day; and those who will take the opportunity of the forthcoming meeting to make themselves acquainted with the scientific equipment and appliances now to be found in Oxford, will not fail to gain the impression that this ancient seat of learning is fully determined to take her proper part in the scientific progress of the present and future ages.

F. A. D.

---

[1] NATURE, June 18, 1914, p 405.

[2] Italics and spelling preserved as in the original text.

The Ross Institute and Hospital.

OPENING BY THE PRINCE OF WALES.

NO ceremony relating to the health and welfare of the British Empire has attracted so wide an interest as the opening of the Ross Institute and Hospital for Tropical Diseases by H.R.H. the Prince of Wales on July 15. It was the outward and visible sign of the initial success of a movement started more than three years ago to found a Ross Institute for Tropical Diseases which should include a Research Hospital. That movement had several objects in view, namely, to do honour to Ross while living for his epoch-making discovery of the method of transmission of malaria to human beings, to commemorate for all time his great achievement, to further the much-needed work of research in the prevention and treatment of tropical and sub-tropical diseases, to create a more general professional and public interest in the prevention and treatment of tropical diseases throughout the vast possessions of Great Britain in the tropics, and to assist medical men to carry out research work.

It has long been the complaint of some of the most promising men in the tropics that there was no institute in London where they could have the facilities when at home for research work on any special subject that had interested them in the tropics, which they desired to pursue further in their leisure time. The Ross Institute will now help them. France has her Pasteur

Institute in memory of her great man of science and to carry on his work. America has her Gorgas Institute at Panama, Japan has her Kitasato Institute, London has now her Ross Institute and Hospital for Tropical Diseases, the president of which is the Duchess of Portland, the chairman, Sir Charles McLeod, Bart., and the vice-chairman, Mr. Walter Shakespeare. There is a strong executive committee and council. The present medical officers are Sir Ronald Ross, director-in-chief, Dr. Castellani, director of tropical medicine and dermatology, and Sir William Simpson, director of tropical hygiene. Sir Ronald is still hale and hearty, and it must have been a source of gratification to him that, twenty-nine years after his famous discovery, and when the application of it is universally acknowledged to have resulted in the saving of an enormous number of lives and made some formerly uninhabitable places habitable, to have this Institute bearing his name opened by the Prince of Wales, who was the first to give a lead to the appeal for the necessary funds which was made in the *Times* of June 23, 1923.

The building, which contains two hospital wards, three laboratories, a library, and nurses' quarters, is not large, but it is on a healthy site facing Putney Heath, and the grounds are sufficiently extensive to allow of great additions in the future.

The Prince on his arrival at the Institute was received by the president, the Duchess of Portland, and the chairman, Sir Charles McLeod. A number of presentations were made to His Royal Highness, who afterwards inspected the wards, laboratories, and library, and then proceeded to the dais reserved for him and facing a pavilion in which more than six hundred guests were assembled. Here the chairman, Sir Charles McLeod, presented an address to the Prince in which he mentioned that His Royal Highness on his visits through different parts of the Empire and in foreign countries had landed on many tropical shores, and that his interest and sympathy cannot but have been aroused by the record of the decimating scourge of diseases incidental to these latitudes. Many of these diseases still hold the field but, thanks to Sir Ronald Ross, in honour of whose discoveries this Institute was founded, one of the greatest of them—malaria—has been or can be practically overcome. Sir Charles described the objects of the Institute, the chief of which is by research into causes of diseases to lessen the burden which weighs so heavily on labour and industry, and still more terribly on human life, in tropical and sub-tropical lands. Great strides in the knowledge of tropical diseases have been made during the last quarter of a century, and there is every hope and encouragement that in the quest and exploration of still unknown regions in medicine it will be possible to add to the stores of that science which aims only at conferring benefits on all human beings. The Prince was then presented by Sir Charles with a golden key, on which was a colour impression of the Ross Institute, and asked to declare the Institute open.

The Prince of Wales in rising to speak was received with great enthusiasm, and said:

"The opening of this Institute, which I am very glad to perform, commemorates a definite achievement in the work which the British Empire has done for civilisation. Not the least important obligation which the development of that Empire has laid on the members of our race is the constant struggle against disease in all the varied forms it can assume in different climates and in different latitudes. The struggle is always fiercest in the tropics, where man, and especially the white man, is the continual prey of diseases from which we in this country are, comparatively speaking, protected by a more temperate climate; and perhaps the saddest page in the whole history of our Empire is that which tells of the terrible toll taken by plague and by fever of those who helped to build it.

"Of all these tropical enemies, malaria has probably been the most deadly and elusive. But now, thanks to the achievement of one man, whose name we are perpetuating in this Ross Institute, its ultimate defeat is certain. Only a few months ago I was able to see in the Sir Alfred Jones Laboratory in Sierra Leone not only the vital need for a campaign against malaria, but also the remarkable progress which has already been made in it. Perhaps I am biassed by many visits to tropical and sub-tropical parts of the world where malaria is rife, and by having talked with so many men and women whose health has been shattered by a life's work in such districts, but I can think of no other single discovery in recent times which will earn the deep gratitude of so many thousands of human beings of all nationalities as the discovery made in India by Major Ronald Ross—as he was then—on August 20, 1897. The story of its subsequent development and of what it has led to is well known to you all. I need only summarise it in the words of a famous writer: 'It is not too much to say that Sir Ronald Ross has made one-third of the world inhabitable.'

"Over a quarter of a century has elapsed since that epoch-making discovery, and this institute and hospital now stands as a memorial to the life-work of Sir Ronald and his colleagues. But it is not merely a passive memorial to work accomplished in the past; it is also, as Sir Charles McLeod has reminded us, a very active centre for work to be done in the future. All who have any experience of the tropics will know that there is still a vast field for scientific medical research, and here, with all the resources that modern science can provide, such research can be effectively carried out, provided adequate funds are forthcoming. From this building may issue results which will bring back health to thousands who have lost it, or safeguard the lives of countless others threatened by unseen dangers in tropical lands. More than that, it may open out for the use and benefit of mankind as a whole, huge districts which are at present denied to civilisation.

"It is not surprising, therefore, that, when the scheme for founding this Institute was first put forward, it immediately received widespread public support. That support happily made its inception possible, and once the first financial obstacle was surmounted, its promoters lost no time in making it a reality. To the president, the Duchess of Portland, to Sir Charles McLeod and Mr. Shakespeare, and to Sir Ronald and his two co-directors, Sir William Simpson and Dr. Castellani, the gratitude of all of us is specially due for the time and energy they have devoted to its execution. They and their fellow-officers of the Institute may well feel proud of the result of their labours and of the knowledge that they have called into being something which cannot fail to be of incalculable benefit to many generations.

"It is with the sincere hope that further public support for the necessary endowment may be forthcoming, and that the labours of those who will work here may be blessed with every success, that I now declare the Ross Institute and Hospital open."

After the Bishop of Southwark offered a dedicatory prayer, a vote of thanks to the Prince was proposed by the Duchess of Portland, and seconded by Sir Ronald Ross, who expressed his grateful thanks to the Prince for the kind manner in which His Royal Highness had referred to his work. He also thanked all the contributors for the honour they had done him in naming the Institute after him. The Prince replied to the vote of thanks, and after his departure the Institute was opened to the inspection of the guests.

News and Views.

ON July 14, in the House of Lords, the Duke of Northumberland directed attention to the alteration in the status of the engineer officers of the Royal Navy brought about by the Admiralty Fleet Order 3241/25 issued last November. This matter has already been referred to in these columns on several occasions. In his remarks the Duke of Northumberland said that the Order abolished the last vestige of the improved status of the engineer officer under the 1902 scheme for the amalgamation of the engineering branch with the deck officers. Not only did it relegate the engineer officer to the non-executive branch of the Navy, but it also emphasised the distinction between the deck officer and the engineer officer by re-imposing the wearing of the purple stripe. The Duke of Northumberland was supported by Viscount Chelmsford and the Earl of Selborne, the latter remarking that the point of view of the engineer officers had been recapitulated by Engineer Rear-Admiral Sheen in a letter in the *Times* of June 1, and to that he had seen no answer. Moreover, the Order might do great harm and could do no possible good. Viscount Chelmsford said that the question had arisen when he was First Lord and he had left a personal note for his successor, Mr. Bridgeman, to the effect that there had been no acute demand for the change, and that the system as it then stood was working well. The Duke of Montrose also spoke. He seemed to think that because purple had been worn by emperors, engineers should not object to it. The answer to that is, of course, that it is the way it has been imposed and what it signifies that renders it so distasteful. With his suggestions that engineer officers should have executive command of certain establishments ashore and that an engineer officer should be appointed a Sea Lord of the Admiralty a good many will agree.

THE reply for the Admiralty was made by Earl Stanhope, who repeated Mr. Bridgeman's assurance that the Order did not affect the ranks, titles, and powers of engineer officers. That, however, is not correct, for the Order does undoubtedly take away the power of engineer officers to rise to certain high appointments which they could have reached as executive officers. Earl Stanhope said that the Order was designed to sweep away an anomalous position, and divided all officers into categories according to their duties. He did not say, however, why there should be three categories of engineer officers—one for the main machinery, one for the gun machinery, and one for the electrical machinery, while navigating, gunnery, and torpedo officers all remained in one category. Such a reply will give no satisfaction in engineering circles, and does nothing towards removing that sense of injustice from which engineer officers are suffering. In view of the apparent determination of the Admiralty to stand by this Order and to impose the purple stripe, we think the Joint Committee of the Engineering Institutions, of which Sir William Ellis is chairman, would do well to issue a short plain statement of the matter as it now stands. The excellent memorandum issued some months back was too long for general distribution, and in the highest interests of Great Britain this is a matter for the widest publicity.

ON July 22 the centenary occurred of the death of Guiseppe Piazzi, the discoverer of the first of the minor planets. Piazzi was born in the north of Italy in 1746, and came under some of the most distinguished teachers of his day. He then entered the monastic order of the Theatines. A professor first at Genoa and then in Malta, in 1780 he was appointed to a chair of mathematics at Palermo. His efforts to found an observatory there were seconded by the Viceroy of Sicily, Prince Caramanico, and the observatory was opened in 1791. Piazzi meanwhile had studied Lalande's methods in Paris and Maskelyne's at Greenwich, and when he returned to Palermo in 1789 he had among his instruments a 5 ft. vertical circle by Ramsden. He devoted himself to the preparation of star catalogues, and it was while pursuing this work that in January 1, 1801, he discovered Ceres, named thus in allusion to the titular goddess of Sicily. He communicated his discovery in the first place to Oriani, who calculated the elements of its orbit, and then to Bode. Piazzi's star catalogues were published in 1803, 1807 and 1814, the latter containing 7646 stars. He served for some time as president of the Academy of Sciences of Naples, and was elected a foreign member of the Royal Society of London. By his will he bequeathed his library and instruments to the observatory at Palermo, and left an annuity for educating students in astronomical science.

THE news of the impending retirement of Prof. J. A. Fleming from the chair of electrical engineering at University College, London, a position which he has occupied since its foundation in 1885, will be received with regret by the large number of friends and students who have come under his influence. His tenure of office has been practically co-extensive with the growth of modern electrical engineering, a development in which he has taken a great part. So early as 1879 he was the scientific adviser of the original Edison Telephone Company of London, and in 1882 he was appointed to a similar position with the Edison Electric Light Company of London, taking part in the establishment of the first electric supply stations. In 1890 he acted in the same capacity for the London Electric Supply Corporation, formed to operate the Ferranti system of high voltage electric supply, using single-phase alternating current. In 1899 he was retained by Marconi's Wireless Telegraph Company to advise on the engineering work in connexion with the establishment at Poldhu of the first high power radio station in the world. Prof. Fleming has thus been in intimate touch with the early development in Great Britain of the three important electrical inventions: the telephone, the electric incandescent lamp and radio communication. During the forty-one years of his teaching work at University College, about 2000 students have passed through his department, many of whom have since achieved great distinction, there being among them three who have become presidents of the Institution of Electrical Engineers. His interest in general education has shown itself in the prominent part which he took in the work which led to the foundation of the Morley Memorial College.

PROF. FLEMING's original contributions to knowledge are comprised in rather more than a hundred papers published in the transactions of various learned societies and covering such matters as the direct reading potentiometer, the investigation in conjunction with the late Sir James Dewar of the electric and magnetic properties of matter at low temperatures, a paper read before the Institution of Electrical Engineers in 1885 on the necessity for a National Electrical Standardising Laboratory, which gave the first impulse to the movement that resulted in the establishment of the National Physical Laboratory, and the invention of the thermionic valve, which in its modernised form is the essential element in radio communication. He is the author of a large number of very widely known text-books on electrical subjects. He was elected a fellow of the Royal Society in 1892 and received the Hughes Medal of the Society in 1910. The Royal Society of Arts awarded him its Albert Medal in 1922, especially for his invention of the thermionic valve. The Institution of Electrical Engineers has awarded him its Institution premium on two occasions, and made him an honorary member in 1923. His membership of other societies includes that of the Society of Engineers of London, the Glasgow Philosophical Society and honorary membership of the Royal Engineers' Institute, Chatham. Prof. Fleming's great gift of clear exposition and successful experimenting has created for him a special place as a public lecturer, as the audiences whose attention he has held on very many occasions at the Royal Institution have testified. He carries with him into his retirement the sincere good wishes of a large circle of friends, colleagues and students.

IN his address to the tenth annual meeting of the Association of British Chemical Manufacturers, held on July 8, Mr. D. Milne Watson, the chairman, dealt with recent activities of the Association and certain topical events, such as the coal strike, from the point of view of the chemical manufacturer. The British chemical industry may be comparatively small, yet it is advancing: during the decade 1911–21 the number of persons engaged in it increased from 0·81 to 1·15 per cent. of the total number of occupied persons in the country. Although rather jaded with fairs and exhibitions, the Association has supported the revived British Industries Fair; the view is held that chemical firms should not, as a rule, exhibit individually or indiscriminately, but unitedly as an industry at selected exhibitions. Whatever views may be held on the policy of protection, there is no doubt that the careful survey of an industry prior to legislating, such as was recently carried out in connexion with the extension of the Safeguarding Act to the fine-chemical industry for a further period of ten years, is very stimulating to the industry; on the other hand, care is needed to prevent a protected industry from becoming lethargic.

REFERENCE was also made in Mr. Watson's address to the harm done in recent years by viewing the dyestuffs industry through magnifying glasses. This industry suffers from fierce competition abroad, and from an excess of plant left over from the War. The contention that it has a secure home market is only a half-truth, for security is only given when a dyestuff is equal in quality to a competing foreign one, and when it is sold at a price which does not place the user in an unduly disadvantageous competitive position. Consolidation of interests, such as has been effected between Scottish Dyes, Ltd. and the British Dyestuffs Corporation, and between British Synthetics, Ltd. and the British Alizarine Co., is advisable and should be extended; and the lines upon which industrial development is proceeding in other countries must be studied with the view of introducing changes in the organisation of British chemical industry. The council of the Association does not see how it can take any effective or direct part in negotiating a settlement of the coal strike, but it is co-operating to that end with other industries under the ægis of the Federation of British Industries. So far, chemical manufacturers have been able to maintain stocks and to meet all demands. The fact that during the general strike only a very few employees in the chemical industry left their work is ascribed to the cordial relations which have always subsisted between masters and men, and to the circumstance that the men are for the most part really interested in their work.

IN the discussion on the chairman's address, Dr. E. F. Armstrong emphasised the need of more effective co-operation among home-producers, and also the undesirability of building up sections of the industry "which are strong because they are members of international groups, in which the British voice varies in loudness." All indications point to foreign competition becoming more fierce. The Right Hon. J. W. Wilson referred to the magnitude of the German Interessengemeinschaft and to the even greater combination in the iron and steel industry; although the United States will probably follow suit, this line of development is not in accordance with the British temperament. Dr. G. C. Clayton, M.P., has noted the increased attention paid by the House of Commons to chemical matters, while the Government is showing considerable interest in the Department of Scientific and Industrial Research. He regards recent results obtained in the Fuel Department as hopeful, and thinks that before long an economic process for recovering the valuable products from coal and for producing smokeless fuel will see the light of day. The Germans claim that they have overcome most of the difficulties in producing liquid fuel direct from coal; we in Great Britain are not very far behind them, if, indeed, we are not actually in front.

THE annual meeting of the Society of Chemical Industry and Congress of Chemists, in which a number of societies with related interests are co-operating, opened on Monday, July 19, and in the afternoon the Messel Memorial Medal was presented to Lord Balfour by the Duke of York. After the presentation, Lord Balfour delivered the Messel Memorial Lecture, taking as his subject the relation of the State to science and industry. In tracing the association between science and industry, Lord Balfour referred first of all to the men of genius, moved solely by the desire to add to the store of human knowledge, to whom falls the glory of making fundamental discoveries. This work can be stimulated only by education. The next stage is accomplished by men of constructive ability who can see how the achievements of the scientific worker are to be applied. Then comes the time for testing the results on a scale larger than that of the laboratory experiment, and finally there is the full scale trial which, if satisfactory, means that another piece of laboratory work has been applied to the purposes of industry, and the organisation of production and marketing can proceed. A Government department can do little to further fundamental discovery and should not interfere with the last stages of development, namely, production and marketing. Its assistance should be given, Lord Balfour stated, in the middle region, where industry as a whole rather than one special branch is concerned. There has been no falling-off in the achievements of British men of science or in the business capacity of the leaders of industry, but more co-operation is needed between them, coupled with the broad and imaginative outlook which has been the basis of the great industries in other countries of the world.

IN the course of an address delivered by Sir Robert Hadfield on the occasion of the opening of new metallurgical and engineering research laboratories during the twenty-first anniversary celebrations of the University of Sheffield, the speaker reviewed the history of the University and its predecessors, the Firth College and the Technical School, and of the efforts made to establish educational facilities in connexion with the industries of the city. Although Sheffield had been for many centuries an important centre for the manufacture of steel by the old methods, it was not until the invention of crucible steel by Huntsman in 1740 that it began to assume the leading position which it has occupied ever since. It is remarkable how, the manufacture of steels of specially high quality having once been established, the existence of a skilled body of workers, and of manufacturers accustomed to the trade, favoured the introduction of new processes, so that a large number of important inventions, especially concerning alloy steels, have originated in that city. It is also appropriate that the study of metallography, which may be said to have furnished the scientific basis for all modern metallurgy, should owe its origin to a Sheffield scientific man, H. C. Sorby, a pioneer in so many branches of science. The new laboratories are equipped for the investigation of metals, and particularly of steel, by modern physical methods, in view of the remarkable results which have been attained by the application of exact physical measurement and by the study of physical properties in the improvement of metallurgical operations.

SIR ROBERT HADFIELD'S address contains statistics concerning the work of Sheffield firms during the War, when the great armament plants were largely increased and enormous quantities of munitions were produced. Statistics as to present employment show the number of employed persons to be about 184,000, of whom, roughly, 42,000 are engaged in the iron and steel industry and 21,000 in cutlery, to name the two occupations most usually associated with the city. The importance of education and training for these industries is therefore obvious, and the University has set itself to meet the needs of the local population, whilst at the same time becoming a centre of post-graduate study and research. In view of the situation on the South Yorkshire coalfield, the study of coal also assumes great importance, and the Fuel Department of the University has been specially equipped for research on the utilisation of coal. One of the urgent needs of the industry is the greater application of electrical power, and interesting facts bearing on this subject are quoted by the author. Even with the existing comparatively high cost of electric power, its use in the steel industry has assumed vast dimensions.

THE fifth Hurter and Driffield Memorial Lecture was delivered by Prof. Charles Fabry before the Royal Photographic Society on April 20 last, and is published, with illustrations, in the July issue of the Society's journal. Prof. Fabry took as his subject "The Photographic Plate as an Instrument for the Measurement of Visible and Invisible Radiations," and passed in review probably all the useful methods of photographic photometry, indicating their respective advantages, difficulties, and limitations. The use of polarisers for varying the intensity of the incident beam is excellent when the light is not partially polarised, but the layer of Canada balsam present in most polarisers is absolutely opaque to ultra-violet radiations of wave-length less than 3400 Å.U. Beyond this the balsam may be replaced by air, but this gives a small angular field. Prof. Fabry adds, "I have, however, used Glan prisms with success." When working in the ultra-violet region in conjunction with M. Buisson, it was found that the stripped gelatine film (glass being inadmissible because of its absorption) of a developed plate gave a sudden diminution of its absorptive power, transmitting about twelve times as much light at 3150 Å.U. as at a little distance on either side of this point, due to the transparency of metallic silver for radiations of about this wave-length. This difficulty was overcome by intensifying the plate with mercuric chloride and ammonia before stripping. Schumann plates are not suitable for photometric purposes because of the irregularities following from the difficulties of their manufacture, but the 'oiled plate' introduced by Duclaux et Jeantet is spoken of as perfectly suitable. A thin layer of mineral oil put upon the plate fluoresces in the ultra-violet and the fluorescent light affects the plate. An illustration shows the effect with and without the oil for wave-lengths from about 2816 to 1854 Å.U. Prof. Fabry urges the desirability of founding one's photometry on the energy (or heating power) of radiations, as this is " the only real measure of the intensity of a radiation." " Two rays which appear equal with a certain exposure may seem to be absolutely different if a longer exposure is given "

A SERIES of postcards depicting objects of scientific interest preserved in or connected with the Old Ashmolean Museum has recently been issued by the Oxford University Press. The collection comprises a set of designs representing the Old Ashmolean at different dates, including a reproduction in colour of a print by Rowlandson (1809). Another set, devoted to the Dodo, begins with an excellent coloured copy by Mrs. Gunther of the well-known picture in the Sloane Collection, and is continued by De Bry's representation of the landing at Mauritius in 1598, by the drawings of Clusius and Savery, and by photographs of the head still preserved at Oxford. An interesting series of portraits starts with Richard of Wallingford, Merton College (1292–1336), the first describer in detail of the making of scientific instruments, and ends with John Evelyn, Balliol College (1620–1706). Other notable portraits are those of Robert Recorde, All Soul's College (1510–1548), the inventor of the mathematical signs of multiplication and equality, Robert Boyle, Elias Ashmole, Christopher Wren, and John Wilkins, the last two of Wadham College. In a set representing the history of medicine occurs a drawing by Christopher Wren of the base of the brain, which for exactness of detail could scarcely be bettered at the present day.

SINCE the quantum theory of spectrum emission was started on its career by Bohr in 1913, the stream of contributions by workers in all parts of the world has been almost unparalleled in its volume and variety of character. The, as yet, semi-empirical character of the whole conception gives the widest possible scope to speculation and the formation of arbitrary practical rules, and such rules have for some time been put forward at too rapid a rate for the controlling factor of experiment to separate the false from the true. The subject has consequently become so intricate and so charged with ideas, many of which are incompatible with one another, that the experimenter who has wished to obtain a clear idea of what is being proposed has had no time left for his experiments. In particular, the notations and numerical values assigned to the various 'quantum numbers' now recognised are almost as numerous as the writers on the subject, and the resulting confusion, which is largely unnecessary, has been a serious hindrance to the acquiring of definite ascertained knowledge. The appearance of a new *Bulletin* of the National Research Council of the National Academy of Sciences, Washington, on " Quantum Principles and Line Spectra," by J. H. Van Vleck, assistant professor of physics in the University of Minnesota (Washington, D.C., National Academy of Sciences, 1926, 3 dollars), in which the many-sided activities of theoretical workers are ably summarised and compared with one another, is therefore an event of great importance. Duplication of Sommerfeld's " Atombau und Spektrallinien " has been avoided so far as possible, and particular prominence is given to the methods of approaching the subject which are suggested by Bohr's correspondence principle. The volume has been brought up-to-date during passage through the press by the insertion of numerous footnotes, and may really be said to be invaluable to the large body of workers in spectroscopy. The author is to be commended on the clearness of his exposition. Each sentence has usually only one possible meaning—a characteristic which is far too rare in many of the original papers on the subject.

ROTHAMSTED Experiment Station appears to have made a new departure in the issue, in very attractive form and under the general title of " Rothamsted Conferences, I.," of an account of a recent discussion at Rothamsted upon the growing of lucerne. This little memoir is extremely effective. The case for a further cultivation of lucerne in Great Britain is first presented by Sir John Russell and members of his staff. Experience with lucerne is then given by members of staff from various experiment stations, by private growers, by big seedsmen, etc. Lord Bledisloe, Parliamentary Secretary to the Ministry of Agriculture and Fisheries, and Lord Clinton, chairman of the Lawes Agricultural Trust Committee, contribute, as also Mr. Dampier Whetham of the Royal Agricultural Society Research Committee. This committee has helped financially Mr. H. G. Thornton's experiments upon inoculation by *Bacillus radicicola*. A summary of points collected at the conference follows upon the discussion and makes a very clear presentation of the main case for lucerne growing. It appears that lucerne has often been a failure because British soils are not infested with the strain of the nodule nitrogen-fixing organisms necessary for its healthy growth. Mr. Thornton's field trials suggest that the difficulties in the way of successful inoculation often met with in the past are now overcome and lucerne then deserves a more extended trial. It will not grow on ill-drained or shallow soil, and probably requires a fair supply of lime; it must be sown on clear land and the weeds kept down by suitable cultivation. Given these conditions, it is apparently one of the most valuable of arable crops, and adds to the fertility of the soil, permitting a more intense farming. It gives each year after the first year usually two good hay cuts and a green aftermath for cutting or grazing.

THE Council of the Royal Meteorological Society has awarded the Howard Prize for 1926 to Cadet B. W. Harman, of H.M.S. *Worcester*, for the best essay on "The Causes and Distribution of Fog in the North Atlantic."

DR. W. H. GIBSON has been appointed Director of Research for the Linen Industry Research Association in succession to Dr. J. Vargas Eyre. Dr. Gibson was educated at University College, London, under Sir William Ramsay, and afterwards spent twelve years at the Research Department, Royal Arsenal, Woolwich; for his services in connexion with high explosives research during the War he was awarded the M.B.E. in 1918 and the O.B.E. in 1920. For the last seven years he has been in charge of the Research Department of a prominent linen firm in Belfast.

EXCAVATIONS on prehistoric sites in the Crimea are about to be commenced under the auspices of the Russian State Academy for the History of Material Culture by G. A. Boutch-Osonolovsky. The first site to be attacked is the Kik-Koba cave, where it is hoped may be discovered missing parts of an early human skeleton already found. Exploration will then be extended to the hill caves of later palæolithic age in continuation of the investigations which were begun in 1924.

IT is stated in *Science* that, at the annual meeting of the Geological Society held at Peking on May 3-5, the first presentation was made of the Grabau Medal, founded by Mr. C. Y. Wang for "accomplishment in the field of geological research in China, or for original advancement of the science throughout the world." This first award was made to Prof. Amadeus W. Grabau, who has been largely responsible for the training of an active group of young Chinese geologists and has himself contributed to our knowledge of the invertebrate fossils and palæogeography of China and Central Asia.

THE secretary of the Department of Scientific and Industrial Research announces that a licence, under Section 20 of the Companies (Consolidation) Act 1908, has been issued by the Board of Trade to the British Food Manufacturers' Research Association, which has been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The secretary of this Association is Mr. R. M. Leonard, 22 Buckingham Gate, London, S.W.1. The investigations of the Association will be conducted in close co-operation with those of the British Association of Research for the Cocoa, Chocolate, Sugar, Confectionery, and Jam trades.

PROF. H. H. BARTLETT, Director of the Botanical Gardens of the University of Michigan, who has just been appointed honorary collaborator of the Smithsonian Institution, is about to make collections of the flora of Sumatra and Formosa for the Smithsonian Institution and the University of Michigan. The flora of Sumatra, which is exceptionally rich from the scientific point of view as well as economically important, is poorly represented in the United States collections. During a year previously spent in studying the rubber-producing plants of Sumatra, Prof. Bartlett's attention was attracted to the folklore of the poorer Malays, and especially to their custom of writing beliefs, legends, and descriptions of the magical and medicinal properties of plants on the internodes of green bamboos which are afterwards dried and preserved. This folklore has received little attention hitherto. Prof. Bartlett proposes to devote some part of his time to the study of it as well as the language during his stay in the island.

REFERRING to the review entitled "Eugenic Reform" in NATURE of July 10, p. 39, Mrs. C. B. S. Hodson writes stating that her share in Major Leonard Darwin's book "The Need for Eugenic Reform" was confined merely to proof-reading for the detection of printer's errors.

UNDER the title "Instructions to Collectors: No. 7—Blood-sucking Flies, Ticks, etc." (1926: price 6*d*.), the British Museum (Natural History) has issued a fifth edition, revised and enlarged, of a useful illustrated pamphlet. The Museum requires carefully collected and properly labelled material of this kind from practically all parts of the world. Medical men and others who may be willing to help in the collection of specimens will find within its pages full directions for the collecting, mounting, and transmission to England of such material (other than mosquitoes).

MR. E. PICKWORTH FARROW'S book upon the plant life of East Anglian Heaths was recently reviewed in these columns (NATURE, December 19, 1925, p. 896). Based upon the experience of vegetation study recorded in this book, Mr. Farrow communicated a brief article entitled "The Study of Vegetation" to *Discovery*, which is intended to stimulate and, to some extent, to guide the beginner in this fascinating field of inquiry. In an enlarged form this article has now been reprinted as a pamphlet which is published by Messrs. Blackie and Son, Ltd., on behalf of the Coastal Research Laboratory and Bird Sanctuary at Blakeney Point, Norfolk (price 2*s*.). The price of the pamphlet may seem a little high, but all proceeds from its sale go towards the maintenance of this well-known centre of ecological research, now under the National Trust.

THE Fuel Research Board of the Department of Scientific and Industrial Research has just issued a further pamphlet in the series of the Physical and Chemical Survey of the National Coal Resources. This pamphlet, No. 6, is the fourth dealing in detail with one of the seams of the Lancashire Coalfield, the present one being devoted to the King Seam; sections of the coal in various parts of the coalfield are given as it happens to vary a good deal both in thickness and in quality, the latter point being brought out by analyses of the coal from a number of points in the coalfield. This pamphlet is on precisely similar lines to those previously published, and gives a mass of valuable information concerning the coal seam under discussion.

MESSRS. J. J. Griffin and Sons and Baird and Tatlock have issued a joint catalogue, No. 50, of scientific apparatus mainly for physics It is well printed and bound and has 735 pages, 14 of which are devoted to the index. In the section on light, an X-ray spectrograph, neon lamps, and a number of new optical benches are described. Under electricity, several new forms of galvanometers, resistance boxes, selenium cells, and electric furnaces are to be found.

THE latest catalogue (New Series, No. 19) of Messrs. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2, deals with upwards of 3000 works relating to astronomy, classified as follows: History, biography, bibliography; origin and development of astronomy from Aristarchus to Sir W. Herschel; periodicals, publications of societies and observatories; elementary works, treatises, dictionaries; spherical and theoretical astronomy; celestial mechanics; practical astronomy; spectroscopy, solar and stellar spectra, photometry, photography; astrophysics, cosmogony; the sun, transits, sunspots; eclipses; Mercury, Venus, minor planets; the earth; the moon; Mars; Jupiter; Saturn, Uranus, Neptune; comets and meteors; stellar astronomy; double and multiple stars; variable stars, red stars and nebulæ, clusters, Milky Way.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Demonstrators in civil and mechanical engineering in the University of Leeds—The Registrar (July 28). An assistant lecturer in philosophy at the University College of Wales, Aberystwyth—The Secretary (August 3). An assistant in the department of physics of University College, London—The Secretary, University College, Gower Street, W.C.1 (August 7). A lecturer in biology and chemistry at the Municipal Technical College, Swansea—The Director of Education, Education Office, Dynevor Place, Swansea (August 9). A chemical pathologist and lecturer on chemical pathology (jointly) at St. Bartholomew's Hospital Medical College—The Dean of the College, E.C.1 (August 16). A professor of music at the University College of Wales, Aberystwyth—The Secretary (August 25). A lecturer in moral philosophy in the Queen's University, Belfast—The Secretary (August 31). An assistant master at the Kingston-upon-Thames Technical Institute, to teach engineering workshop practice—The Principal.

Our Astronomical Column.

KOPFF'S PERIODIC COMET.—This short-period comet was discovered by Kopff in 1906, and was detected again after two revolutions in 1919. It passed perihelion last January, when ephemerides were published in the *B.A.A. Handbook* and elsewhere. However, the comet was then badly placed for observation, being nearly behind the sun; it escaped observation for six months after perihelion. Prof M. Wolf succeeded in photographing it on July 13 at $1^h\ 52^m$ U.T. in R A. $1^h\ 17^m\ 12^s$, N. Decl. 18° 14′, the magnitude being 16. The observation indicates Jan. 27·15 as the date of perihelion. The other elements are taken from the *Handbook*:

ω	19°	43′	29″	log q	0·232113
Ω	263	55	10	e	0·51422
i	8	41	30	Period	6·5842y

The comet is probably only observable with large reflectors; the following ephemeris is for 0^h U.T.:

	R.A.	N. Decl.	log r.	log Δ.
July 26.	$1^h\ 27^m\ 48^s$	19° 55′	0·3680	0·3060
Aug. 3.	1 32 24	20 47	0·3761	0·2949
11.	1 35 33	21 31	0·3839	0·2828
19.	1 36 48	22 3	0·3917	0·2715

THE CONSTITUTION OF THE INTERIOR OF THE EARTH.—Dr. H. Jeffreys read a paper on this subject at the June meeting of the Royal Astronomical Society which is printed in vol. 1, No. 7, of the Geophysical Supplement of the *Monthly Notices, R.A.S* It has hitherto been supposed that the rigidity near the earth's centre is very great, but since it was discovered that secondary seismic waves are (apparently) not transmitted through this region, Dr. Jeffreys reinvestigated the data for rigidity in the interior, including that based on the tides, and finds that they are quite consistent with the interior being composed of liquid iron, possibly with an admixture of nickel. The depth of the outer boundary of this liquid core is given as 2900 km. or 0 455 of the radius, this being the surface of discontinuity of seismic waves found by Gutenberg. Though mainly geophysical, the paper has also an astronomical bearing.

LARGE SOLAR PROMINENCE.—The recent appearance of a very large prominence has been reported by Mr. Newbegin observing with his solar spectroscope at Sutton. On July 16 at $10^h\ 25^m$, it extended 40° around the sun's west limb—from position angle 276° to 316°—and its height was then 85 seconds of arc. Probably it is the largest prominence observed as yet during the present cycle. Its character was of 'massive' formation and quiescent in type. An amount of fine detail is indicated by Mr. Newbegin's sketch, the prominence appearing to be composed of a number of tree-like structures rising at more or less equal distances from the chromosphere and connected together by branching filaments.

As a class, the large massive prominences last for some time—frequently for several weeks—and although usually found within the sunspot zones they are rarely, if ever, seen above a spot. In the present instance there was no spot in the vicinity, but there were faint patches of faculæ which were the remains of the extensive area connected with the great spot of December and January last. Indeed, the position of the prominence, at least for a portion of it, is almost identical with that of this spot. The mean position of the spot during its two transits in December and January was longitude 32°, latitude 22° N. Allowing for the average polar retardation at latitude 22°, the longitude of the place originally occupied by the spot was 0° on July 16, while the longitude of the sun's western limb on the same day at the time of Mr. Newbegin's observation was 2°.

Spectroheliograms showing disc markings and limb phenomena have doubtless been secured at several observatories equipped with spectroheliographs and should give additional information of great value as to the life-history of this large prominence, which is evidence of a recrudescence of activity in the chromosphere above an extinct sunspot. It may be added that no unusual magnetic disturbance has recently been recorded in this connexion.

Research Items.

Effects of Mental Work.—A paper of great interest on the changes which take place in the metabolism of the body during severe mental work has been published by Prof. V. Suk of the Masaryk University, Brno, Czechoslovakia (*Bull. internat. de l'Acad. des Sc. de Bohême*, Nov. 20, 1925). Prof. Suk took the following three groups of students: Group 1—29 men undergoing physical training in a teachers' college; group 2—31 members of the highest class in a *gymnasium* working for final examinations; group 3—31 members of another class also working for examinations. He kept these three groups under observation for three months, keeping a record of the amount of hæmoglobin and of sugar in their blood. There was a slight increase on the percentage of hæmoglobin in those undergoing physical training while that in the brain-workers remained stationary. On the other hand, while the blood-sugar remained stationary in those who exercised their bodies, there was a fall of 36-38 per cent. in the sugar content of the blood in the brain-workers. Severe and prolonged mental toil, therefore, does interfere with the carbohydrate metabolism of the body. The exact mechanism by which the nervous system produces this change is not apparent, but it may be through an effect produced in the functions of the liver. It is well known that brain-workers are particularly liable to colds and other infections, and Prof. Suk suspects that this liability may arise from the reduction of their blood-sugar.

The Chancelade Skull.—In *Annals of Eugenics*, vol. 1, Parts 3 and 4, Mr. G. M. Morant compares, by means of modern statistical methods, the craniometrical features of the skull found in 1888 by Féaux and Hardy near Raymonden, Chancelade, with those of Fürst and Hansen's series of Greenland Eskimos. He concludes, in agreement with the suggestion of Testut, and contrary to Keith's recent verdict (*Man*, 1924), that the Magdalenian skull is not more removed from the mean type of the modern inhabitants of Greenland than many individuals picked at random from that population are likely to be. In accordance with the view that the Chancelade individual was closer to the Eskimo than to the modern English, he sees justification for assuming that, in the Magdalenian period, a race of hunters existed in southern Europe, which migrated northwards following the reindeer, or was pushed to the fringe by other and invading races. Excellent photographs, taken with a telephoto-lens to reduce distortion, accompany the study.

Pottery from Chancay, Peru.—A further study of the Uhle Collections of Peruvian pottery in the University Museum appears as vol. 21, No. 7, of the *University of California Publications in American Archæology and Ethnology*. Mr. A. L. Kroeber now describes the pottery from Chancay which was obtained by Dr. Uhle in graves on five sites described in his field notes, part of which form an appendix to the present publication. Five successive styles are represented: black-on-white, a style known as that of Chancay and the latest in date; three-colour geometric, epigonal (three and four colour), white-on-red, and the interlocking style. White-on-red is a hitherto undescribed style which is definitely Central Peruvian. The interlocking type, of which the most common design has the typical outline of complementary animal heads with worm-like bodies having serrated edges, is undoubtedly textile in origin. Certain vessels present affinities with the Proto-Nasca of Ica, and, further, round lumps of adobe characteristic of Proto-Nasca construction were also found with the Chancay burials. Dr. Uhle has demonstrated the relation of Ica in the north and Truxillo in the south. Notwithstanding the wide geographical separation of the two styles, Chancay, lying half-way between the two, appears to bridge the gap by a civilisation of the same general character, and suggests a cultural stage all over Peru at a remote epoch antedating Tiahuanaco. The importance, undoubtedly religious, of this design was indicated by the discovery of a painted wall belonging to a small terrace building on an artificial base. The wall was 23 m. long and 1·6 m. high at its best-preserved part, and was painted in four colours with outlines of the textile design.

The Fox Indians.—The fortieth annual report of the Bureau of American Ethnology (1918–19), which has just been issued, contains, in addition to the report of the chief of the Bureau, five accompanying papers by Dr. Truman Michelson based upon material gathered fourteen years ago and supplemented by later information dealing with the Fox Indians of Iowa. Each paper is a Fox text written out in the current syllabary by one of the Indians and afterwards phonetically restored, accompanied by an English translation and ethnological and linguistic notes by the author. The first paper deals with the mythical origin of the White Buffalo dance, and contains, in addition to the information about Fox ritual, some interesting data bearing upon changes in custom and the social and religious outlook of the Indians. The reverent observance of religious rites still to be found among the older men is no longer characteristic of younger generations, who attend the dance purely for social purposes and to get something to eat. A note on mortuary customs and beliefs is important for its detail and for the light it throws on observances in connexion with behaviour after death of a husband or wife and remarriage. Of the remaining three papers, two deal with Fox religious societies, and the third, an autobiography of a Fox woman, is unique. It begins with her earliest recollections, and from her eighth year gives particulars of her introduction to the various household duties which fall upon the woman in the Indian family. At nine years she helped her mother in the planting; at ten in washing clothes and cooking, and in cutting and gathering wood; at eleven she learned to make bags, and so on. One of the most interesting features of the story is the importance of the mother's brother, which becomes especially marked after marriage, when the father ceases to function in relation to his daughter and his place is more than taken by the uncle. For example, the uncle advises his niece as to her behaviour after divorce, and when her husband dies instructs her in the mourning ceremonies and the observances which secure release from the death ceremonies. Apparently this function of the maternal uncle has nothing to do with matrilinear descent, and cannot be regarded as a survival of that system, though the Foxes are now patrilineal.

The Alimentary Canal of Scorpions.—In the current issue of the *Quarterly Journal of Microscopical Science* is a detailed account by Prof. E. N. Pavlovsky and Prof E. J. Zarin of their studies on the structure and functions of the various parts of the alimentary canal of scorpions. The authors have not been able to investigate the physiological properties of the maxillary glands, which it is believed may produce a proteolytic ferment. The food—the juices and muscles of arthropods and of earthworms—passes into the stomach of the scorpion, where it is acted upon by pepsin, trypsin, chymosin, and lipase. The mid-gut of scorpions is of insignificant volume as compared with the cavities of the liver tubules, and it is evident that the latter are of the greatest importance. They contain two kinds of cells, secretory cells, producing ferments which act on proteins, fats, and carbohydrates, and absorptive cells. The authors suggest that the liver also plays a part in excretion, the presence of brown granules in its cells being cited as evidence. The intestine appears to play little or no part in the digestive processes.

LUMINOUS FISHES AND CEPHALOPODS OF THE MEDITERRANEAN.—Number 9, vol. 2 (Biology), A. 12, of the report of the Danish Oceanographical Expedition, 1908–10, to the Mediterranean and adjacent seas includes an extremely interesting account of the Mediterranean Sternoptychidæ by P. Jespersen and Å. Vedel Tåning (Copenhagen: Andr. Fred. Høst and Søn, 1926. 35*s*.). In their study of these peculiar luminous fishes, much light is thrown on their breeding, life-histories, and migrations. Many of these fishes tend to move to a greater depth with increasing age, the adults often occurring naturally at a depth of more than 1000 metres, whereas the post-larvæ are found much higher up. The photophores in this group are important as a means of classification, but in many of the genera these do not appear until late in post-larval life or after metamorphosis, and there is often an enormous alteration in general appearance and also a great reduction in length, as, for example, in *Ichthyococcus ovatus*. Dr. Degner's important monograph (C. 1), which is also included in No. 9, vol. 2, of this report, on the cephalopods deals also with a group which in many forms is luminous, but in this case comparatively few are from great depths. The majority occurred between the surface and a depth of 65 metres, and mainly belonged to the Decapoda. A single specimen of an adult Argonauta was obtained in the Mediterranean and one of Spirula just outside, close to Gibraltar. Many young forms of various species were taken and a few new species are described, including *Mastigoteuthis Schmidti* and *Desmoteuthis Thori*, both from waters of 2700 metres depth.

AMPHIPODS AND DIATOMS FROM THE DANISH OCEANOGRAPHICAL EXPEDITION.—In Number 9, vol. 2 (Biology), D. 5, of the report of the Danish Oceanographical Expedition, 1908–10, to the Mediterranean and adjacent seas (Copenhagen: Andr. Fred. Høst and Søn, 1926. 35*s*.); Dr. K. Stephensen finishes his account of the Hyperiidea-Amphipoda, of which Parts 1 and 2 have already appeared. A large portion of the present work is taken up by the valuable synopsis of the Hyperiidea in which the Mediterranean species, eighty in all, are fully discussed. The author finds that there do not seem to be any species endemic to the Mediterranean, nearly all being found also in the Atlantic, and there seem to be scarcely any differences between specimens from the two areas. The Hyperiidea are almost exclusively oceanic, and many are found over great depths, some never rising above a 300-metre level; but of these deep-water forms few enter the Mediterranean. The species found there belong almost exclusively to the surface layers. Prof. Pavillard, in the same volume (J. 4), gives an interesting account of the planktonic diatoms which in these regions are really fairly well known, and his investigations show few new species but much new matter as regards distribution. The absence or great rarity in the Mediterranean of certain species common and well known in the English Channel and outside is striking. Thus *Hyalodiscus stelliger* apparently does not occur, *Paralia sulcata* is very rare, and *Thalassiosira gravida* is replaced by *T. rotula*. The summaries of the larger genera such as Chætoceros, Rhizosolenia, and Coscinodiscus are instructive and helpful, and as an up-to-date guide to pelagic diatoms the whole work is extremely valuable.

MICRO-ORGANISMS IN INDUSTRY.—In his presidential address to the Royal Microscopical Society, Mr. A. C. Chapman gave an account of some of the Fungi imperfecti—torula, mycoderma, ooidia—and their activities (*Journ. R. Micr. Soc.*, vol. 46, Part 1). He referred to a yeast-like organism, isolated by Prof. Lindner of Berlin in 1916 from the sap which had exuded from a birch tree, which was able to grow freely on the surface of carbohydrate solutions containing ammonium salts and to form a thick greasy film. This film when separated and dried was found to contain 18 per cent. of fat, 31 per cent. of crude protein, and 43 per cent. of carbohydrates, so that, given a cheap source of carbohydrate and ammonium salts, it was evident a food product rich in fat and protein could be produced in large quantity. Mr. Chapman isolated a similar organism in 1917, and reports that the product of its activity contained about 50 per cent. of crude protein and up to 10 per cent. of fat, and that when pressed it formed cakes having the odour and flavour of cream cheese. He points out that if an efficient biochemical process were discovered for the conversion of cellulose into sugar, the production of a synthetic food product on a large scale would become practicable perhaps even under peace conditions. He quoted a sentence from a lecture which Hayduck delivered in Berlin in 1916—"when we can convert our evening papers into sugar so rapidly that we are able the following morning to eat the albumen prepared therefrom, then indeed we shall have solved one of the greatest problems of the century." Mr. Chapman advocates the founding of a National Institute of Industrial Microbiology for research on micro-organisms which play an important part in industry, for the training of teachers of microbiology, and for maintaining a collection of pure cultures of micro-organisms for industrial purposes.

AUSTRALIAN RIVER BASINS.—A map of Australia, showing the extent of the drainage areas of the various rivers, has been published by the Bureau of Meteorology of the Commonwealth of Australia. The positions of river gauges and flood report stations are also shown. The map should prove useful in connexion with the flood warning service of the Bureau. In times of heavy rainfall, it will facilitate the issue and distribution of flood warnings to the districts concerned. The map is on the scale of 200 miles to an inch and a half.

THE CLIMATE OF HELWAN.—A discussion on the above by Mr. L. J. Sutton, Director of the Egyptian Meteorological Service, has been issued by the Ministry of Public Works, Egypt, as Physical Department Paper No. 20 (Government Publication Office, Cairo, price P.T. 10). The present report deals with the observations of the years 1906–20, and fifteen years are said to be probably sufficient in a climate like that of Helwan to give a fair representation of a true normal, except perhaps for rainfall. The scheme for the report was commenced by Mr. Knox-Shaw, but, owing to his appointment as Radcliffe Observer at Oxford, the work of preparing the report was handed to Mr. Sutton. The climate of Helwan is essentially of the Saharan desert type. There is a short winter, December to February, when the nights are cold, averaging 9° C., and the days comparatively warm, averaging about 20° C. The temperature never falls to the freezing-point, the lowest ever recorded being 1·6° C. Nearly 8 hours of sunshine are enjoyed each day, and normally there are only 3 days of rain in each of the winter months, but sometimes thunderstorms occur with heavy rain. Summer commences in June and lasts until the end of September; from June to August there are more than twelve hours of sunshine a day, the temperature reaches 35° C. on the average during the daytime and falls to about 21° C. at night. In the early part of summer, temperatures of 40° C. are not uncommon, and on two occasions a temperature of 46° C. (115° F.) has been recorded. The summer is rainless, and there is scarcely any rain from May to October. Tables and diagrams with detailed accounts are given of all the meteorological elements. The work adds much to our knowledge of weather conditions in this part of the globe.

WEATHER AND AGRICULTURE.—Responsible United States officials engaged in the Weather Bureau, the Bureau of Agricultural Economics, and the Forest Service have co-operated in producing a discussion, No. 918, published by the United States Department of Agriculture (Washington: Government Printing Office, price 20 cents). It is asserted that so early as 3000 years B.C. man was a tiller of the soil and gathered a harvest. Since then the history of agriculture and the weather has been contemporaneous with that of civilisation itself. The development of agricultural education such as the establishment of agricultural colleges and experimental stations is dealt with. The influence of the weather and especially the control of weather by cyclones and anticyclones is referred to and the adjustment of agriculture to climate, soil condition and topography Maps are given showing the distribution of rainfall over the globe, and the natural vegetation, and also air isotherms over the world for January and July. Referring to the rapidly increased population in recent times, the unoccupied arable land of the world has become gradually occupied until to-day very little remains in regions with healthful climates. It is stated that the United States, with only about 5 per cent. of the world's population, produces one-seventh of the world's cattle, one-fifth of its wheat, and three-fourths of its corn. Rainfall and crop growth is gone into with considerable detail, also the temperature influence on crop distribution. It is asserted that where climate and other conditions permit of mixed farming, the weather hazard is very much reduced. Many matters such as weather and the railroads and details intimately associated with salving the crops are of much interest.

METEOROLOGY AND GEOPHYSICS IN POLAND.—In Communications Nos. 1-18, Institut de Geophysique et de Meteorologie de l'Université de Lwów, Prof. H. Arctowski and eight collaborators publish a series of papers on meteorological, astronomical, and geophysical subjects. Eight papers contain discussions of temperature variations observed during the years 1910–1919 at Arequipa and at a number of widely separated stations. These temperature variations are employed to show the distribution and movement of "thermo-pleions" (areas of positive departure of temperature from the normal) and "anti-pleions" (areas of negative departure) in Egypt, Hawaiian Islands, India (the Deccan), New Zealand, Peru, Philippine Islands, Russia, and Scandinavia. The agreement between the Arequipa or standard type of thermo-pleionian fluctuation and that prevailing in the Deccan is found to be particularly striking during the ten years of observation. Four other papers deal with pyrheliometer observations During 1924 a number of these observations were made by three different methods at Pozyzewska (altitude 1406 metres) in the eastern Carpathians for the purpose of finding a suitable site for a solar observatory. The remaining contributions relate to (1) The dissimilarity of the variation of the frequency of sunspots observed north and south of the sun's equator, and the desirability of considering sunspot statistics for each hemisphere separately, (2) the anomalies in the measurement of rainfall and the exposure of rain-gauges; (3) the determination of the "geothermic" degree from observation of the temperature gradient existing in certain petroleum wells in Poland, and (4) the occurrence of potassium salts in Poland The above series of papers have been published in the *Kosmos*, vols. 46-50, 1922–1925.

MAGNETIC VARIATION IN NORTH AFRICA.—The secular magnetic variations at Tunis, Carthage and Malta are considered by Dr. L Palazzo in the ***Memorie della Pont. Accademia delle Scienze Nuovi Lincei***, vol. 8, 1925. Dr. Palazzo himself made observations of all three magnetic elements at Tunis and Malta in 1890, and has recently repeated the observations. In 1890 he also measured the horizontal intensity at Carthage. In this memoir he summarises other observations available for the three stations, and constructs graphs showing the secular variation of declination, dip and horizontal intensity; for Tunis the graphs extend from 1875 to 1925, in which time the declination has decreased by about 5° to its present value of about 7° 20′ E. The Carthage declination and dip graphs extend from 1820 to 1905, and are in general agreement, as regards secular variation, over the period in common with those for Tunis, as would be expected from the proximity of the stations. The Malta data extend from about 1820 to 1925, and show a decrease in E. declination from 17° 20′ to 5° 40′.

VELOCITY OF DETONATION FOR EXPLOSIVES.—The explosives in general use in fiery and dusty mines belong to the class of detonating explosives. It is known that the ignition of inflammable gases in the neighbourhood of the borehole depends in large measure on the velocity of detonation. It is therefore of great importance to find a method of determining this velocity for the practical explosives used in mines To determine this velocity, very small intervals of time of the order of a millionth of a second have to be measured. A method suitable for doing this is described by E. Jones in the Safety in Mines Research Board, Paper No. 22 (London: H.M. Stationery Office, 1926. Price 9*d* net). The method is an electrical one. It depends on the partial discharge of a condenser through a known non-inductive resistance. The time of the discharge is the time taken by the detonation wave to travel between two points at which the circuits are broken. The times computed were tested with mechanical arrangements which gave time intervals of the order 10^{-4} sec. to 10^{-6} sec. The results were concordant for long fuses, but unsatisfactory when the trinitrotoluol fuse was only about 10 cm long. The discrepancies in this case were traced to electrical phenomena due to detonation, and were overcome by removing the break-points of the circuit to a distance from the detonating explosive. Consistent results were now obtained, although the fuse length was reduced to 2 cm. The difference between the results and that given by the Mettegang method for metre lengths of the explosive was rather less than 3 per cent. The latter method, however, only gives the average velocity over the metre. The agreement consequently is satisfactory. Further researches are in progress.

Oxford Meeting of the British Association.

PROVISIONAL PROGRAMMES OF SECTIONS

WE print below short accounts of the proceedings of the various sections of the British Association at the Oxford meeting to be held on August 4-11. For these particulars we are indebted to the recorders of sections. The statements are brief, but it is clear that interesting and stimulating sessions have been arranged which should do much to make the Oxford meeting memorable in the history of the Association.

SECTION A (MATHEMATICS AND PHYSICS).

The coming meetings of Section A (Mathematics and Physics) are likely to be filled with interest. Apart from the attractions of Oxford itself with its own important schools in these subjects, there are two other contributing factors. First, the list of foreign guests is a particularly interesting one, the visitors including Bohr, Born, Carathéodory, Franck, Runge, Siegbahn, Wien and Zeeman, in addition to well-known representatives of the Dominions overseas. Secondly, a full programme has been arranged for a subsection in mathematics, meeting for three mornings. This should attract many mathematicians who may have refrained from attending previously owing to the minor part that this subject has played in the programme of the Section in recent years.

In physics, in addition to full accounts of work being carried out in the laboratories of Prof. Townsend and Prof. Lindemann, papers will be read by Sir Ernest Rutherford, Sir William Bragg, Prof. W. L. Bragg, and others. On Monday, August 9, Prof. A. Fowler's presidential address will be followed by a discussion, in which most of the foreign guests are expected to take part. A joint discussion with Section B (Chemistry) on the mechanism of homogeneous chemical reactions should enable many physicists to learn something about a subject in which few of them have specialised.

In mathematics, in addition to a full morning on integration and trigonometrical series, special lectures from Dr. T. M. Cherry, Mr. F. P. Ramsay, Mr. M. H. A. Newman and Mr. T. W. Chaundy have been arranged, and contributions are expected from Sir George Greenhill and Prof. E. A. Milne. Lastly, a paper by Mr. Stratton on the recent eclipse observations, and by Prof. Turner on the coming total eclipse in England, should make a wide appeal throughout the Section.

SECTION B (CHEMISTRY).

Prof. J. F. Thorpe will deliver the presidential address to Section B (Chemistry) at 10 A.M. on Thursday, August 4, and will take as his subject "The Scope of Organic Chemistry." Two discussions have been arranged—one (a joint discussion with Section A) on the mechanism of homogeneous chemical reactions and the second one on tautomerism. Prof. W. N. Haworth is to submit a paper on modern views on the structure of the disaccharides, and Mr. J. J. Manley is to describe the work he has conducted on the union of mercury and helium. Of the foreign visitors, Prof. J. Backer is reading a paper on separation and racemisation of simple optically active compounds, and Prof. H ter Meulen is to describe the uses of hydrogenation in organic analysis. A novel feature of the work of the section will be a paper by Mr. A Chaston Chapman and Dr. H. J. Plenderleith on an examination of King Tutankh-Amen's cosmetic.

SECTION C (GEOLOGY)

The communications promised for Section C have been so numerous that the time available for presentation and discussion may prove inadequate. Although the meetings of the Section have been extended beyond the normal number, selection of papers has been necessary; yet the programme as at present arranged covers a very wide range of interest, and, so far as possible, kindred studies have been grouped. It is invidious to pick out any papers for special mention, but, to take a conventional subdivision of the subject-matter into mineralogy and petrology, palæontology and physical and stratigraphical geology, the following notes may suffice to convey some idea of the scope of the programme

The atomic structure of silicate minerals has proved difficult up to the present, but a paper on certain of these minerals is promised, while communications on the textures and structures of igneous rocks will also be received. Sedimentary petrology is also represented. In the realm of palæontology the faunas and classification of the faunas of certain epochs in the past will be considered, notably those of Cambrian and Silurian times: the fauna of more recent deposits, local to Oxford, will be represented by an exhibit which may be consulted during the meeting. Physical and stratigraphical geology will naturally figure largely, and here interests range in time from pre-Cambrian to recent, and in space from England to the farthest confines of the British Empire.

Two important discussions will be held: one on problems connected with the Thames gravels and their fossil contents, and the other in conjunction with Sections D (Zoology) and K (Botany) on the "Conception of a Species." In all branches of natural science the definition of units is necessary, and a biological unit is as fundamental as a unit of length or of temperature. Unfortunately the species, as a unit, has not proved capable of rigid definition, and, from time to time, it is obligatory to take stock of the position. The discussion therefore should be of value in stating the present ideas on this fundamental biological concept.

In the interests of those who are beginning research work and desire some knowledge of technique, a series of short descriptions of certain research methods will be given by workers who have taken special interest in the development of such processes. Demonstrations have also been arranged in illustration.

A most important part of the work of the section centres round the excursions. The local secretaries have so arranged their work that this part of the programme has been in the hands of Mr. C. J. Bayzand, who has drafted an excellent series of half-day and whole-day visits to the neighbourhood. Ill-health may prevent him from being present on these trips, but it is hoped that he may be recovered in time to reap the reward of his sowing. On present showing, then, the Oxford meeting, so far as Section C is concerned, promises to be an excellent one from every point of view

SECTION E (GEOGRAPHY).

Much attention has been directed of late to economic and social problems associated with the awakening of Negro Africa Their complexity defies unanimity on methods of administration and development. The president of the Section—the Hon. W. Ormsby Gore, Under Secretary for the Colonies—following his recent investigations in East and West Africa, will speak on "The Economic Development of Africa and its Effect on the Native Population." This will be followed on the afternoon of Thursday, August 5, by an important joint discussion with Section H (Anthropology) on "The Effect on African Native Races of Contacts with European Civilisation." Among those who will take part in the discussion may be mentioned the Rev. Edwin Smith, Sir Frederick Lugard, Capt. G. Pitt-Rivers, Prof. J. W. Gregory, Sir James Currie and the Hon. Hugh Wyndham.

In Britain, of recent years, one of the most striking applications of geographical study has been the attempt consciously to adjust conditions of life and industry to locality, especially in urban areas. Town planning and regional surveys have in a measure reacted on the character of some of the geographical research in the universities. Two papers, one on London and the other on Manchester, illustrate what is being done in the several university schools of geography, and will form the basis of a general discussion on "Regional Work in Geography."

Several papers present historical aspects of geographical science: Elizabethan theodolites and astrolabes, by Dr. R. T. Gunther; the 'Pantometria' of Leonard Digges, by Mr. A. R. Hinks; the British Isles in the nautical charts of the fourteenth and fifteenth centuries, by Mr. M. C. Andrews; roads on English and French maps at the end of the seventeenth century, by Sir George Fordham. The numerous implications which the geographical study of a region involves is well represented by such contributions as Dr. D. G. Hogarth's on "Our Near Eastern Borders," Prof. Lyde's on modern markets for Canadian wheat, and Mr. Dunlop's comparison of Queensland and Jamaica.

Geographical excursions have been arranged to Brill, the Cotswolds, the central Chilterns and the Goring Gap.

SECTION F (ECONOMICS).

In his presidential address to Section F (Economics), Sir Josiah C. Stamp will deal with "Inheritance as an Economic Factor"; it is expected that Prof. Rignano (Italy), Dr. Hugh Dalton, M.P., Prof. Edwin Cannan and others will take part in the discussion.

A distinctive point of view upon "Collective Bargaining" will be presented in a paper by Sir Lynden Macassey, in which he will argue that effective collective bargaining is the basis of industrial stability and that recent events have shown the absence of this condition in Great Britain. Mr. Flux, of the Board of Trade, will deal with the markets of the chief British export industrial centres and will use material which has not previously been available for this purpose.

A discussion of peculiar present-day importance will take place upon currency problems, and it will be opened by Prof. Gregory in a paper dealing with the gold standard.

In addition to such topics of outstanding interest as those mentioned above, the Section is to take part in a discussion on a "Survey of the Limits of Agricultural Expansion," which will form the subject of Sir Daniel Hall's presidential address to Section M (Agriculture).

SECTION G (ENGINEERING).

The programme of Section G includes discussions on subjects of very varied interest. The president, Sir John Snell, chairman of the Electricity Commission, in his address will deal with the important subject of electric supply, its recent and probable future development. Following the address Mr. Kennedy will read a paper on the distribution of electric energy, and Mr. Borlase Matthews will discuss the use of electricity in agriculture; some phenomena of conduction will be discussed by Prof. Cramp. Refrigeration, particularly in relation to food preservation and transport, is a subject of scientific and practical interest, and two papers by Dr. Ezer Griffiths and Prof. C. F. Jenkin are to be followed by a discussion in which Sir William Hardy and Sir Richard Glazebrook will take part. The papers will describe small plants that have recently been developed and experiments carried out in the laboratory and on four ships. In connexion with this discussion, a number of small plants will be working in the University Engineering Laboratories.

Recent developments in aircraft are to be discussed. Mr. Wimperis will deal with the 'rotating wing' and describe experiments and the attempts that have been made to use the device for sustentation purposes; the possibilities of its use will be discussed. The researches that have been carried out in connexion with the development of a compression ignition engine for aircraft and burning heavy oils will be described by Mr. H. D. Pye. The problem of producing a fuel jet which penetrates the compressed gas sufficiently to give adequate mixing of air and fuel, and at the same time to obtain sufficient pulverisation and combustion in the short time available, will, *inter alia*, be dealt with. It has been found possible to burn 70 per cent. of the oxygen in the cylinder, but to get perfect mixing at high speeds is extremely difficult. The possibility of eliminating all complications and danger incidental to electric ignition makes it worth while to attempt to develop a compression ignition engine sufficiently light for aircraft purposes. The use of light alloys in aircraft is becoming increasingly important, and the paper by Mr. Bengough and Mr. Sutton will describe the anodic oxidation process which has been successfully developed to render these alloys immune from surface corrosion.

Experiments on materials subject to complex stress conditions will be discussed by Prof. F. C. Lea and Mr. S. Timoshenko.

The microscopic and macrographic methods of detecting the sulphur bacterium *Beggiatoa Alba*, and investigations in which its presence indicates sewage pollution, will be described by Prof. Ellis. The cause of the blackening of the river sands below water level in the Clyde Estuary has been investigated, and it has been shown that this is not due to sewage pollution but to the formation of ferrous sulphide by a reaction between the ferruginous constituents of the sand and the hydrogen sulphide liberated by bacteria which consume the animal and vegetable remains on the shore. A paper by Mr. Edgar Morton on the "Composition and Texture of Sandstone and Limestone in relation to Strength and Durability" should prove of interest to geologists, engineers, architects and builders. Papers dealing with the distribution of pressure in turbines and the influence of voltage harmonics on power factor correction are to be given.

SECTION H (ANTHROPOLOGY).

In Section H (Anthropology) one of the most important features of the programme will be the exhibition of the human skull found in association with Mousterian implements by Miss D. A. E. Garrod near the Devil's Tower, Gibraltar. In view of the conditions of its discovery and its possible relation to the skull of Neanderthal type found at Gibraltar in the middle of the last century, it should give rise to an important discussion. Miss Garrod's discovery will give added interest to Sir W. Boyd Dawkins' paper on the range of the Neanderthal race on the Pleistocene continent.

The Section will engage in two joint discussions with other sections. The first, with Section E, on the effect on African races of contact with European civilisation, arises directly out of Mr. Ormsby Gore's presidential address to Section E, and will be opened for Section H by the Rev. E. Smith, who will be followed by Sir Frederick Lugard, should his engagements permit. The second joint discussion, with Section D (Zoology) and Section J (Physiology), on mental and physical aspects of heredity, will be opened by Dr. C. S. Myers, to be followed by Profs. Ruggles Gates and Julian Huxley. Sir William Ridgeway will open a sectional discussion on "The Origin of the Scot."

Among a large number of communications making up the remainder of the programme mention can be made of a few only. Sir Arthur Evans on "The Shaft-Graves of Mycenæ and their Contents in relation to the Beehive Tombs" is likely to prove provocative of animated discussion; Mrs Zelia Nuttall, the distinguished American archæologist, in dealing with the ancient calendar systems of America, will give the Section what is virtually a summary of the results of her life's work. The excavations of the British School at Athens during the past three seasons will be described by Mr. A. M. Woodward, the Director, and Mr. W. A. Heurtley, the latter dealing with his own investigations in Macedonia. Recent excavations in Mesopotamia will be covered by Mr. C L Woolley on his recent work at Ur, and Prof. Langdon on work at Kish, skulls from the latter site being described by Mr L H. D. Buxton. In Egyptian archæology Miss Gardiner and Miss Caton-Thompson will describe their recent work on the geology and early archæology of the Fayum, and Sir Flinders Petrie will put forward for discussion his views on the prehistoric relations of Egypt and the Caucasus. An important paper by Mr. Gordon Childe will deal with the Terramare and the Hungarian Bronze Age, in which he will carry further his previously published work on the prehistoric archæology of Central Europe.

An interesting series of papers dealing with physical anthropology must be passed over; but in conclusion mention must be made of Miss Alford's communication on 'the ritual dance,' in which she discusses the ritualistic origin of a number of English folk-dances and cites continental parallels. The paper will be illustrated by dances performed by members of the English Folk-Dance Society.

SECTION I (PHYSIOLOGY).

By an unfortunate chance the British Association meetings this year fall at the same time as the (triennial) meetings of the International Congress of Physiology, which will be held at Stockholm on August 3-6. Although the Section may, in consequence, lack a certain number of British and of foreign workers, the sectional programme is quite a full one. The subject of the presidential address is "Function and Design": to this question Prof. Leathes is bringing a fresh outlook, notably from recent work on molecular structure and orientation, with a special consideration of the arrangements at the limiting surfaces and membranes of the organism.

As was suggested in the columns of NATURE of May 29, p. 747, the lecture by Dr. J. S. Haldane on "Acclimatisation to High Altitudes" is of particular interest, in that a reply to Prof. Barcroft's recent publications may confidently be expected, and a consideration of the physiological observations and problems connected with the climbs on Mount Everest. In the joint discussion with Section D (Zoology) on the value of tissue-culture in biology, members will have the first opportunity in England of hearing from Prof. Ch. Champy, of the Sorbonne, an account of his technique and the results he has obtained in this work. The discussion will be opened by Dr. H. M. Carleton, who is in charge of the Department of Histology at Oxford.

A symposium on the 'machinery' whereby a posture is set up or maintained, will allow an exchange of observations and opinions between clinicians and laboratory workers, who have a common interest in this problem, though their paths of approach may be entirely different. Of wide interest, again, is Sir J. C. Bose's lecture on "The Pulse-Beat of Plant and of Animal," while among the more specialised papers are contributions on colour-vision, on biochemistry, and on visceral sensation.

SECTION J (PSYCHOLOGY).

Applied psychology figures prominently in the programme of Section J (Psychology); thus the presidential address by Dr. J. Drever is entitled "Psychological Aspects of our Penal System." A whole session is given to such industrial questions as accidents in industry, restriction of output, and the judgment of value of individual advertisements. There is also a lecture on recent progress in vocational selection. These papers will give an account of some of the activities of the National Institute of Industrial Psychology.

Medical psychology is represented by three papers, namely, personality and value, a method of self-analysis, and heredity and environment in the production of morbid mental reactions. That psychologists are paying attention to heredity is shown by their participating with Sections D and H in a joint discussion on heredity in its physical and mental aspects.

It is gratifying to note that all past presidents of the Section are contributing papers: Prof. C. Lloyd Morgan, "Individual and Person", Dr. C. S. Myers, "Heredity in its Physical and Mental Aspects"; Prof. Cyril Burt, "Estimations of Temperament and Character"; Prof. W. McDougall, "An Experiment supporting the Lamarckian Hypothesis" and "Intelligence in Rats": Prof. C. Spearman, "The Origin of Error."

Of the more academic papers mention should be made of one by Prof. Rignano of Milan on "La psychologie dans ses Rapports avec la Philosophie et avec la Science," one by Prof. Michotte of Louvain on observation and analysis of mental facts, one by Dr. Aveling on the psychogalvanic phenomenon, and one by Dr Banister on the localisation of sound. A paper by Dr. Maxwell Garnett on the psychology of patriotism should prove of wide interest; also one by Mr. F. C. Bartlett, Director of the Cambridge Psychological Laboratory, on the social psychology of leadership.

SECTION K (BOTANY)

Owing to the lamentable death of Mr. W. Bateson, Section K (Botany) will meet at Oxford under the presidency of Prof. F. O. Bower. The Section will participate in a discussion on "The Conception of a Species" with the Sections of Geology and Zoology. Within the Section there will be a discussion on sex-determination in plants, which will be opened by Dame Helen Gwynne-Vaughan and contributed to by Dr. Heslop Harrison, Prof. H. Kniep, and Miss Cayley. Prof. J. H. Priestley will initiate another sectional discussion on the scientific principles underlying vegetative propagation, a subject on which a good deal of light has been thrown recently. The popular lecture will be given by Sir Frederick Keeble on "The Nervous System of Plants."

A large number of papers representative of different branches of botany have been included in the programme, the subject of genetics being particularly well represented this year. A notable feature of the Oxford meeting will be the attendance of a larger number of distinguished foreign botanists than has been the case in recent years. All of them are contributing actively to the programme. As in the last few years, there will be a Sub-section of Forestry, which will be linked with Section K. The Sub-section also has a very full programme, and will be presided over by Lord Clinton.

SECTION L (EDUCATION).

Section L (Education), under the presidency of Sir Thomas Holland, opens its session at Oxford on Thursday, August 5, with several papers dealing with the place of history of science in education. Dr. Charles Singer and Prof Cecil H. Desch will discuss the subject from the point of view of its value as a humanising element in the teaching of science at university or school. Dr Gunther will demonstrate the educational value of the Lewis Evans' Collection of historic scientific instruments at the Old Ashmolean Building.

Later in the meeting the more recent advances in educational science will be discussed: the development in the general conception and scope of education during the last twenty-five years by Prof T. P. Nunn; the education of children under eleven years of age by Miss Margaret Drummond; developments in methods of teaching by Dr. M W. Keatinge; the organisation of education by Prof. Strong; and educational psychology by Prof. C. Burt. The Section will be invited to discuss scholarships—methods of award and their effect on the present system of education—by Mr. William Hamilton Fyfe. Important results of a recent investigation into the claims of the kinema and of radio to be potent agencies in modern education will be brought before the Section by Dr. C. W. Kimmins, Mr G. T. Hawkin, and Dr. J. C. Stobart. The public school system is to be reviewed by Mr. Ronald Gurner, Mr W. W. Vaughan, Mr. M. L. Jacks, Dr. Crichton Miller, and Mr. F. J. R. Hendy. Its relation to national life, its psychological interpretation, its value as a training in community life, together with a critical appreciation of its economic position, are some of the features of the papers to be read.

On Thursday, August 5, a joint session of Section L (Education) and M (Agriculture) will be held in the hall of the Union Society to discuss the educational training of boys and girls in secondary schools for life overseas. Various aspects of this question will be dealt with by Sir A. Daniel Hall, Hon. W. Ormsby-Gore, Sir Halford Mackinder, Miss Gladys Potts, Sir John Russell, Sir Alfred Yarrow, and others. This meeting has been organised for the purpose of directing public attention to the results of an investigation carried out by a special committee, appointed by the Council in 1923. Two reports have already been issued. The Committee hope this year, through this meeting, to emphasise the most important results of their investigation, namely, first, that a growing and widespread demand exists in the Overseas Dominions for boys and girls well educated with an agricultural bias; secondly, that Great Britain has an increasing need of finding healthy and profitable employment within the British Empire for a large number of her sons and daughters; and thirdly, that practical studies of all kinds, especially those related to agriculture, possess a training value far too little realised by parents and by educational authorities.

SECTION M (AGRICULTURE).

The Section will meet under the presidency of Sir Daniel Hall, whose presidential address on the limits of agricultural expansion will form the basis of a joint discussion with Section F (Economics), at which the speakers will include Lord Bledisloe, Sir Thomas Middleton, and Mr. R. J. Thomson. Sir Daniel Hall will also open a joint meeting with Section L (Education) on training for overseas life, at which several distinguished people have promised to speak, and at which it is hoped that the president of the Association may be present.

In addition to these two joint discussions, much time will be devoted to sectional discussion, so that the number of individual papers which are being presented is smaller than usual. It is proposed at a sectional meeting to review the present position of agricultural education in Great Britain, and to consider the methods adopted to make available to those engaged or about to be engaged in the agricultural industry the results of scientific research. Another session will be devoted to possible improvements in cultivation methods, both hand and machine, which is a subject with very important practical and economic bearings at this time when the position of arable land farmers is so precarious.

Other subjects of more technical interest which will occupy the Section are those of soil classification and the nutrition of dairy cattle, in which connexion a paper by Sir A. Theiler and Drs. Green and Du Toit on the minimum mineral requirements of cattle should be of great interest. This South African work forms an interesting complement to that carried out at Aberdeen, Cambridge, and elsewhere in Great Britain.

Messrs. Sutton of Reading have kindly invited members of the Section to visit their seed establishment, and a visit will also be made to the Agricultural Department of the University of Reading.

Universities of the British Empire.

THE universities of the British Empire are parts of a system dependent for its equilibrium and orderly progress in changing conditions on adjustments of factors making for integration and differentiation. The Congress of Universities of the Empire, which met last week at Cambridge, represents an adjustment on the side of integration. A glance at the lists[1] of subjects discussed at the first and second Congresses, 1912 and 1921, brings out the fact that the subjects of last week's discussions are, like those of 1912, but to an even greater extent, concerned directly with co-operation between universities, whereas the programme of 1921 was of a more open and exploratory character. Of the seven subjects of the plenary sessions, five, of the four subjects of sectional meetings, three, were directly and obviously concerned with the question as to how universities in different parts of the British Empire may most effectively help one another. Congresses are sometimes criticised adversely as "leading to nothing," especially where, as in the present instance, the discussions do not culminate in 'resolutions.' It remains to be seen whether the third Congress of the Universities of the Empire will merit this criticism, but definite practical suggestions for immediate action were not lacking.

---

[1] "Universities Yearbook, 1926," pp. 12 and 13.

Lord Balfour opened the proceedings of the first session on Tuesday, July 13, the subject of discussion being "The State and the University." The new problems confronting universities arise, he pointed out, not from the social changes of the time so much as from the growth of modern knowledge and its paradoxical correlative, the growth (due to specialisation) of modern ignorance. The former has brought in its train an enormous increase in the expensiveness of the material plant indispensable for the pursuit of the study of science and urgent pressure on the State, and, through the State, on the universities, to develop the applications of science to the problems of industry. In the absence of other sufficient available means of obtaining the wherewithal to provide and maintain the requisite buildings and equipment, the universities of Great Britain have sought and obtained State subsidies, and, even where these have not been ear-marked for work in applied science, have inevitably aroused a natural and pardonable, but dangerous, instinct on the part of the State to control and supervise. Hitherto that instinct has not found expression in Britain in any serious menace of excessive interference, but the universities must ever be watchful lest they betray their trust to cherish the spirit of disinterested research, a dereliction which would in the long run be fatal to the very industrial interests it might be supposed to serve. The sphere in which the universities can at present most fruitfully study to promote the material interests of the community lies in the middle region between fundamental and practical research.

The idea of the duty of watchfulness against State encroachments or enticements proved to be the keynote of most of the discussion which followed Lord Balfour's address. Prof. E. R. Holme, of the University of Sydney, while proudly asserting that in Australia there has never been a sustained public policy that is contrary to the right British tradition, admitted the existence of dangers in the large " and necessary " dependence upon the State which characterises Australian universities. A specially insidious risk is that of political parties being tempted to make capital out of the pride of the people in their university and the desire to spread its benefits—to make, in American parlance, the campus of the university coterminous with the State.

This same danger was touched upon in a paper by President Klinck, of the University of British Columbia, one of the four State (Provincial) universities of Western Canada—who remarked, however, that while the unwillingness of the universities to pander to the expectations of those primarily interested in utilitarian education has led to their disappointment and disillusionment, it has not yet led to any appreciable diminution in the numbers demanding admittance. He was able to assure the Congress that the governors of a State university in Canada are no more liable to be dictated to by the legislature than the governing board of an endowed institution by private benefactors. The academic freedom of the professorial staff in the State universities is even more jealously guarded and more universally respected than is freedom from political interference in matters affecting the financial administration of the universities. The legislatures are not interested in staff appointments or in the details of academic policies, but leave the universities completely autonomous in these respects.

Prof. Holme referred to a recent political agitation of the question of the Australian universities' duty to country students, and, in this connexion, to the commission now studying the project of a Commonwealth University at Canberra for examinational purposes only. He suggested that the University of London might well offer to undertake for Australia the function of such a Commonwealth University. Either plan would have the advantage that Australian universities would not be driven to establishing (as Queensland has done) departments of " teaching by correspondence." Sir Theodore Morison suggested that the proper safeguard against the exertion of undue influence, whether by the State or by benefactors, is to present a bold front and a frank exposition of the grounds of the university's claim to autonomy. Prof. Payne, of Melbourne, quoted an instance of a government offering a chair coupled with the name of a prospective holder—an offer which the university rightly refused.

Sir Alfred Hopkinson summed up the relationship of State and university under five heads: Initiation, which should not be, and in the past has not been in Great Britain, the business of the State; recognition, which should always be in the hands of the State, to prevent fraudulent degree-granting; support, for which, ideally, the university should not be mainly dependent on the State; control, which should not be exercised by the State except to the extent of seeing that State grants are spent on development and not on fancy fads; service, in which there should be close co-operation. This last aspect of the relationship between State and university was presented with some enthusiasm in a speech by Dean Mackay, of the graduate school of McGill University, where, he said, the prevalent attitude towards the State is one, not of watchfulness against imaginary dangers of interference by the State, but of eagerness to promote its welfare. In one respect this has been prejudicial to the university, for it has led to an excessive withdrawal of the most talented alumni for the service of the State in other spheres.

" Co-operation in Research throughout the Empire " was discussed at the morning session of July 14 under the presidency of Lord Londonderry, Chancellor of the Queen's University of Belfast. This session attracted a maximum attendance—between five and six hundred. Sir Thomas Holland outlined the history of the Department of Scientific and Industrial Research and the various other governmental agencies in different parts of the British Empire for promoting and conducting research—agencies which, originating in the necessities of the War, have demonstrated that they are equally indispensable in time of peace. Two questions in connexion with them were, he suggested, of obvious importance to the Congress: " Does the establishment of Government laboratories tend to supplant university functions ? " and " Can the universities take further advantage of the new official machinery for correlation and financial support ? " To the first the answer seems, he said, to be favourable so far as Britain is concerned, but such official institutions have a strong natural tendency to extend their activities. This tendency is minimised where, as in England, the scope of their work is strictly limited to well-defined, large-scale investigations beyond the capacity of any university to undertake, and the universities are well represented on controlling committees. As regards the second question, he had found at the Imperial College a ready response to suggestion and a willingness to render the necessary financial assistance to research workers.

Sir John Farmer, professor of botany at the Imperial College, suggested that more might be done towards keeping the universities in touch with scientific workers in the outlying parts of the British Empire. The universities might, for example, give assurances that such workers would be welcomed should they visit the university laboratories when on leave in England. At present the universities seem, he said, scarcely alive to the importance of the great development that is going on in tropical agriculture, and the opportunities open to their graduates in connexion therewith. Dr Andrew Balfour, of the London School of Hygiene and Tropical Medicine, complained of the ignorance on the part of men working in his field of what others working in the same field are doing. An organisation is badly needed for laying down lines of research, following up what is done, and deciding what results should be recorded and how. India has its Scientific Advisory Board, which advises on the disposal of the Indian Research Fund Association's money, but it has no link with England. A central co-ordinating body in London, possibly a committee of the Medical Research Council, should be established, and one of its most important functions should be the selection and training of personnel. A recent promising move in this direction is the appointment of a Chief Medical Advisor to the Colonial Office.

The same subject, co-operation in research, came up again for discussion on July 16 under the title "The Actual Working of the Ph.D. Scheme." Questions relating to facilities for the migration of university teachers and students were touched on in this discussion, and were dealt with at other meetings under various aspects: interchange; an Imperial policy in education; mutual recognition of examinations; pension schemes. The sectional meeting devoted to the discussion of "An Imperial Policy in Education," under the presidency of Sir Frederick Lugard, aroused much interest. A paper on the subject was read by Prof. Earle, of the University of Hong-Kong, who advocated the formation of a committee with a constitution designed to secure interest in the assistance of educational effort throughout the British Empire, a function which the Universities' Bureau is not competent to undertake.

University and Educational Intelligence.

BIRMINGHAM.—Applications are invited for the Walter Myers travelling studentship for research in pathology, value 300*l*. for one year. Candidates must be under 30 years of age and graduates in medicine of the University of Birmingham or of some other university in Great Britain or Ireland. In the case of graduates of other universities, candidates must have been students of the Birmingham Medical School for three years immediately preceding their application for the studentship.

Further information may be obtained from the Dean of the Medical Faculty, and applications must be lodged with the Dean not later than September 1 next.

CAMBRIDGE.—The late Captain H. E. Laver has bequeathed to the Museum of Archæology and Ethnology his collection "of Chinese and the Far East Archers' Implements, meaning all [his] collection of Bows and Arrows and all implements connected with the manufacture of the same and all [his] Archers Thumb Rings, consisting of Jade and other hard stones of Ivory, Bone, Porcelain, Glass and Metal." One of the conditions of the bequest is that the specimens shall never at any time be lent for exhibition out of the precincts of the University.

C. R. N. Winn, Trinity College, has been nominated by the Vice-Chancellor to the Choate Memorial Fellowship at Harvard, and N. H. France, St. John's College, to the Princeton Visiting Fellowship. The Harkness Scholarship for geology has been awarded to M. Black, Trinity College, and the Wiltshire Prize to F. W. Shotton, Sidney Sussex College.

The Observatory Syndicate reports the addition of a photo-electric photometer, mainly by Günther and Tezetmeyer, to the equipment of the Observatory. The photometer will be used with the Sheepshanks equatorial.

C. B. Timmis has been elected to the Caldwell Studentship at Corpus Christi College.

MANCHESTER.—The Council has made the following appointments: Mr. H. E. Buckley to be lecturer in crystallography; Miss Margaret S. Willis to be assistant lecturer in geography; Dr. C. E. Brunton to be demonstrator in human physiology; Dr. O. R. Howell, lecturer in applied chemistry in the faculty of technology; Mr. Robert Grindley, demonstrator in chemical technology in the faculty of technology.

THE Air Ministry has announced that five hundred aircraft apprentices, between the ages of 15 and 17 years, are required by the Royal Air Force for entry into the Schools of Technical Training, Halton, Bucks, and Flowerdown, near Winchester. They will be enlisted as the result of an open and a limited competition held by the Civil Service Commissioners and the Air Ministry respectively. Successful candidates will be required to complete a period of twelve years' regular Air Force service from the age of 18 years, in addition to the training period. Full information regarding the aircraft apprentice scheme, which offers a good opportunity to well-educated boys of obtaining a three-years' apprentice course of a high standard and of following an interesting technical career, can be obtained on application to the Secretary, Air Ministry, Kingsway, London, W.C.2.

VACATION courses being held in Germany this summer are described in a 16-page pamphlet published by 'Hochschule und Ausland,' Charlottenburg. Courses for foreigners in the German language and culture are provided by, or in connexion with, the Universities of Berlin, Greifswald, Heidelberg, Jena, Kiel (of special interest to Swedish students), and Marburg. Göttingen (October 4–14) and Munich (September 27–October 9) offer post-graduate medical courses; the Nordic Association of Lübeck is giving (August 2–20) a course of lectures for foreigners entitled "German Light on European Problems." Greifswald has an attractive programme including not only literary, artistic, and philosophical subjects but also astronomical, botanical, chemical, geographical, geological, physical, and psychological. The Jena courses are grouped in ten divisions including philosophy, pedagogy, University extension problems, natural science, domestic science, political and economic science, and German for foreigners.

THE Board of Education announces that the Institution of Naval Architects and the Worshipful Company of Shipwrights have consented to co-operate with the Board in arrangements for the award of national certificates in naval architecture to students in technical schools and colleges in England and Wales. Under the agreement which has been reached, 'Ordinary Certificates' and 'Higher Certificates' will be issued jointly by the Institution and the Company and the Board on the successful completion of approved courses. The scheme will provide only for part-time students. Should the authorities of any school in England or Wales desire further information, their inquiries should be addressed to the clerk to the Worshipful Company of Shipwrights, 4 New London Street, London, E.C.3, in the case of ordinary certificates, and to the secretary of the National Certificates Committee, Institution of Naval Architects, 5 Adelphi Terrace, London, W.C.2, in the case of higher certificates.

Contemporary Birthdays.

July 25, 1848. The Earl of Balfour, K.G., O.M., F.R.S.
July 26, 1872. Prof. Joseph Barcroft, C.B.E., F.R.S.
July 27, 1857. Sir E. Wallis Budge, D.Litt. (Oxon.).
July 27, 1857. Dr. John William Evans, F.R.S.
July 28, 1843. Sir W. T. Thiselton-Dyer, K.C.M.G.
July 28, 1844. Sir Howard Grubb, F.R.S.

The EARL OF BALFOUR, Chancellor of the University of Cambridge, and also of the University of Edinburgh, was born in Scotland. He was educated at Eton and Trinity College, Cambridge. Always deeply interested in the advancement of science, he is a past-president of the British Association, and has, at two separate periods, served on the council of the Royal Society.

Prof. JOSEPH BARCROFT was educated at Bootham School, York, and King's College, Cambridge. He succeeded the late Prof. J. N. Langley as professor of physiology in the University of Cambridge, and is also Fullerian professor of physiology in the Royal Institution. His researches on the respiratory function of the blood and its relation to the activity of the tissues form but one department of many physiological inquiries. He has explored the conditions of life at high altitudes with persistency and acumen, undertaking the leadership of two expeditions for that purpose, one to Monte Rosa, and another to the High Andes. Prof. Barcroft was awarded a Royal medal by the Royal Society in 1922.

Sir WALLIS BUDGE, Oriental scholar, formerly keeper of Egyptian and Assyrian antiquities in the British Museum, is a graduate of Christ's College, Cambridge. He has conducted excavations at Assuan, Nineveh, in the Sudan, and elsewhere.

Dr. JOHN W. EVANS, lately president of the Geological Society of London, was educated at University College School. He has rendered much service to geological science by initiating, extending, and guiding the conduct of geological investigations in the colonies and dependencies of the British Empire. In western and southern India and in South America he has led official exploring expeditions. The Geological Society recognised the high value of his work by awarding him, in 1922, its Murchison medal. Dr. Evans is the author of a useful pamphlet of 20 pp. issued by the Colonial Office in 1914, on "Directions for the Collection of Geological Specimens."

Sir W. T. THISELTON-DYER, who was born at Westminster, attended King's College School, graduating afterwards at Christ Church, Oxford. In 1875 he became assistant director of the Royal Botanic Gardens, Kew, and he was director from 1885 until 1905. The "Flora Capensis," recently completed, and the "Flora of Tropical Africa," which will run to eleven or twelve volumes, will always be associated with his many years at Kew, where he also started the *Kew Bulletin*. He has contributed notably to the economic and systematic botany of the British Empire.

Sir HOWARD GRUBB, to whom our hearty congratulations are extended on the occasion of his eighty-second birthday, was educated privately and at Trinity College, Dublin. The practical outcome of his skill and labours in the production of objectives and instruments of precision is known wherever there are observatories. Early this year Sir Howard was the recipient of a congratulatory address signed by the leading astronomers and astrophysicists of Great Britain, referring to his resourcefulness and ingenuity in the development of the instrumental equipment of astronomers through more than sixty years.

Societies and Academies.

LONDON.

Optical Society, June 24.—**M. von Rohr**: Joseph Fraunhofer and the development of optical instruments. The position of high-grade optical work at the beginning of the nineteenth century was discussed. The chief cause of the transference from England to Germany of supremacy in telescope construction at that time was the appreciation in the latter country of the importance of fundamental research to the industry. The developments which took place in Munich and later at Benediktbeurn due to Fraunhofer's activities were detailed and some of the more important instruments produced under his direction were described.—**T. Smith**: (1) Reflection as a special case of refraction. Some difficulties which arise in applying the formulæ for refraction to reflection, and particularly the sign conventions which should be adopted for reflection, were discussed. (2) On the light transmitted and reflected by a pile of plates. The properties of a series of media or of a pile of plates which absorb and scatter light, and the interfaces of which may also absorb and scatter as well as transmit and reflect light, were investigated. In general, the ratio of the transmissive factors of a pile of plates in the two directions is independent of all reflective properties of the surfaces, and the factors are equal if the individual transmissive and absorptive factors are the same for the two beams. The ratios of the light transmitted without reflection to the total light transmitted are equal in both directions. The reflective properties of the pile depend upon all the factors of the system, and the ratio of the two reflective factors is not independent of the order in which the plates are placed. In non-absorbing systems, the sum of the intensities of the reflected and transmitted beams is equal to the intensity of the incident beam, and the ratio of the intensity of the reflected to that of the transmitted beam is equal to the sum of the corresponding ratios for the component plates or surfaces of the pile. Such a pile forms an exception to the rule that the reflective coefficients depend on the order in which the plates are arranged.—**D. S. Perfect**: Note on the immutability of transmissive factors with reversal of light. Direct experimental evidence has been obtained that the transmissive factor of the surface separating two media is unaltered if the direction in which the light travels is reversed.

DUBLIN.

Royal Dublin Society, June 22.—**P. A. Murphy**: The downy mildew of onions (*Peronospora Schleideni*), with particular reference to the hibernation of the parasite.—**W. R. G. Atkins** and **H. H. Poole**: Photo-electric measurements of illumination in relation to plant distribution (Part 1). Measurements of the illumination in shaded and open sites have been made by means of two photo-electric photometers and an apparatus already described, the readings being nearly simultaneous. The ratio of the illumination at a shaded site to the illumination due to diffused light in the open forms a useful index for comparing different sites. This ratio is conveniently expressed as a percentage which is called the daylight factor. It is usually found with both the photometers horizontal (so as to measure the vertical illumination), but a useful value near the edge of a wood is that found by tilting the photometer so as to receive the maximum illumination. There is a marked correlation between the flora and the daylight factors of the sites examined.—**J. Reilly** and **G. T. Pyne**: Studies in peat (Part 1). The thermal decomposition of peat under reduced pressure. Distillations of dried peat were carried out under atmospheric and reduced pressures, and at both low and moderately high temperatures The vacuum distillations gave larger yields of tar, of the heavier acidic substances, and of paraffin, while those at atmospheric pressure gave larger yields of simpler products such as ammonia, methyl alcohol, acetic acid, and gases. This points to a type of decomposition under low pressure favouring the formation of the more complex intermediate products.—J. **Reilly** and Miss H. E. **Bastible**: The velocity of formation of 3-5-dimethylpyrazole-4-diazonium chloride. The rate of reaction between nitrous acid and the amine was retarded by working in $N/100,000$ solutions. Owing to the great stability of 3-5-dimethylpyrazole-diazonium salts, measurements were possible up to comparatively high temperatures The reaction is bimolecular, and at 0° C., $K = 0·022$, the value increasing regularly with rise of temperature. At 72° C, $K = 5·8$, more than 90 per cent. of the nitrous acid being destroyed in two minutes. In a control experiment without the base, less than 1 per cent. of the acid was destroyed in two minutes at 100° C.

PARIS.

Academy of Sciences, June 14.—E **Goursat**: A problem of the theory of surfaces.—Marcel **Brillouin**: The centre of gravity and moments of inertia of the oceans. The mean action of the earth on the ocean —Charles **Moureu**, Charles **Dufraisse**, and Paul Marshall **Dean**: A coloured hydrocarbon · rubrene. The substituted phenylacetylene, $(C_6H_5)_2CCl.C\vdots C.C_6H_5$, has been proved to be very unstable, owing to the mobility of the atom of chlorine. If this compound is heated alone in a vacuum, hydrogen chloride is evolved, and from the residue a new hydrocarbon (rubrene) can be extracted, distinguished by its fine orange red colour, high melting point (331° C.), and sparing solubility in ordinary solvents It combines with four atoms of bromine giving derivatives remarkable for their stability at high temperatures, one melting at 460° C. and another at 500° C., both without decomposition.—A **Blondel** and A **Dargenton**: Apparent brilliance of the face of exit of an optical system with any number of thick lenses.—Léon **Guillet**. The cementation of copper and its alloys by aluminium As cementing agent an aluminium copper alloy (aluminium 20 per cent.) was used, the powdered alloy being mixed with 5 per cent. of ammonium chloride. Details of the results of experiments with various alloys are given, including the depth of penetration, hardness of the surface, and microscopic structure of the surface.—Charles **Nicolle** and Charles **Anderson**. Recurrent fever transmitted both by Ornithodorus and by lice Sadi de Buen has recently announced the existence in Spain of a special type of recurrent fever, not transmitted by lice, but by *Ornithodorus marocanus*. These experiments were made on rats, but the author now proves that if monkeys are substituted for rats, the Spanish recurrent fever can be transmitted both by lice and by Ornithodorus.—N. E **Norlund** was elected corresponding member for the Section of Geometry in succession to the late Cl. Guichard.—Bertrand **Gambier**: Voss-Guichard surfaces.—Gaston **Julia**: Correction to the note on the polynomials of Tchebichef. Admitting priority to D. Jackson and G. Polya.—E. **Lainé**: Equations of the form $s = f(x, y, z, p, q)$ which are of the first class —Jacques **Risler**. The formation of luminescent helium tubes. Details of the methods of purifying the helium and cleaning the tubes from foreign gases.—D. K. **Yovanovitch** and Mlle. A. **Dorabialska**: A new method for measuring the absorption of the β- and γ-radiation of radioactive bodies. The usual method consists in measuring the ionisation produced by the energy remaining in the rays after traversing several layers of material: the method now proposed is to measure calorimetrically the energy retained by the material itself in the form of heat —**Frilley**: Absorption of the penetrating radiation of actinium in equilibrium with its derivatives —René **Dubrisay**: Researches on surface actions. Solutions of various dyes (methylene blue, congo red, methyl orange, etc) were shaken with absorbent materials (sand, kieselguhr, asbestos, cotton) and the quantity of dye adsorbed measured colorimetrically. The addition of an electrolyte, sodium chloride, increased the amount adsorbed in every case —P. **Mondain-Monval**. The thermal properties of the various varieties of selenium. The heat of transformation of vitreous selenium into metallic selenium at 130° C was found to be 13·5 cal. per gm., and that of red crystallised selenium at 150° C. into metallic selenium, 2·2 cal. per gm.—A. **Kirrmann** and H. **Volkringer**. The absorption in the ultra-violet of two isomers The substances compared were the two bromoheptenes, $C_5H_{11}-CH=CHBr$ and $C_5H_{11}-CBr=CH_2$. —L. **Barthe** and E **Dufilho**. The estimation of sodium: applications A modification of the method of Blanchetière suitable for material containing organic matter or phosphates. The sodium is precipitated as the triple acetate of uranium, magnesium, and sodium.—B. **Bogitch**: The removal of iron from copper and nickel matte.—Charles **Prévost**: The two stereoisomeric α-ethylene-γ-glycols.—P. **Russo**: The presence of three transported beds in the southern Rif.—Pierre **Termier**: Remarks on the preceding communication.—**Pouget** and **Chouchak**: The radioactivity and chemical composition of the mineral waters of Hammam des Ouled Ali.—Ignace **Puig**: The large electromagnetic disturbances of the four first months of 1926 according to the records of the Observatory of Ebro, Tortosa, Spain.—André **Dauphiné** · New experiments on the vascular relations between the leaf and the root.—B. P G **Hochreutiner**: A new genus, intermediate between the Malvaceæ, the Bombacaceæ and the Sterculiaceæ —L. **Blaringhem**: The production of double flowers as a result of complex crossings between divergent species of Geums (Rosaceæ).—G. **Mouriquand**, M. **Bernheim**, and Mlle. **Theobalt**: The antirachitic power of Wood's light. The radiations corresponding to Wood's light possess a protective action against the development of experimental rickets —R. **Legendre** · The presence of two sea birds in the stomach of *Lophius piscatorius*.—R **Courrier**. The quantitative action of the follicular hormone.—Em. **Perrot** and Al. **Rouhier**. *Yocco*, a new drug containing caffeine. The bark of the stem of a plant known as Yocco grown in Colombia, especially in the Putumayo and Caqueta regions, is used as a stimulant by the natives The bark contains about 2·7 per cent of a crystalline substance presenting all the characters and reactions of caffeine.

ROME.

Royal Academy of the Lincei, May 16.—O. M. **Corbino**: Perot and Fabry fringes obtained with a half-silvered doubly refracting plate.—Federico **Sacco**: The tunnel at Drink (Valle d' Aosta). A representation is given of the stratigraphic metamorphic crystalline series traversed by the tunnel at Drink.—Angelo **Tonolo**: Equations for the conformable representability of a three-dimensional variety of Euclidean space.—Alessandro **Terracini**: The geometrical signification of the projective normal.—G. **Horn-D' Arturo**: The theory of flying shadows. The recent suggestions of Armellini and Ronchi with regard to the origin of flying shadows during solar eclipse are refuted, the author re-asserting his view that the light intervals of these shadows represent real images of the solar crescent.—Giorgio **Abetti**: The structure of the *Hα* line of the chromosphere.—Filippo **Burzio**: Some new properties of ballistic precession.—E. **Persico**: Magnetic rotatory polarisation in an alternating field.—Ubaldo **Barbieri**: Astronomical determination of latitude and azimuth made at Cape Noli in 1911—Ramiro **Fabiani**: First results of new investigations in the Permian outcrops in the Sosio basin (Palermo).—Enoch **Peserico**: The manner in which the electrical conductivity of the submaxillary gland is modified during its functional activity (ii.)—Giulio **Savastano**: Non-productivity of the pistachio in Sicily. Faulty fertilisation due to lack of pollen, rather than adverse climatic conditions or ovular abortion, is the principal cause of non-productivity.—P. **Pasquini**: Ineffective closing of the blastopore and subsequent development of the segmented ovum of *Rana esculenta* subjected to rapid centrifugation.—Constantino **Gorino**: The microflora of the Italian silo

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 12, No 5, May)—L H. **Adams** and R. E **Gibson**: The compressibilities of dunite and of basalt glass and their bearing on the composition of the earth. Direct measurements were made of the cubic compressibilities in the pressure range 2000 to 12,000 megabars (1 megabar $=$ 1·0197 kgm./cm.$^2 =$ 0·987 atmos.) Assuming change of compressibility with pressure is a function of the compressibility, the compressibilities of dunite are $0{\cdot}84 \times 10^{-6}$ and $0{\cdot}79 \times 10^{-6}$ reciprocal megabars at 2000 and 10,000 megabars pressure respectively. The velocities of longitudinal waves at these pressures would be 7·9 km/sec. and 8·2 km./sec. Seismological data indicate that the velocity for longitudinal waves at 60 km. depth increases suddenly from 5·9 km./sec to about 8 km./sec. The average compressibility of basalt glass was $1{\cdot}45 \times 10^{-6}$ for the above pressure range, giving a velocity for longitudinal waves of $6{\cdot}4_5$ km/sec. The results suggest the existence below 60 km of ultra-basic rock.—Edwin B. **Frost**, Storrs B. **Barrett** and Otto **Struve**. Radial velocities of 368 helium stars Of these stars, 158 are spectroscopic binaries the periods of revolution of which are mostly only a few days. Using 350 stars, those brighter than mag. 2 have an average residual velocity of 6 km./sec., while for those fainter than mag 5·3 it is 12 km./sec The remainder have intermediate velocities—George E **Hale**: Visual observations of the solar atmosphere. The spectrohelioscope is of value for detecting exceptional phenomena quickly, while observations can readily be made with light of different wave-lengths. The chromosphere, prominences, spots, and faculæ can be investigated, and the instrument affords a means of searching for solar magnetic and electric phenomena. In the laboratory it should prove of service in the study of arcs, sparks, and other light sources with lines of various types.—William C. **Bray** and Hal D. **Draper**: Capillary condensation and adsorption. Sorption isotherms have been found for water vapour on partially hydrated oxides of copper and manganese, and mixtures of them in the form of porous granules There is a rapid increase of sorption at higher pressures due to condensation of liquid in the capillaries This occurs only when the surface, covered with a monomolecular layer by adsorption, is sufficiently curved.—Cecil D. **Murray**: The physiological principle of minimum work. (ii.) Oxygen exchange in the capillaries. The principle of minimum work can be applied to the circulation in the arterial system and in the capillaries The general conclusion is that a minimum principle holds in physiology; the internal environment is in a state of mobile equilibrium, its components settling down to a new equilibrium with new constraints—Cesar **Uribe**: Nuclear division in the trophozoites of *Endamœba histolytica*. Stained preparations were made of the intestine of a cat experimentally infected A consecutive series of stages of nuclear division in trophozoites is described. Cloudy material forming two polar masses and an "axial band" in which the spindle is embedded appear to arise from the karyosome. The polar masses are surmounted by two clear cones with a centriole at the apex of each. The number of daughter chromosomes is estimated as six.—D L. **Hopkins**: The effect of hydrogen-ion concentration on locomotion and other life-processes in *Amœba proteus* Optimum conditions for growth and reproduction of Amœbæ from both acid and alkaline solutions occur at about *p*H 6·7 and *p*H 7·6. Locomotion, measured by sketching a pseudopodium with a camera lucida at minute intervals, shows similar optimum points. A neutral solution seems to cause a marked change in permeability, leading to decreased movement and vitality.—A. F. **Blakeslee** and J. L. **Cartledge**: Pollen abortion in chromosomal types of Datura The size and condition of the pollen is an indication of the chromosomal group to which a plant belongs—Edward **Condon**: Remarks on penetrating radiation. (*a*) Assuming that an electron is a sphere of negative electricity of uniform density and that a proton is a point charge, it is calculated that the 'neutron' can execute simple harmonic motion with a frequency of the same order as that of Millikan's penetrating radiation (*b*) Using a corrected absorption law to accord with the geometrical conditions of Millikan's experiment, the results suggest that the radiation observed is truly homogeneous. There are difficulties in accepting the 'neutron' postulated—Edwin H. **Hall**: New evidence in favour of a dual theory of metallic conduction. This theory gives an explanation of the Peltier development of heat observed by Bridgman, where an electric current changes direction within a metal crystal.—R. de L. **Kronig**: (1) The magnetic moment of the electron. (See NATURE, April 17, p 550.) (2) A theorem of space quantisation—E. O. **Salant**: On the heat capacity of non-polar solid compounds. Taking Born's theory of the heat capacities of crystalline solids and assuming a mean vibration in all directions for the molecule, terms are obtained expressing the contributions to heat capacity by (*a*) molecular vibrations, (*b*) bond frequencies (determined by characteristic bond frequencies in the infra-red), and (*c*) vibrations of the atoms across their bonds—Robert S. **Mulliken**: Systematic relations between electronic structure and band-spectrum structure in diatomic molecules (iii) Molecule formation and molecular structure.—Richard C **Tolman** and Sinclair **Smith**: On the nature of light G. N. Lewis has suggested that an atom never emits a quantum of radiation except to another atom, the possibility of transmission being determined by the laws of interference. His crucial experiment of arranging a mirror on a pivot in order to detect the effect of reflexion of quanta from one half only, those from the other half being forbidden by interference laws, is considered inadequate The suggestion is made that a radiation field contains both waves and light quanta, the latter carrying energy and the former providing a signalling system When and where both wave and quantum theory permit, the action of light occurs.—Einar **Hille**: On Laguerre's series (iii.).—Tracy Yerkes **Thomas**: On conformal geometry.—R. L. **Moore**: Concerning indecomposable continua and continua which contain no subsets that separate the plane

Official Publications Received.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 543. Surface Water Supply of the United States, 1921. Part 3: Ohio River Basin. Pp. vi+263+2 plates. 25 cents. Water-Supply Paper 563: Surface Water Supply of the United States, 1922. Part 3: Ohio River Basin. Pp. vi+258+2 plates. 25 cents. Water-Supply Paper 567: Surface Water Supply of the United States, 1922. Part 7: Lower Mississippi River Basin. Pp. iv+122+2 plates. 15 cents. Water-Supply Paper 572: Surface Water Supply of the United States, 1922. Part 12: North Pacific Slope Drainage Basins. A: Pacific Basins in Washington and Upper Columbia River Basin. Pp. v+193+ii+2 plates. 25 cents. Bulletin 780D: Antimony and Quicksilver Deposits in the Yellow Pine District, Idaho. By Frank C. Schrader and Clyde P. Ross. (Contributions to Economic Geology, 1925, Part 1.) Pp. iv+137-167+plates 18-19. Bulletin 785A: Recent Developments in the Aspen District, Colorado. By Adolph Knopf. (Contributions to Economic Geology, 1926, Part 1.) Pp. ii+28+1 plate. Professional Paper 146: Mississippian Formations of San Saba County, Texas. By P. V. Roundy, George H. Girty and Marcus I. Goldman. Pp. iv+63+33 plates. 35 cents. (Washington, D.C.: Government Printing Office.)

Bird Sanctuaries Committee (England). Report for 1925. Pp. 15. (London: H.M. Office of Works.)

Proceedings of the United States National Museum. Vol. 68, Art. 9: North American Species of Two-winged Flies belonging to the Tribe Miltogrammini. By Harry W. Allen. (No. 2610.) Pp. 106+5 plates. Vol. 68, Art. 10. Field Notes on Gall-Inhabiting Cynipid Wasps, with Descriptions of New Species. By Lewis H. Weld. (No. 2611.) Pp. 131+8 Plates. Vol. 68, Art. 20: A new Genus and Species of Borborid Flies from South America. By Mario Bezzi. (No. 2621.) Pp. 6. Vol. 68, Art. 21: New Genera and Species of Acalyptrate Flies in the United States National Museum. By J. R. Malloch. (No. 2622.) Pp. 35+2 plates. Vol. 68, Art. 23: North American Two-winged Flies of the Genus Cylindromyia Meigen (Ocyptera of Authors). By J. M. Aldrich. (No. 2624.) Pp. 27+1 plate. Vol. 69, Art. 2: The Optical Properties and Chemical Composition of Glauconite. By Clarence S. Ross. (No. 2633.) Pp. 15. (Washington, D.C.: Government Printing Office.)

Year Book of the Academy of Natural Sciences of Philadelphia for the Year ending December 31, 1925. Pp. 100+8 plates. (Philadelphia, Pa.)

Research Publications of the University of Minnesota. Bibliographical Series, No. 2: Research in Progress at the University of Minnesota, July 1924—July 1925. Compiled by Dr. Clarence M. Jackson. Pp. vi+806. (Minneapolis, Minn.) 1.25 dollars.

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 45: Statistics of Universities, Colleges and Professional Schools, 1923-24. Pp. 161. (Washington, D.C.: Government Printing Office.) 25 cents.

Astronomical and Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, in the Year 1924. Under the Direction of Sir Frank Dyson. Pp. 8+Axxxii+A55+iv+B92+C7+Dix+D85+5+Exxii+E76+2l. (London: H.M. Stationery Office.) 27s. 6d. net.

Researches of the Department of Terrestrial Magnetism, Vol. 5. Ocean Magnetic and Electric Observations, 1915-1921. Magnetic Results, by J. P. Ault; Atmospheric-Electric Results, by J. P. Ault and S. J. Mauchly. Special Reports: The Hudson Bay Expedition, 1914, by W. J. Peters; Navigation of Aircraft by Astronomical Methods, by J. P. Ault: The Compass-Variometer, by Louis A. Bauer, W. J. Peters and J. A. Fleming; Sunspot and Annual Variations of Atmospheric Electricity, with Special Reference to the *Carnegie* Observations, 1915–1921, by Louis A. Bauer; Studies in Atmospheric Electricity based on Observations made on the *Carnegie*, 1915–1921, by S. J. Mauchly. (Publication No. 175.) Pp. vii+480+15 plates. (Washington, D.C.: Carnegie Institution.) 7.25 dollars.

Papers from the Department of Marine Biology of the Carnegie Institution of Washington. Vol. 23: Some Marine Bottom Samples from Pago Pago Harbor, Samoa, by M. N. Bramlette; Proportions of Detrital Organic Calcareous Constituents and their Chemical Alteration in a Reef Sand from the Bahamas, by Marcus I. Goldman; Report on a Bacteriological Examination of 'Chalky Mud' and Sea-Water from the Bahama Banks, by N. R. Smith; Recent Foraminifera from Porto Rico, by J. A. Cushman; Fossils from Quarries near Suva, Viti Levu, Fiji Islands, and from Vavao, Tonga Islands, with Annotated Bibliography of the Geology of the Fiji Islands, by Wendell C. Mansfield; Miocene Corals from Trinidad, by T. W. Vaughan and J. E. Hoffmeister. (Publication No. 344.) Pp. ii+184+15 plates. (Washington, D.C.: Carnegie Institution.) 2.50 dollars.

Papers from the Department of Marine Biology of the Carnegie Institution of Washington. Vol. 24: Taxonomy of the Amebas, with Descriptions of Thirty-nine new Marine and Freshwater Species. By Prof. Asa Arthur Schaeffer. (Publication No. 345.) Pp. iii+116+12 plates. (Washington, D.C.: Carnegie Institution.) n.p.

Human Metabolism with Enemata of Alcohol, Dextrose and Levulose. By Thorne M. Carpenter. (Publication No. 369.) Pp. ix+197. (Washington, D.C.: Carnegie Institution.) 2.25 dollars.

Contributions to Embryology. Vol. 17, Nos. 85 to 89. No. 85: Development of the Human Embryo during the period of Somite Formation, including Embryos with 2 to 16 pairs of Somites, by George W. Bartelmez and H. M. Evans; No. 86: Origin and Development of the Rete Ovarii and the Rete Testis in the Human Embryo, by Karl M. Wilson; No. 87: Physiological Study of Cortical Motor Areas in Young Kittens and Adult Cats, by Lewis H. Weed and Orthello R. Langworthy; No. 88: Lymphatics and Blood-Vessels of the Ovary of the Sow, by Dorothy H. Anderson; No. 89: Relation of Onset of Decerebrate Rigidity to the Time of Myelinization of Tracts in the Brain-Stem and Spinal Cord of Young Animals, by Orthello R. Langworthy. (Publication No. 362.) Pp. iii+140+27 plates. (Washington, D.C.: Carnegie Institution.) n.p.

Proceedings of the Board of Agriculture in India held at Pusa on the 7th December 1925, and following days; with Appendices. Pp. iv+154. (Calcutta: Government of India Central Publication Branch.) 1.14 rupees; 2s. 3d.

Patents for Inventions: including some Useful Information on Trade Marks, Designs and Copyright. By Benj. T. King. Pp. 16. (London: King's Patent Agency, Ltd., 146a Queen Victoria Street, E.C.4.) Free.

Observatoire de Zi-ka-wei. 1122 étoiles doubles de J. Herschel: étudiées d'après les catalogues photographiques et les cartes-du-ciel. Par le Rev. P. Gauchet. (Annales de l'Observatoire de Zô-sè, Tome 14, Fascicule 2.) Pp. B72. (Zi-ka-wei, Chang-hai.)

Canada. Department of Mines: Geological Survey. Memoir 144, No. 123 Geological Series: Mount Albert Map-area, Quebec. By F. J. Alcock. (No. 2063.) Pp. ii+75+6 plates. 20 cents. Memoir 147, No. 127 Geological Series: Michipicoten Iron Ranges. By W. H. Collins, T. T. Quirke and Ellis Thomson. (No. 2079.) Pp. iii+175+9 plates. 30 cents. Economic Geology Series, No. 1: Geology and Economic Minerals of Canada. By G. A. Young. (No. 2065.) Pp. iv+187+57. 50 cents. (Ottawa: F. A. Acland.)

Leeds Tercentenary Celebrations. Report of the Tercentenary 'Clean Air' Committee, July 1926. Pp. 52. (Leeds: Walter Gardham.) 3d.

A Bibliography on Research: Selected Articles from the Technical Press, 1923, 1924, 1925. Pp. 46. (New York: National Research Council.)

The Royal Society for the Protection of Birds. Thirty-fifth Annual Report, January 1st to December 31st 1925: with Proceedings of Annual Meeting, 1926. Pp. 108. (London: 82 Victoria Street, S.W.1.) 1s.

Proceedings of the Imperial Academy. Vol. 2, No. 4, April. Pp. vii-xi+149-191. (Ueno Park, Tokyo.)

Annalen van de Sterrewacht te Leiden. Deel 12, Stuk 3. New Mathematical Theory of Jupiter's Satellites 1 and 2: The Intermediary Orbit and the Variations. By Prof. W. de Sitter. Pp. ii+83. Deel 14, Stuk 3: Measures of Double Stars made with the 10½-inch Clark-Repsold Refractor in the Years 1920-1925. By W. H. van den Bos. Pp. 88. (Haarlem: Joh. Enschedé en Zonen.)

Diary of Societies.

MONDAY, JULY 26.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—Dr. P. A. M. Dirac: On Quantum Algebra.—Miss B. Swirles: The Polarisabilities of Atomic Cores.—J. R. Oppenheimer: On the Quantum Theory of the Problem of the Two Bodies. (Preliminary Communication.) *Communicated by title only.* M. H. A. Newman: Integral Invariants of the Affine Field.—Dr. A. Young and Prof. H. W. Turnbull: The Linear Invariants of Ten Quaternary Quadrics.—G. S. Mahajani: A Contribution to the Theory of Ferromagnetism.—E. B. Moullin: On some Resistance Properties of a Certain Network containing Inductances and Capacities, and their Analogies in a Mechanical System.—J. C. Burkill: On Mellin's Inversion Formula.—Major P. A. MacMahon: The Elliptic Products of Jacobi and the Theory of Linear Congruences.—R. Hargreaves: Geodetic and Dynamical Principles, a Comparison and Connexion.—J. R. Oppenheimer: On the Quantum Theory of Vibration-Rotation Bands.—P. A. Taylor: An Approximation to the Motion of Two Rotating Electrical Doublets in a Plane.—D. R. Hartree: Some Relations between the Optical Spectra of Different Atoms of the same Electronic Structure: II. Aluminium-like and Copper-like Atoms.—J. P. Gabbatt: Note on the Extension to Higher Space of a Theorem of Wallace.—J. B. S. Haldane: A Mathematical Theory of Natural and Artificial Selection. Part III.

CONFERENCES.

JULY 26 TO 31.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Lyons).

AUGUST 3 TO 6.

INTERNATIONAL PHYSIOLOGICAL CONGRESS (at Stockholm).

AUGUST 16 TO 23.

INTERNATIONAL BOTANICAL CONGRESS (at Cornell University).

AUGUST 23 TO 28.

AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Perth, Western Australia).—Prof. E. H. Rennie: The Chemical Exploitation, Past, Present and Future, of Australian Plants (Presidential Address).—The Presidents of Sections and the Titles of their Addresses are as follow: *A* (*Astronomy, Mathematics and Physics*), Prof. K. Grant, Atomic Transformation; *B* (*Chemistry*), Prof. J. Kenner, Some Aspects of the Problem of Molecular Structure; *B 2* (*Pharmacy*), A. T. S. Sissons, The Indebtedness of Pharmacy to Organic Chemistry; *C* (*Geology and Mineralogy*), Sir Douglas Mawson, The Igneous Rocks of South Australia—a brief Survey of Present Knowledge relating thereto; *D* (*Zoology*), Prof. L. Harrison, The Composition and Origins of the Australian Fauna, with special reference to the Wegener Hypothesis; *E* (*Geography and History*), Prof. E. Scott, The Discoveries of the Western Australian Coast, with especial reference to Dampier and D'Entrecasteaux; *F* (*Ethnology and Anthropology*), Prof. F. Wood Jones, The Claims of the Australian Aboriginal; *G* (*Social and Statistical Science*), Major L. F. Giblin, Federation and Finance—an Examination of the Financial Relations of States to a Federal Commonwealth; *H* (*Engineering and Architecture*), Sir John Sulman, Town Planning; *I* (*Sanitary Science and Hygiene*), F. S. Hone; *J* (*Mental Science and Education*), P. Board, Social and Economic Values in Education; *K* (*Agriculture and Forestry*), C. E. Lane Poole, Forestry and Land Settlement; *L* (*Veterinary Science*), Prof. J. D. Stewart, The Relationship of Veterinary Science to the Prosperity of the State; *M* (*Botany*), Prof. A. J. Ewart, Past and Future Development of Botanical Science; *N* (*Physiology and Experimental Biology*), Prof. W. A. Osborne, The Study of the Reflex.

AUGUST 26.

MEDICAL WOMEN'S INTERNATIONAL ASSOCIATION (at Prague): Discussions on Tuberculosis and Pregnancy; Women Police-surgeons.

SATURDAY, JULY 31, 1926.

CONTENTS.

PAGE
The Practice of Forestry in the British Empire. By Prof. E. P. Stebbing 145
Science and Psychical Research By Dr. R. J. Tillyard, F.R.S. 147
Civil Aviation in the United States . . . 149
Military Explosives and Gases 150
Our Bookshelf 151
Letters to the Editor:
  Spirals and Waves in Wool.—Prof. J. E. Duerden 153
  The Reduction of Carbon Monoxide.—Oliver C. Elvins and Prof. A. W. Nash . . . 154
  The Spark Spectrum of Lithium.—Sven Werner . 154
  The Distribution of Red Algæ in Relation to Illumination.—Dr. W. R. G. Atkins, F.R.S., and Dr. H. H. Poole 155
  The Caryophyllene Alcohols and their Occurrence in Nature.—Dr. J. Monteath Robertson . 156
  The Reversal of the Hydrogen Series in the Extreme Ultra-Violet.—Prof. Theodore Lyman . . 156
  Plastic Deformation of Single Metallic Crystals.—F. S. Goucher 157
  Use of Pith Dust in Kundt's Tubes.—Prof. Rolla V. Cook 157
  The Ancestral Third Claw of a Spider: *Clubiona interjecta.*—Theodore H. Savory . . . 157
  Egyptian History.—Sir Flinders Petrie, F.R S 157
The Bose Research Institute, Calcutta . . . 158
The Lewis Evans Collection at Oxford. RECENT ADDITIONS. By R. T. G. 160
The Oxford Meeting of the British Association By F. A. D. 161
Obituary:
  Sir Peter Scott Lang 164
  Miss Gertrude Lowthian Bell 165
  Mr. F. Harrison Glew, M.B.E. By Prof. S. Russ 165
News and Views 166
Our Astronomical Column 170
Research Items 171
Society of Chemical Industry: Annual Meeting and Congress of Chemists 173
The Commercial Production of Hormones . . 174
University and Educational Intelligence . . . 176
Contemporary Birthdays 177
Societies and Academies 177
Official Publications Received 180
Diary of Societies 180
Recent Scientific and Technical Books . . iii. Supp.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

The Practice of Forestry in the British Empire.

THE practice of forestry as a science has been a plant of slow growth in the British Empire. Many reasons have contributed to this cause, the chief being the facility with which we have been able to obtain our requirements, either by imports from closely adjacent forests belonging to our Continental neighbours, as in Great Britain, or from the existing primeval forests, as in India and the great Dominions and Colonies. Forestry as a science on a par with agriculture has long been known and practised in many of the great European States. A study of the methods employed and the comparative ease with which forest property, both belonging to the States and to private proprietors, is managed and protected, will show that not only the people on the countryside, but also even the dwellers in the towns, and the great industrial classes, understand the value of forest property and to some extent the aims of a forest policy—that, in effect, the forest, in the economy of the countryside, has an equal value with the tracts devoted to agriculture.

Many motorists from Great Britain annually make the journey from the north to the south of France and pass through great tracts of forest, either in State or private ownership and managed with an efficiency which has long been unknown, or at least unpractised, in Britain. They will have remarked upon the absence of fences. Boundary ditches there may be, or hedges, but little in the nature of the artificially constructed fences so necessary at present in Great Britain if the forest areas are to be safeguarded from a public to whom their economic value to the nation at large is unknown, and from that pest the rabbit. During the War thousands of men and women from the British Empire must have seen some of the forests of France, but very few possessed even the little knowledge of forestry practice which would have enabled them to recognise the differences which underlie the management in France and in Britain; or to have appreciated one of the most essential necessities for the successful practice of forestry in a country—that the public should be so far educated as to understand its true value to themselves and therefore to respect and help in the protection of forest areas.

It is unfortunately a not uncommonly accepted idea in Great Britain that a proper conservation of forest tracts means entire closure and the prohibition of picnic-parties, and so forth; or that the introduction of rational management into such areas of forest as have come down to us from early times in the form of Crown forests, *e.g.* the Forest of Dean, New Forest, etc., entails their destruction as beauty spots or what are termed 'playgrounds' for the public. The controversy which recently took place in the press in connexion with certain beautiful spots in the New Forest—old decrepit woods of admittedly great beauty and picturesqueness—is a case in point. It has had its counterpart in the past in the case of other beauty spots in Great Britain, and even outside Great Britain in other parts of the Empire. The enunciation of such opinions, often by men whose names carry weight with public opinion, incontestably proves that what may be termed a forestry 'sense' is at present lacking in the British public and, it may be added, in the Empire public, if we except perhaps India. The growth of this forestry 'sense' can only arrive with the young generations and through the schools; it is an asset for the future that some schools in Great Britain and the Empire are introducing the teaching of the elements of forestry and its potential value into their curricula.

The love, which is strong in the British, for the maintenance of beauty spots and old woods, is a perfectly natural one and an attribute which any race may be proud to possess. Where trees and woods, however, are in question, it will be conceded that, unlike old historic buildings and famous ruins, no Government department, such as that for the protection of Ancient Monuments, with which the late Lord Curzon was so closely identified, both in India and Great Britain, can maintain them in perpetuity. Each succeeding generation which clamours to maintain untouched, for example, the afore-mentioned old woods in the New Forest, is merely assuring the disappearance from England at no distant date (though they themselves may not live to see it) of one or more famous beauty spots. Yet, as the Continent of Europe well shows, to those possessing the education and knowledge to be able to see and appreciate the management of such problems, it is quite possible to put in practice a method of management which, whilst assuring the minimum of change in artistic values, for forestry and the cult of trees is a lengthy business, will preserve for future generations what the present ones are enjoying.

This is but one aspect of the practice of forestry science, far removed from the commercial aspect, but one in which, owing to the interest aroused, it is of the first importance that the present generations should endeavour to make themselves acquainted with—if only in the interests of their future posterity and the maintenance of many beautiful spots and regions in Great Britain.

That the introduction of and practice of scientific forestry within the Empire has come to stay appears assured from the fact that the Prince of Wales is setting an example to the country by his personal interest in the subject. As president of the Empire Forestry Association, he delivered an address at the annual meeting in March last. As would be expected from the Prince of Wales, he dealt with the matter from the Empire point of view. He alluded to the ten-years planting programme of 150,000 acres undertaken by the Forestry Commission in Great Britain, which it was hoped to complete within the next three years; he then discussed the present position of forestry in South Africa and the planting schemes being carried out in that country to provide its population with "the conifers which Nature has denied them," and the work upon which Canada, Australia, and New Zealand are engaged.

Perhaps as great and, in some cases, greater advances have been made in the many forestry services, some already of considerable age, under the Colonial Office in the Malay States, Nigeria, Gold Coast, Kenya and the other East African colonies, and elsewhere. But the greatest of all, in point of progress, is the case of India. The first scientific forest service inaugurated in the British Empire was commenced in that country more than sixty years ago. A paper dealing with the practice of forestry read in the north of Great Britain a short time ago commenced with the sentence, "Forestry is a new industry which is happily growing up within the Empire, and nowhere more rapidly than at home." In the past, and at the present day, the Empire has often been accused of working in water-tight compartments, and the practice of forestry is no exception to the rule. India is the only country within the Empire at the present day in which it can be said that forestry as a science, occupying its place in the economy of the countryside and in the true interests of the people as a whole, has become recognised and appreciated alike by the statesman, the cultivator, and to a considerable extent by the more educated of the public outside the great towns. The *Journal of the Empire Forestry Association*, to the value of which the Prince of Wales alluded in his address, has clearly exhibited to the trained forest officer the position which forestry science and practice has attained in India—a position which in some parts of the country vies with the best to be seen on the Continent of Europe. A study of the lines of management and work in the Indian forests and the research work which has been carried out, especially in connexion with the utilisation of tropical timbers, will be as useful to many of our Empire forest officers as the studies they have made in Europe.

It would not be in the true interests of forestry in Great Britain to say that, within the short space of time which has elapsed since the Forestry Bill was passed by Parliament some seven years ago, the industry—or, to give it its true name, since the industrial is but one side of the business—the science of forestry has as yet made great strides. A beginning has been made, but forestry cannot hope to take its real place in the economy of the nation or of the Empire as a whole until the public has become educated and has accepted its aims and objects, alike from the economic and amenity points of view.

E. P. STEBBING.

Science and Psychical Research.

The History of Spiritualism. By Sir Arthur Conan Doyle. In 2 vols. Vol. 1. Pp. xiii+342+8 plates. Vol. 2. Pp. vii+342+8 plates. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1926.) 42*s*. net.

THE recent publication of two large volumes entitled "The History of Spiritualism" by Sir Arthur Conan Doyle is perhaps a suitable occasion on which men of science may once again turn their thoughts in a direction in which many more of them are probably interested than would be willing to admit it. Spiritualism is a cult, a faith, or perhaps even a full-blown religion, the central tenet of which is sufficiently well stated by Sir Arthur (vol. 2, p. 263) in the following words:

"A belief in the existence and life of the spirit apart from and independent of the material organism, and in the reality and value of intelligent intercourse between spirits embodied and spirits discarnate."

Spiritualism as a religion does not come within the confines of the subjects which a scientific periodical like NATURE may appropriately discuss. But right through the warp of Sir Arthur's book, though by no means carefully distinguished, and most certainly very unscientifically handled, runs the woof of psychical research, which is, or at any rate purports to be, the *scientific* study of what are called *supernormal phenomena*. These phenomena are of two kinds—(*a*) *physical*, such as telekinesis, or movement of solid objects without contact; independent voice, or the production of sound recognisable as that of the human voice and recordable objectively on a dictaphone; the formation of the substance known as ectoplasm or teleplasm; psychic lights and cold breezes; formation of structures invisible except by the reflection of ultra-violet rays; and so on: (*b*) *mental*, such as clairvoyance, clairaudience, automatic script, telepathy and other similar types of phenomena not involving the use of material objects.

Many years ago, when this question of psychical research was brought to his notice, Huxley replied, "Supposing these phenomena to be genuine, they do not interest me." We are sorry to be obliged to have to record so unscientific a remark from so great a man, and even sorrier to have to admit that Huxley's attitude is still that of the great majority of biologists at the present day. The opinion of any man, however great, or of any body of men, however influential, on a subject which they deliberately refuse to investigate, either because it "does not interest" them, or because of a preconceived idea that the phenomena involved are necessarily fraudulent, is really not worth much. It is a sad commentary on human nature that, even at the present day, when the reality of some at least of these phenomena has surely been put beyond the shadow of a doubt by the work of such men as Lodge and Richet, no scientific man can take up the study of psychical research without 'losing caste' and undergoing either secret or more or less open persecution from his fellows. Truly, we have not got very far from the Middle Ages after all, and there is a very real danger that organised science in the twentieth century is taking its seat in the very chair from which it once drove the medieval church. "E pur si muove" applies equally to the movement of the earth round the sun or to the movement of a levitated table upwards against gravity without visible support. The former was no more incomprehensible and no less anathema to the medieval church than the latter is to-day to organised science. But the spirit of to-day is different from that of the past, and martyrdom no longer wins many converts. Modern Galileos may undergo persecution for what they hold to be the truth, but the modern world will soon forget them in the hurry and rush of modern life, and the truths for which they suffer will perish with them unless they can be presented in such a form as to appeal to the reason of mankind.

It is just here that a great danger lies. The history of the world is full of evolutionary failures; for every organism, Nature selects a path from which there is no turning back. The advance of science during the past seventy years has been definitely along the road to materialism. Though the pace has somewhat slackened and many an anxious glance is now being turned backwards, yet the impetus is still driving us forward mainly in the same direction. For hundreds of years mankind looked to religion to lead them along the right path. Now, in the western world, their gaze is fixed on science. It is certain that, for the next hundred years at any rate, where science leads, there mankind will follow. Are we, the men of science, the leaders of mankind, so absolutely sure of the path along which we are travelling?

Pilate's question "What is Truth?" has never yet been answered, and perhaps it never will be. It is, however, the duty of science to search diligently for truth and to leave no avenue unexplored in which it may be found. The broad highway may lead us to destruction, even if it appears well marked out and easy to travel upon. The neglected side-path, foul with mire and overgrown with noxious weeds, may be the real entry into the Promised Land, for which we are searching. But because of the foul mire, and because of the noxious weeds, organised science refuses to explore this side-path, in spite of the fact that a few brave spirits, more adventurous than the rest, a Crookes, a Lodge, a Richet, have penetrated into the thicket and returned to report both progress and promise.

The present writer cannot claim the experience either of a Lodge or a Richet in the study of psychical research. His interest in the subject is one of comparatively recent growth and arises chiefly from dissatisfaction with the adequacy of present-day biological theories to explain life in acceptable terms. He can, however, claim sufficient experience to be able to say, with both Lodge and Richet, that a clear case has been made out for psychical research, and that it is the duty of science to recognise the genuineness of the phenomena and to attempt to explore them. Fraud exists, and always has existed, in all branches of human affairs. It is even blatantly active in biology, to judge by the remarks passed quite recently by leading British and American biologists on the work and character of a certain Austrian professor. Let fraud and cheating be exposed, certainly, wherever it exists; but is that any reason for refusing to accept as a recognisable branch of science any subject in which fraud has been found?

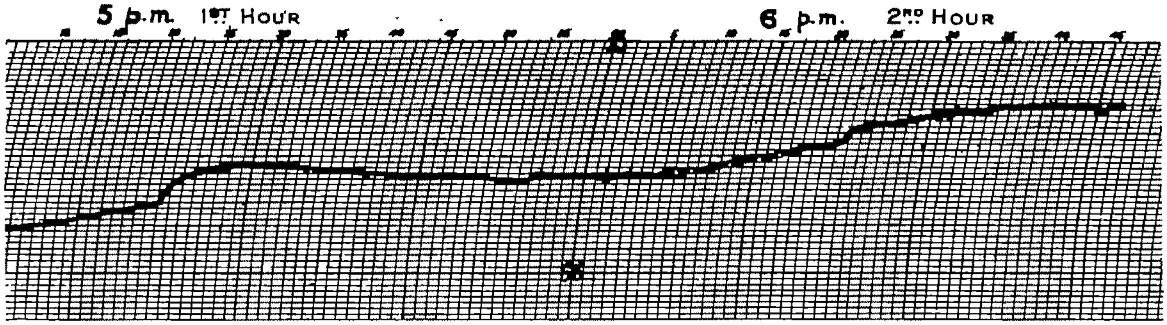


FIG. 1.—Thermograph record inside Pugh table. Temperature at 5.10 P.M., before beginning of séance, 67° F. Red light throughout.

5.23 P.M. Stella goes into trance. Marked rise in temp.
5.30 to 5.55 P.M. Steady fall in temp.
5.55 P.M. Electric bell with contact inside closed cage was rung vigorously four times within a minute or two. Note irregularity in thermograph record.
6.24 P.M. Bright light flashed inside cabinet.
6.29 P.M. Zither pushed partly out of opening in Pugh table.
6.33 P.M. Two very fine blue flashes inside Pugh table.
6.42 P.M. Stella comes out of trance

Note.—Cold breezes preceded each of these phenomena. Other phenomena were also recorded at 5.39, 5.42, 5.48, 5.51, 5.58, 6.01, 6.05, 6.07, 6.10, 6.16, and 6.18 without any sudden variation of thermograph record.

The control thermograph record taken separately on the wall of séance room, about 10 feet from the medium, showed a steady rise in temperature without any marked changes in gradation from 67° F. at 5.10 P.M. up to 69.5° F. at end of séance.

It appears to the writer that the best avenue of approach for men of science to make on this subject is the study of the so-called physical phenomena. Either these are entirely fraudulent (that is, due to conscious or subconscious cheating on the part of the medium), or else they extend the realm of physics beyond the boundaries explored at present. Take, for example, one of the simplest and most easily experienced of the physical phenomena, that of *cold breezes*, which generally precede any manifestation of greater energy in a séance. It has been maintained that this effect is purely subjective, that the sitters imagine they feel the cold owing to the tense situation created in the mental atmosphere of the séance room. In the National Laboratory of Psychical Research, two very accurate thermographs have recently been installed. One of these is placed against the wall of the room, far from the sitters, while the other records the changes which occur in the temperature of the closed cage of the Pugh table in which phenomena occur during sittings with the medium Stella C. in red light.

Normally, when a number of people sit in a closed room, the temperature mounts steadily upwards; this is also the case for the temperature of the séance room as recorded on the wall during a sitting. But the record of the temperature inside the Pugh table shows a steady rise at first, followed by a fall during the production of supernormal phenomena, as in the accompanying record (Fig. 1); there are also several marked sudden changes at points where special phenomena occurred. These careful experiments prove the objective nature of the cold breezes and present us with a purely physical problem, which is surely worth solving. It is not an extravagant hypothesis which finds an explanation for the production of 'supernormal' physical phenomena in the withdrawal of heat from the circle of sitters, such heat being turned into some other form of energy, possibly of a kind not yet investigated officially by science!

The so-called 'physical' phenomena of mediumship should be of interest to biologists as well as to physicists, because, if they are genuine, they offer an avenue towards the study of the control and manipulation of matter by mind which is at present unique in its character. The invisible operators who apparently control the more striking phenomena of mediumship claim that they are able to draw out from the organism of the medium 'psychic stuff,' by the moulding of which they can produce at will the phenomena of independent voice, levitation, materialisations of portions of their personalities, and so on. We who have seen these things done under conditions precluding deliberate fraud are not fools, but in full possession of keen faculties. Every man who witnesses these phenomena and becomes convinced of their reality has only two choices before him. He can, as numbers have done, keep quiet and say nothing about it, thereby preserving the respect of his fellow-scientists and committing the sin against the Holy Ghost, namely, turning his back on truth when he has recognised it; or he can, like Sir Oliver Lodge, speak out the truth boldly and allow his reputation to drop in the estimate of his fellow-men. The writer ranges himself alongside Sir Oliver, well knowing what is in store for him in consequence. This article is a plea for a wider and more generous outlook on the part of science towards these phenomena. Science has nothing to fear from fraud; it need only go on applying its experimental method to any problem, and a solution will shape itself in time, either in the form of an overwhelming proof of the fraudulent production of the phenomena, or pointing towards the existence of genuine supernormal results.

The mind of man seems to have reached out so far in recent years that it has almost succeeded in exploring the entire limits of its own cage. Is it to rest in the belief that there is nothing at all outside that cage, or may it, so to speak, extend a cautious paw outside the bars and begin to feel its way towards a realisation that there may be another world outside? Psychical research may perhaps afford the only possible way of exploring the unknown territory outside the cage.

R. J. TILLYARD.

Civil Aviation in the United States.

Civil Aviation: a Report by the Joint Committee on Civil Aviation of the U.S. Department of Commerce and the American Engineering Council. Pp. xvii + 189. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) *12s. 6d.* net.

IN Europe rapid developments have been made in the application of aircraft to commercial uses. In the United States, however, air transportation, in spite of many conditions naturally favourable, has not achieved a development commensurate to the opportunities.

The Department of Commerce and the American Engineering Council, recognising this deficiency, have for some time past gathered information relating to this matter. A joint committee was formed in June 1925, to make a comprehensive survey of the economic aspects of aviation throughout the world, and to recommend the measures necessary to encourage a national development of commercial aviation in the United States. All available sources of information on this subject have been examined by the committee, including the attitude of American business interests and the experience of aircraft operators.

In the report before us, which here deals comprehensively with the situation, the committee lays down first and foremost the development of the commercial side of aircraft as of vital importance both to industry and to national defence. Whilst stressing the fact that development must mainly depend on private initiative and enterprise, the committee maintains that provision of facilities essential to this development is a public responsibility, and, if these facilities are provided, direct subsidies to civil aviation in the form of money grants are both unwise and unnecessary.

Certain fundamental difficulties, the committee maintains, are retarding the development of this venture in the United States. Broadly speaking, they are intimately associated with the lack of an established Government policy to encourage civil and industrial uses of aircraft; with the lack of commercial aircraft and equipment best adapted to commercial operation; and with the consequent want of public and business confidence and support.

After due consideration of the large part played by the commercial department and by big businesses in this field, the committee recommends a number of far-reaching proposals which, if adopted, would undoubtedly make a ground-work for a vast new development eminently suited to the geography of the United States. It is proposed that Congress should enact a civil aeronautic law providing for the establishment of a Bureau of Civil Aeronautics in the Department of Commerce; that is to say, it is to be completely dissociated from the military or naval wing. It would be the function of this bureau, among other duties, to regulate civil air navigation, license pilots, and inspect machines; to develop, establish, and take over air routes and facilities, and generally to encourage and promote the aircraft industry on the civil side.

The committee, moreover, recommends that the several States should authorise their municipalities to acquire landing fields out of public funds and to lease them when necessary. Great stress is laid on the fact that the Government should not undertake any non-military flying activities, but that it should be left entirely within the scope of private operation. Even air mails, forest patrol, agricultural, entomological, and coastguard services, aerial photography, map making, etc., should be conducted by private agencies under contract wherever possible. Much assistance, however, is expected from the Government departments; the war, naval, and other departments are to permit the use of Government landing fields and to provide facilities for commercial operations. The Post Office should retire from the ownership and operation of air mail routes as soon as it is possible to contract with responsible private operators. The purchases of Government aircraft are to be arranged to confotm to a definite and continuous programme which will give the greatest aid to the industry, and State encouragement is to be extended to the exportation of commercial aircraft.

Whilst much of the report is thus concerned with the part to be played by private owners, under security and assurance which is to be granted to those who are thus encouraged to invest their capital in the industry, scarcely any mention is made of that form of research and development which would be vital to maintain such an industry in the forefront of technical and scientific knowledge. There does occur a bald statement that the Government should carry on fundamental aeronautical research in the interests of civil aviation, but, unlike the other sections of the recommendations, this aspect does not appear to have been expanded, or its far-reaching implications grasped. From the point of view of the corresponding industry in Great Britain, it will be an interesting experience to watch how these proposals work themselves out in practice.

Military Explosives and Gases.

Explosifs, poudres, gaz de combat: leçons professées à la Faculté des Sciences de Lille. Par Paul Pascal. Pp. viii + 296. (Paris: J. Hermann, 1925.) 35 francs.

THIS book embodies the lectures delivered by Prof. Paul Pascal, of Lille, to candidates for the French Service des Poudres. While in Great Britain the Royal Naval College and the Artillery College afford specialised instruction to combatant officers in the subject matter of these lectures, in France this is also obligatory for chemical engineers destined for employment in the Government factories.

The first part of the book deals with the different aspects of explosive reactions, such as the temperature and pressure of explosion, its propagation on one hand by the explosive wave, and in the case of propellants by rapid burning, along lines which have been developed by the French masters in this subject, such as Berthelot, Vieille, Sarrau, and Le Chatelier.

The second and third parts deal with the manufacture of explosives, together with the properties of several of the more important ones. Naturally, in a book of this size, manufacturing details cannot be exhaustively given, and the treatment is sometimes unequal. At the same time, several of the processes used in Great Britain are accurately described, such as the displacement process for making nitroglycerine of Nathan, Thomson and Rintoul, and the displacement process for making nitrocellulose of the Thomsons.

The production of explosives derived from aromatic hydrocarbons was greatly hampered by France's loss of territory containing coke ovens, and acknowledgment is made of the assistance afforded by Great Britain in sending over benzol, the partition being roughly that while we kept the toluene to ourselves, France was supplied with the benzol from which were made phenol and its derivatives so largely used in French explosives during the War.

The occurrence of isomerides in the nitration of toluene is clearly described, as well as the large-scale methods for making trinitrotoluene. Thus attention is directed to the important features of the process developed in Great Britain, such as the detoluation of the waste acids and the process for continuous nitration of mononitrotoluene, a sketch of a nitrating vessel used here in the large factories being included. Mention is also made of the purification of the trinitrotoluene by alcohol and by sodium sulphite, although the principle of the latter process, which was developed first in France, is not described. As would be expected from the use of nitronaphthalenes in France for many years, their manufacture is fully illustrated, as is also that of synthetic phenol and its nitro derivatives, including a sketch of a continuous nitration process developed in this country for picric acid.

The manufacture of nitric peroxide and its use in aerial bombs, in which the fuel for this oxidising material was kept apart until the bomb was launched on its flight, are also described, this being a type of bomb that was used to some extent by the French when it was desired to have a very violent local effect.

Sections are devoted to the manufacture of gunpowder and also to the mixture of ammonium nitrate with the nitronaphthalenes, but little is said of the British Service high explosive amatol (ammonium nitrate and trinitrotoluene), the use of which it is understood the French were contemplating on a larger scale towards the end of the War.

Under smokeless propellants a description is given of the methods of manufacture of Poudre B, and the

French views are stated as to the stabilising action of amyl alcohol and diphenylamine. As a war measure these substances were sometimes omitted, and the nitrocellulose propellant was tinted red as a distinguishing mark. While the composition of British cordite MK. I. is correctly given, cordite M.D., which superseded it, is not mentioned; the composition, however, is given of cordite R.D.B. adopted by Great Britain for land service during the War, as it utilised the solvent ether-alcohol instead of acetone which was impossible to obtain in the quantities required. There is a short section on the preparation and properties of the initial detonants, mercury fulminate and lead azide.

The fourth part deals with gases used in warfare, and after a short statement as to their first employment and subsequent tactical use, proceeds to describe the different natures of 'gas,' lachrymatory, toxic and vesicant, sternutatory, etc., and the manufacture of various types. The longest description is given to mustard gas, for the making of which the different processes are compared; the French method of reacting on ethylene with a mixture of chlorides of sulphur approaching sulphur dichloride in average composition and dissolved in carbon tetrachloride is given in some detail.

Sections are also devoted to compounds of arsenic, their physical constants, such as density and vapour tension; in some cases figures are given illustrating methods of manufacture of these bodies.

This book should prove of interest to the technical expert, not only from the presentation of its subject matter, but also as it gives reasoned views sometimes at variance with those held in Great Britain. While the explosive subjects are treated in a manner suitable for the students to whom they are addressed, there would seem to be insufficient information on the properties of the explosives. Thus the book would have been more valuable if it had included some collected information giving the heat produced on detonation of the different types of explosives and their chemical stability, their sensitiveness, rates of detonation, and explosive effects.

Our Bookshelf.

Manual of the New Zealand Flora. By T. F. Cheeseman. Second edition, revised and enlarged by the Author. Edited by W. R. B. Oliver. Pp. xliv + 1163. (Wellington, N.Z.: W. A. G. Skinner, 1925.) n.p.

THE appearance of the long-expected second edition of Cheeseman's manual is most welcome, and, as the editor remarks, "the present edition of the manual will long remain the standard work on the flora." It is much to be regretted that Mr. Cheeseman died before the work was completed; but his full notes on the unfinished portions have enabled Mr. Oliver to complete the book according to Mr. Cheeseman's original ideas.

The value of the new edition is shown in the fact that 192 additional species, the greater number of which are new to science, are enumerated therein. In the family Compositæ alone 40 additions have been made, while in Scrophulariaceæ 25 new plants have been recorded, 19 of these being included in the genus Veronica. All but one of these latter belong to the very critical section Hebe (now considered a separate genus). A useful feature is Mr. Oliver's continuation of the history of botanical discovery in New Zealand, covering the years 1905–24, in which he gives references to the more important work done on the flora and cites broadly the places of publication. The list of Mr. Cheeseman's publications is an apt tribute to the writer of the manual, and at the same time valuable for purposes of reference. The lists of introduced species and native names have also been revised and enlarged and are of great value to the student. It is to be hoped that a fuller treatment of the former will not be long delayed.

In the body of the book the most notable feature is the replacement of Bentham and Hooker's system by that of Engler and Prantl in the arrangement of the families. Although this brings the manual into line with many modern floras, it is doubtful if such an alteration is advisable at the present time, when systems of classification are again under consideration. It is also rather a pity that the sub-kingdoms, classes, and sub-classes are not separated from one another adequately in the text, in accordance with the synoptical key given in the appendix.

In detail the arrangement of the text follows closely that of the first edition. One difficulty which is encountered in working with the manual in herbaria is the absence of collector's numbers in the enumeration after each species, but this, of course, does not arise in the field. Nevertheless, with the exception of a few minor mistakes, especially in the references, the general arrangement and finish of the book reach a high standard.

In spite of the many additions, the book has been kept within approximately the same compass by a slight enlargement of the pages, so that the whole volume is still easily handled.

Ticks: a Monograph of the Ixodoidea. By George H. F. Nuttall, C. Warburton and L. E. Robinson. Part 4: *The Genus Amblyomma.* By Dr. L. E. Robinson. Pp. xii + 302 + 8 plates. (Cambridge: At the University Press, 1926.) 20*s*. net.

THE genus Amblyomma is by far the richest in species of the genera of ticks, comprising many forms remarkable for the beauty of their ornamentation. Dr. L. E. Robinson considers the number of valid species to be eighty-six. Although not of such great importance as carriers of disease as some other genera—for example, the cattle ticks (Boophilus), also the genera Rhipicephalus and Dermacentor—the genus Amblyomma includes several forms very injurious to domestic animals. The South African 'Bont tick' (*Amblyomma hebræum*) is the principal transmitter of heartwater—

a disease frequently fatal to sheep, goats, and cattle. This tick and some allied species are known to cause very severe ulcerating sores, sometimes leading to the loss of one or more udders of the host. Pyæmia and other complaints of horses due to soil-infesting organisms are also believed to ensue from the bites of *Amblyomma variegatum* and allied forms. Live-stock infested with these ticks sometimes suffer greatly from loss of blood and 'tick worry' due to the large number of parasites present. The larvæ of *Amblyomma cajennense*—a common tick in the West Indies, Central and South America—are a great plague, freely attacking man and domestic animals.

Clear and concise descriptions of all the known species of Amblyomma are given in this work, and the illustrations are numerous and excellent. A few notes on biology are to be found at the end. Parthenogenesis is recorded as occurring in *Amblyomma dissimile* and *A. rotundatum*. The author is to be congratulated on producing a monograph which will certainly be of the greatest value to all scientific workers interested in the Ixodoidea, and will no doubt for many years remain the standard work on the genus Amblyomma.

A. S. H.

Die Kriegsschauplätze 1914–1918 geologisch dargestellt. In 13 Heften. Herausgegeben von Prof. Dr. J. Wilser. Heft 2 (zu Heft 1 gehörig): *Lothringen.* Von Prof. Dr. E. Kraus. Mit einem Beitrag (Abschnitt Jura) von Dr. W. Klupfel. Pp viii+212+4 Tafeln. 24 gold marks. Heft 3: *Zwischen Maas und Mosel.* Von Prof. R. Lais. Pp. iv+116. 13·50 gold marks. Heft 13: *Südostmazedonien und Kleinasien.* Von Prof. Dr. O. H. Erdmannsdoerffer, Prof. Dr. Cl. Lebling, Prof. Dr. K. Leuchs, Dr. K. Osswald, Dr. A. Wurm. Pp. v+114+4 Tafeln. 18·60 gold marks. (Berlin: Gebrüder Borntraeger, 1925.)

THE conception of a series of volumes portraying the geology of the War areas as such has little to commend it either from the scientific or from any other point of view. Apparently numerous geologists were attached to the German Imperial staff to advise on such matters as water-supply, building materials, and the laying of mines; in the present volumes the results of their investigations are brought together.

Of the three now before us, the first two deal with areas of the western battle front, and give a fairly detailed account of the local stratigraphy and tectonics; there seems to be but little new matter, the contents being mainly a digest of information long ago published elsewhere. The volume on south-east Macedonia and Asia Minor consists of a series of articles recording the original observations of several geologists, who give most attention to tectonic structure; a few are accounts of hurried traverses, but a number of districts are surveyed in some detail.

The Effects of Inanition and Malnutrition upon Growth and Structure. By Prof. C. M. Jackson. Pp. xii+616. (London: J. and A. Churchill, 1925.) 30*s.* net.

PROF. JACKSON'S book is a systematic review of the subject of inanition, which term he uses to indicate the lack of food or of any food-stuff which is essential to the living organism. The general outline is on a strictly anatomical basis, the effects of starvation and malnutrition being considered separately for each system of the body. There are also included chapters on the effects of inanition on plants, protozoa, and the higher invertebrates. The book is singularly complete. The author not only gives the results of his own researches into the subject, but reviews in the widest possible manner the literature of the last fifty years. He classifies the various states of inanition according to their character, degree, duration and severity, and mode of occurrence, and discusses fully the results of experimental starvation and the observations of morbid anatomists on cases of clinical malnutrition and deficiency diseases. Being a study from the morphological aspect, the book is of theoretical rather than practical interest to the physician, but it will be warmly welcomed by the pathologist and biologist. It is well indexed, and a very full bibliography is included.

The Works of Aristotle. Translated into English under the Editorship of Prof. W. D. Ross. *Categoriæ* and *De Interpretatione*, by E. M. Edghill; *Analytica Priora*, by A. J. Jenkinson; *Analytica Posteriora*, by G. R. G. Mure. Pp. 348. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) Paper, 6*s.* net; cloth, 7*s.* 6*d.* net.

THE monumental work of the English translation of all the writings of Aristotle by the Oxford Aristotelian Society, under the editorship of Prof. W. D. Ross, has received its latest accession in this volume, which contains four of the logical treatises. They constitute the work of Aristotle which is usually placed at the beginning and about which there is the least difficulty and the smallest amount of controversy. More than anything else, more even than the "Metaphysic," they are responsible for the idea of 'authority' which attached itself to the name of Aristotle throughout the Middle Age. This edition makes it possible for the English reader to understand how the philosopher Immanuel Kant could cite logic as the example of a science which had emerged complete and perfect from its first formulation, and take it as the model of the work he himself proposed to do for metaphysics.

Physikalisch-chemische Mineralogie und Petrologie: die Fortschritte in den letzten zehn Jahren. Von Prof. Dr. Wilhelm Eitel. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, Band 13.) Pp. viii+174. (Dresden und Leipzig: Theodor Steinkopff, 1925.) 8 gold marks.

THIS is a welcome addition to the series of which it forms part. Within the limits of its scope, it is an invaluable guide to the results of recent investigations on the physics and chemistry of minerals and rocks. It is not intended to supersede larger works such as that of Boeke; but to constitute a supplement by which the student of the subject may bring his knowledge up-to-date. Similar publications are to follow on kindred subjects. It will be noticed that the author speaks of "Petrologie," not "Petrographie," as he is concerned with the evolution, not the mere discription, of rocks.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spirals and Waves in Wool.

ALL the Merino wool imported from Australia and South Africa is characterised by a conspicuous waviness throughout the individual lock or staple (Fig. 1). When drawn out, each separate fibre exhibits a regular series of convexities and concavities, and it is the adjustment of these to one another which gives the waviness to the complete lock. They are permanent structural features, returning after the elastic fibre has been stretched. The degree of the waviness, whether close or open, shallow or deep, varies in individual fleeces, and affords a ready means by which the farmer and manufacturer estimate the fineness or coarseness of the wool, from which the 'spinning count' is largely determined.

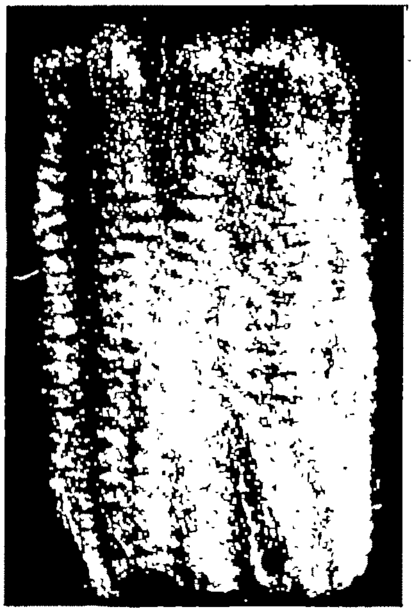


FIG. 1.—Staple of coarse Merino wool showing waves or crimps.

Much discussion has taken place recently as to the manner of formation of this waviness, whether determined by unequal lateral growth of the fibre within the follicle or superimposed later by the mechanical conditions in the fleece. A comparison of the fine, compact, short Merino wool with the coarse, open, long wool of many of the British breeds is found to afford a satisfactory solution of the problem. In the first instance, examination has been made of the natal coat of a large series of Merino, Karakul, and British breeds of sheep, and these show a remarkable degree of similarity, despite the conspicuous differences which the adult fleeces display. In all instances the coat of lambs at, and shortly after, birth is constituted of short spiral tufts, curls or ringlets of wool, usually intermingled with larger, coarser, medullated fibres known as kemp, and representing the outer coat of primitive sheep (Fig. 2). The spirals reach their most regular and compact form in the natal coat of the Karakul, and it is this which gives the attractiveness of the so-called Astrakhan fur. They are well shown as close, distinct spirals in the Merino and Southdown, and as loose and more open in the curl in the coarse, straight wool of the Scotch blackface, but all intermediate stages can be obtained by comparing different breeds, or even from within a single breed. It is significant of the common origin of all the varieties of sheep that at this early stage of their ontogeny their woolly coats should bear such a close resemblance.

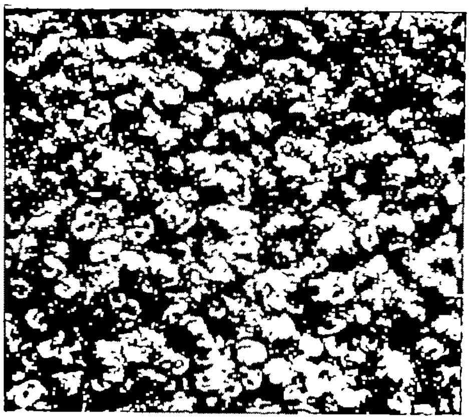


FIG. 2.—Natal fleece of Southdown with spiral tufts or ringlets under an outer coat of kemp fibres.

Enclosed as the unborn lamb is within the fœtal membranes, and surrounded by the amniotic fluid, it is clear that the individual fibres, however close or scattered, can have little or no mechanical influence upon one another, and each one is free to assume the form impressed upon it by its structure. Therefore the spiral form they assume in the natal coat may be deemed to be that given them from their growth within the follicle, and to represent, as it were, the natural form of the fibre.

With the continuance of fibre growth after birth, new factors are introduced which modify the natural spiral form. If the staples are sufficiently free from one another as to be unimpeded in their growth, each continues the natal spiral form, and we get the well-known ringlets of the Leicester, Lincoln, and Wensleydale, as well as of the Angora goat. If, however, the fibres are so closely arranged that the staples press upon one another and form a compact fleece, then each lock is mechanically unable to assume the independent spiral form and the wavy structure is produced. The change can be best illustrated by compressing a rather open spiral of wire, the spire when flattened assuming a wave-like form, altogether resembling the waviness in the wool fibre. All

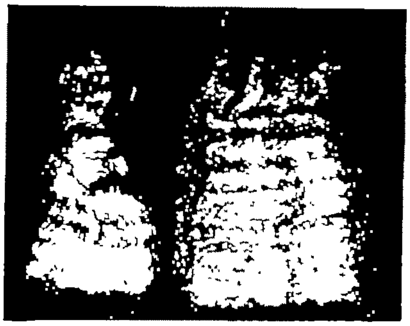


FIG. 3.—Staples of lamb's wool with spiral tufts (mother hair) at tip and wavy wool below.

degrees of transformation of the spiral lock into the flattened wave can be traced in such fleeces as the Border Leicester, according as the staples are free throughout their length ('locky') or compact below for a greater or lesser part of their length.

The change from spiral to wave is also recognisable in the first coat of sheep having a short compact fleece, as in the Merino and Southdown. At birth, as already remarked, the coat consists of independent spirals, maybe with an outer coat of kemp. The spirals grow upwards as the tip of the corresponding lock or staple and retain their form, while the wool below is in waves or crimps (Fig. 3). The spiral tips, known to the farmer as 'mother hair,' enable the woolman to determine wool of the first from later shearings.

J. E. Duerden.

Animal Breeding Research Department,
University of Edinburgh,
June 17.

The Reduction of Carbon Monoxide.

F. Fischer (*Brennstoff Chem.*, 7, 97, 1926), in describing the formation at atmospheric pressure of solid, liquid and gaseous hydrocarbons by passing a mixture of carbon monoxide and hydrogen over a variety of catalysts, has advanced the theory that hydrocarbon formation depends on the transient formation of high carbon carbides which, by the action of hydrogen, give rise to products similar to petroleum. He states that no acids or other oxygenated substances are formed.

We have confirmed the formation of liquid hydrocarbons by passing an artificial water gas over a catalyst consisting of reduced manganese, cobalt and copper oxides (*Fuel*, 5, 263, 1926). Further experiments have shown the possibility of synthesising oxygenated compounds from this gas mixture, at ordinary pressure, although the literature available on the subject seems to indicate that pressure is essential for the production of such compounds. From thermodynamic considerations (Matignon), the reaction $CO + 2H_2 \rightarrow CH_3OH$ is scarcely possible at atmospheric pressure and $CO + H_2 \rightarrow HCHO$ cannot be carried out at all. The following reactions are perhaps possible:

$$2CO + 4H_2 \rightarrow C_2H_5OH + H_2O.$$
$$3CO + 5H_2 \rightarrow CH_3COCH_3 + 2H_2O.$$
$$2CO + 2H_2 \rightarrow CH_3COOH.$$

In an experiment where a gas mixture (composition 53·9 per cent. carbon monoxide and 44·6 per cent. hydrogen) was passed at atmospheric pressure over a contact mass consisting of the reduced oxides of manganese, cobalt and copper, impregnated with 0·5 per cent lithium carbonate at 302° C., we obtained evidence of the formation of products apparently similar to those obtained in the now well-known high-pressure reactions between these gases over certain catalysts.

In this experiment 1·2 c.m. of the gas mixture gave 1·4 gm. of a yellow oil not miscible with water, and water-soluble acids equivalent to 0·33 gm. of potassium hydroxide. The steam distillate from this solution of potassium salts of the acids, on distillation through a column, gave about 0·5 c.c. of a pleasant smelling liquid with a boiling range of 74-80° C. This liquid possessed a ketonic odour and gave the iodoform reaction in the cold, but did not readily reduce ammoniacal silver nitrate. Reducing substances were present in the aqueous part of the fractionated liquid. There was also formed 0·5 gm. of solid which blackened on exposure to light and air.

The theory of the intermediate formation of carbides advanced by Fischer does not suffice to explain the formation of oxygenated compounds.

It is possible that the hydrocarbons he obtains are formed by the dehydration of alcohols followed possibly by hydrogenation, but again this does not explain the absence of acids and ketones from the products obtained by him at atmospheric pressure.

If the view is accepted that catalysis is an acceleration of reactions already taking place, then the formation of organic substances, other than methane and carbon dioxide, must depend on the preferential acceleration of the definite reactions which give rise to them. In the case considered here the question is complicated by the probability that not only does hydrogenation take place, but also oxidation, dehydration, and possibly polymerisation.

The reaction stages, if any, which lead to methane from carbon monoxide and hydrogen are possibly

$$\begin{aligned} & CO + 3H_2 \rightarrow CH_2O + 2H_2O \rightarrow CH_3OH + H_2 \\ & \qquad\qquad \rightarrow CH_4 + H_2O \\ \text{and}\quad & CO + H_2O \rightarrow CO_2 + H_2. \end{aligned}$$

Up to the present, however, the formation of formaldehyde and methyl alcohol has not apparently been established at ordinary pressure without the intervention of extraneous sources of energy such as ultra-violet light, X-rays, etc.

The formation of oxygenated compounds and hydrocarbons may also be regarded as being preceded by the hypothetical formation of methyl alcohol, which is converted, according to the catalyst and the experimental conditions, into methane or into other substances. Thus the reaction may proceed in consecutive stages or the catalyst may accelerate one or more of the thermodynamically possible reactions from carbon monoxide and hydrogen. No doubt, where a mixed product of aldehydes, ketones, acids and hydrocarbons is obtained, both of these courses may be followed.

Manganous oxide, cobalt and copper are not generally considered to have dehydrating powers as catalysts, but Medsforth (*J. Chem. Soc.*, 123, 1452, 1923) has explained the action of nickel in methane formation as being partly of a dehydrating nature, while the addition of oxide with dehydrating properties leaves the nickel more free to accelerate the hydrogenation stage of reaction. Nevertheless, we are of the opinion that the majority of the products obtained, in which acids, alcohols, ketones, aldehydes and hydrocarbons are all probably present, are formed simultaneously rather than consecutively. Carbon dioxide, water and methane would have to be considered in formulating chemical equations for the reactions involved.

Oliver C. Elvins.
A. W. Nash.

Department of Oil Engineering and Refining,
University of Birmingham.

The Spark Spectrum of Lithium.

It has been shown by Schuler and the present author that the first spark spectrum of lithium (the Li II spectrum) is of the same type as the arc spectrum of helium and consists of two spectral systems. In a letter published in Nature of October 17, 1925, a scheme of those terms of the lithium spark spectrum was given, which must be considered as analogous to the terms of the ordinary 'doublet' spectrum of helium (the orthohelium spectrum). In this note the results of further research on the lithium spark spectrum will be given. A number of new spark lines has been found which makes it possible to establish a series scheme of the terms of the lithium spark spectrum which are analogous to the terms of the singulet spectrum of helium (the parhelium spectrum).

To distinguish between the two spectral systems it is proposed to denote the system, which by analogy with the parhelium spectrum must include the normal state of the spectrum, the *p*-system of the lithium spark spectrum (abbreviated the Li II *p*-spectrum), while the other by analogy with the orthohelium spectrum will be denoted as the *o*-system of the lithium spark spectrum (the Li II *o*-spectrum). As observed first by Schüler (*Ann. d. Phys.*, 76, 292, 1925), and confirmed by recent observations by the author, the Li II *o*-spectrum is not a doublet spectrum, but seems to be a triplet spectrum of a type different from the ordinary triplet spectra.

Table I. gives the wave-lengths of the lines belonging to the Li II *p*-spectrum, and their series notation. The numbers in brackets are the estimated intensities of the lines, relatively to the lines of the *o*-spectrum given in my former letter (*l.c.*). It will be seen that the *p*-spectrum as a whole is considerably weaker than the *o*-spectrum. A similar behaviour is observed in helium under the same conditions of discharge, the parhelium spectrum being weaker than the orthohelium spectrum. Table II. gives the terms derived from the lines in Table I., with the effective quantum numbers (n^*) added in brackets.

TABLE I.

5037·8	(1)	$3P$-$4S$	2952·7	(0·5)	$3S$-$5P$
4788·8	(1·5)	$3P$-$4D$	2767·0	(1)	$3P$-$6D$
4677·7	(2)	$3D$-$4F$	2730·7	(0·5)	$3D$-$6F$
4156·3	(0·5)	$3S$-$4P$	2508·9	(0·3)	$3D$-$7F$
3305·2	(0 5)	$3P$-$5S$	1681·8	(2)	$2P$-$3D$
3249·8	(1)	$3P$-$5D$	1755 4	(3)	$2P$-$3S$
3199·4	(1·5)	$3D$-$5F$			

TABLE II.

$3S=$ 51300	($n^*=2·925$)	$3D=48803$	($n^*=2$ 999)
$4S=$ 28484	($n^*=3$ 926)	$4D=27448$	($n^*=3·999$)
$5S=$ 18080	($n^*=4$ 927)	$5D=17464$	($n^*=4$ 999)
		$6D=12200$	($n^*=5·999$)
$2P=108264$	($n^*=2·014$)		
$3P=$ 48328	($n^*=3$ 014)	$4F=27434$	($n^*=4·000$)
$4P=$ 27244	($n^*=4·014$)	$5F=17556$	($n^*=5$ 000)
$5P=$ 17440	($n^*=5·017$)	$6F=12193$	($n^*=6$ 000)
		$7F=$ 8957	($n^*=7$ 000)

The value of the term $2S$ has not been found. An extrapolated value of this term ($2S=120000$) shows that the line $2S$-$2P$ is in the infra-red at about λ8500 Å U., and for $2S$-$3P$ (λ about 1400 Å.U.) no line has been observed which with certainty could be ascribed to this transition. It is not possible to give the value of the $1S$-term corresponding to the normal state. The excitation potential of the $2s$-$2p$ line seems to be about 60 volts, and from this the ionisation potential for the Li^+ ion can be estimated to be about 70 volts, which gives the value 550000 for the $1S$-term and for n^* a value between 0·85 and 0·90.

The scheme given in Table II. is in good agreement with the theoretical expectations. For the theory of the spectrum of an atom with two electrons, the reader is referred to a paper by W. Heisenberg, soon to appear, and a paper by I. Waller.

A remarkable feature is that the two strong lines 2934 Å.U. first reported by Mohler, and the line 3715 Å.U. first reported by Schüler, seem, contrary to what was previously assumed, not to belong to the series of the ordinary lithium spark spectrum. From a kind communication from Dr. Paul Foote, the author learns that Dr. Schüler has arrived at the same conclusion.[1] The excitation voltage of these lines is nearly the same as that of the strong green Li II- line ($2s$-$2p$). In addition to these two lines, two rather strong lines at 4607·4 Å.U. and 2337·0 Å.U. have been observed, which seem to be of the same character.

SVEN WERNER.

Universitetets Institut for teoretisk Fysik,
Copenhagen, June 16.

The Distribution of Red Algæ in Relation to Illumination.

WE have recently been engaged in photo-electric measurements of submarine illumination, as a result of which certain conditions governing the distribution of algæ have become evident.

The illumination in the water is reduced in amount and altered in spectral character, and these effects are composite. First, there is the absorption due to the water, as such, which results in the longer wave-lengths being reduced in far greater proportion than are the blue and violet. Grein has shown how surprisingly large the ultra-violet transmission may be in very clear water. Secondly, there is the non-selective absorption due to gross particles in suspension; this merely reduces the illumination and might be more correctly termed scattering or reflection than absorption; but as it can only be measured by the absorption coefficient of the water as a whole, the term absorption is used. Thirdly, there is the selective absorption or scattering due to very small particles, which have most effect upon the ultra-violet, violet, and blue. Fourthly, there is the selective absorption due to any tint in the water occasioned by substances in solution, as in the clear amber water of bog pools.

Determinations of the coefficient of absorption were made under various conditions by means of a photo-electric cell sensitive mainly to the blue. Values of μ were obtained as follows: near shore, with water obviously sandy, $\mu=0·81$; same spot in calm weather, $\mu=0·165$; about 20 miles from land in calm weather, $\mu=0$ 110. Consider now the illumination at 10 metres depth, taking that immediately below the surface as unity; with sandy water the illumination at 10 m. was only 0·033 per cent., on the calm day it was 19·2 per cent. and 20 miles out 33·5 per cent. In pure water 37 per cent. of blue light of 4750 Å.U. is transmitted to about 50 m., and the same percentage of light of 4490 Å.U—the most sensitive region for the cell used by us—to about 82 m; on the other hand, only 19 per cent. of red light 6000 Å.U. is transmitted by pure sea water to 10 metres, a depth at which we found 33 5 per cent. of blue light for actual sea water 20 miles off shore.

It is thus obvious that the selective absorption of the water, as such, is most noticeable in clear water in which there is absolutely no tint and the grosser particles are much reduced in number save for the plankton organisms themselves. The red end of the spectrum being cut out, the light remaining is largely blue in clear water, so red algæ—which appear black to the eyes of a diver—are obviously efficient absorbers of light; they flourish, therefore, in clear water, where their red pigment is an adaptation that enables them to utilise to advantage the blue light present in reduced amount. In fresh water, however, such clear conditions are rarely encountered, and algæ with red pigment are conspicuous by their absence.

It is true that Paschen has recorded that in Alpine lakes flagellates and Cyanophyceæ with red spotted olive green and, finally, deep red are found at about 10 metres and downward, but there is no general development of algæ with red pigment in fresh water, simply because at the depth at which the water, as such, would have left light preponderatingly blue, the gross particles would have reduced the illumination to less than that at which plants could survive. The presence of a selectively absorbing tint and of finer particles also reduces the blue light.

---

[1] *Note added in the proof.*—Since the above was written a short paper by Schüler (*Z. f. Phys.*, 37, 568, 1926) has appeared, containing the results of his recent measurements in the Li II *p*-spectrum. The results given in his paper and in the present note confirm and supplement each other.—S. W.

Evidence as to the relatively great turbidity of fresh-water lakes is afforded by measurements with the Secchi disc. Southern and Gardiner found that in Lake Atorick, which is supplied by drainage from bogs, the maximum depth for visibility was 3 m., for Lake Derg, 10 miles from the entry of the River Shannon, 4·8 m., for a very clear lake, Loughrea, 10·3 m. Values for certain lowland European lakes range from 0·2 to 7·25 m., according to Thomasson. In the sea, however, off Plymouth, Russell has found 13 m. in April to more than 20 m in June, and values up to 50 m. are not uncommon in the open sea. Moreover, most of the fresh waters are subjected to periodical floods, with increase in turbidity. Only rarely, therefore, would the possession of a red pigment be of any service to fresh-water plants.

W R. G ATKINS.
H. H. POOLE.

Marine Biological Laboratory, Plymouth,
and Royal Dublin Society,
July 8.

The Caryophyllene Alcohols and their Occurrence in Nature.

IT is a well-known fact that most hydrocarbons of the terpene and higher terpene classes are associated in Nature with corresponding alcohols from which the hydrocarbons themselves can be derived by removal of the elements of water. It is very probable, indeed, that these unsaturated hydrocarbons are actually produced in the plant by this method. Now, with the exception of cadinene, caryophyllene is probably the most widely distributed sesquiterpene in Nature, and it has therefore long been a matter of surprise that caryophyllene alcohol (which may readily be prepared from caryophyllene by Wallach's hydration method) does not occur naturally. The author knows of no recorded discovery of this alcohol in essential oils.

A study of the chemistry of caryophyllene, however, and in particular some work carried out recently in this laboratory (Henderson and Robertson, *Jour. Chem. Soc.*, 1926, 62-70), throws considerable light on this problem. Briefly, it has been established that Wallach's hydration method effects ring closure in the caryophyllene molecule with the production of a tricyclic structure. The reaction is not reversible, and the dicyclic caryophyllene structure cannot again be derived from the alcohol and its derivatives. The alcohol and its esters, therefore, possess a different configuration from that of caryophyllene, and hence could not be expected to occur as parent compounds of this hydrocarbon.

This may be said to explain the non-occurrence of caryophyllene alcohol in Nature. Another interesting result of this work, however, has recently been brought to my notice. In the paper referred to above, a new caryophyllene alcohol, called caryophyllol, was synthesised directly from the hydrocarbon, and was shown to retain the dicyclic caryophyllene structure. Caryophyllol, therefore, and not Wallach's hydrate, we would expect to find occurring in plants as the natural parent of caryophyllene, and this surmise appears to be justified by some work of Semmler on an oil drawn from clove stems (*Ber.*, 1912, 45, 1392). In the higher boiling fractions he discovered a bicyclic sesquiterpene alcohol the properties of which are practically identical with those of the synthetic caryophyllol, as the following figures show:

	b p.	d$^{17-20°}_{4°}$	n$^{17-20°}_{D}$	$[R_L]_D$
Semmler's alcohol from clove stems	138-148° at 8 mm.	0·9681	1·5010	68·18
Synthetic caryophyllol . .	142-150° at 10 mm.	0·9652	1·5015	68·03

The agreement is the more striking in that the boiling-point and density of these compounds are both lower than is usual with alcohols of this class, and are therefore the more characteristic.

It is hoped that further work will establish the chemical identity of these two alcohols, although the experiments may be complicated owing to the theoretical possibility of four closely related isomers. In the meantime it may with some safety be predicted that caryophyllol will be found to occur in the higher boiling portions of other essential oils which contain caryophyllene.

J. MONTEATH ROBERTSON.

The Chemistry Department,
University of Glasgow,
July 5.

The Reversal of the Hydrogen Series in the Extreme Ultra-Violet.

IN the course of the presentation of a paper on the spectrum of neon at the spring meeting of the American Physical Society a year ago, I mentioned that I had been able to obtain the first three members of the hydrogen series in the extreme ultra-violet reversed. Recently I have repeated the experiment with the purpose of improving the technique and confirming the results.

In the first place, it is necessary to produce a continuous spectrum in the region in question; I have already described briefly how this may be accomplished (*Astrophysical Journal*, vol. 60, July 1924, p. 2). The procedure consists in charging a condenser of about 0·5 micro-farad capacity with a direct current and then discharging it through a vacuum tube of the internal capillary type arranged in series with a half-centimetre spark gap. The best results are obtained with a discharge tube of common glass. It is important that the capillary be not too large: I have found a diameter of about a millimetre satisfactory. The material of the electrodes is not important: I have employed tungsten.

The continuous spectrum seems to owe its existence to the disintegration products of the glass set free by the erosive action of the discharge; its strength depends scarcely at all on the nature of the gas in the discharge tube. The experiment is not without mechanical difficulties, for the slit of the spectroscope frequently becomes plugged up by glass dust, the removal of which involves a troublesome process.

Once the conditions for producing the continuous background have been secured, the best results were obtained by admitting hydrogen into the discharge tube at a pressure of about one millimetre. Upon applying the explosive condenser discharge, the first four members of the series—1215·6, 1025·8, 972·5, and 949·7—appear on the photographic plate sharply reversed. It is not necessary to employ pure hydrogen, however; the first two members of the series have been obtained with helium containing a trace of hydrogen. The nature of the apparatus is such (*Astrophysical Journal*, vol. 60, p. 8, 1924) that a distance of about one centimetre separates the end of the capillary from the slit of the spectroscope, while the gas which fills the discharge tube is removed from the light path by a pump the inlet of which lies two centimetres on the grating side of the slit. The path length available for absorption is thus of the order of three centimetres. It seems certain that a very small quantity of hydrogen is sufficient to produce the reversal of the lines. THEODORE LYMAN.

Jefferson Laboratory,
Harvard University,
June 29.

Plastic Deformation of Single Metallic Crystals.

IN a letter to NATURE (May 22, 1926, p. 720), Messrs. W. E. Millington and F. C Thompson have proposed a formula for the angle of a uniform wedge formed by the fracture of a single metallic crystal, which purports to be more general than that given by the writer in connexion with the fracture of tungsten single crystals (*Phil. Mag.*, Aug. and Nov. 1924). By the use of this formula they consider it "possible to extract from the experimental results obtained on these single crystals of tungsten information with regard to the distance through which the atoms move and the number of planes involved which has hitherto remained unrealised."

The writer would like to point out that the use of their formula presupposes a type of slip which is inconsistent with experimental fact and that consequently it is inapplicable as a theory of wedge formation.

They have assumed that slip takes place on two sets of planes equally inclined to the specimen axis, and that the wedge angle depends only on the extent of slip per plane and the distance apart of the slipping planes. It has been shown, however, that a minimum extension of the crystal is required in such a case if fracture is to take place (*Phil. Mag*, pp. 234-235, Aug. 1924), from which it follows that a definite wedge angle (39° approx) must result if the two halves of the divided crystal are symmetrical; and further, that if a wedge were formed in one half of the crystal with an angle greater than 39°, a wedge having an angle less than 39° must be formed in the other half. Such unlike wedges are not found by experiment; either the wedge angles were both 39° or both were greater than 50°.

The explanation of the 39° wedges is based on a purely geometrical argument and tells us nothing about the extent of slip per plane or the distance apart of the slipping planes other than that on the average they give the theoretical wedge form. The explanation of the large wedge angles given by the writer, although it may not be entirely satisfactory, was at least based on the experimental fact that they were always associated with crystals asymmetrically inclined to the specimen axis—a case which Messrs Millington and Thompson did not consider.

F. S. GOUCHER.

New York City, June 30.

Use of Pith Dust in Kundt's Tubes.

DURING the summer of 1924, while experimenting at Indiana University with a Kundt's tube, I discovered that the striæ could be most readily observed by using pith dust in the tube. I obtained the pith dust by grinding dry pith from sunflower on a fine-grained emery wheel. By the use of this dust I was able to obtain discs that extended completely across the tube and having the same diameter as the inside of the tube.

These striæ were obtained by the ordinary method used with a Kundt's tube, but for demonstration purposes I found the following to be an excellent way to produce them: Some pith dust was placed in a glass tube of any convenient length and diameter. In one end of the tube a stopper was placed and the open end of the tube was inserted in the open end of a sounding organ pipe. When the tube was inserted the proper distance the striæ formed at regularly spaced intervals and showed the nodes and loops in an excellent way. Discs apparently but one particle in thickness were formed, and when the tube was carefully adjusted with regard to the distance to which it was inserted into the organ pipe, the separate particles remained almost motionless. Often they wove themselves into thin sheets, and when the air was turned off they fell over, maintaining the sheet form.

ROLLA V. COOK.

Bethany College,
W. Va., U.S.A.

The Ancestral Third Claw of a Spider: *Clubiona interjecta.*

THE accompanying photomicrograph (Fig. 1) shows a leg of a young spider of the species *Clubiona interjecta* Koch, before its escape from the egg-cocoon. Adults of the family Clubionidæ possess two tarsal claws, but on the tarsi of the spiderling the median, third, claw is present, demonstrating the fact that the possession of three claws is the ancestral condition. All web-spinning spiders have retained the third claw, while many hunting spiders lose it when very young.

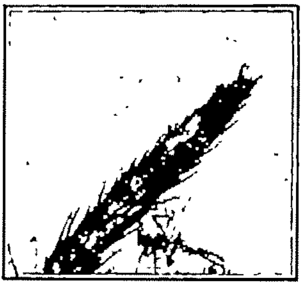


FIG. 1.—Leg of young spider, *Clubiona interjecta* Koch.

I have referred to this fact in a recent paper on "Evolution in Spiders" (*Science Progress*, Jan. 1926, pp 475-480), but I believe that this photomicrograph is the only published illustration in support of my statement. For the photography, I am indebted to my friend and colleague, Mr. R. W. Barney.

THEODORE H. SAVORY.

The Biological Laboratory,
Malvern College.

Egyptian History.

HISTORICAL truth compels me to remark that it is inexact to say that the dating by the Egyptians is only "*modern* calculations" (NATURE, June 5, p. 788). All three ancient versions of the lists of kings named by Manetho also state the totals of each of the three great periods; excepting the last, which is not in dispute, only named in one version. These totals count up to Alexander. Where these lists can be checked by external sources they show that overlapping periods of rule were eliminated. It is quite impossible to discuss the details here, but at least the facts justify my statement of the Egyptian reckoning. FLINDERS PETRIE.

The Bose Research Institute, Calcutta.

IN view of the lively interest that has been aroused by the lectures that have been delivered recently by Sir J. C. Bose in London and elsewhere, on the methods and results of his investigations on the physiology of plants, it will no doubt be agreeable to many readers of NATURE to have some general information concerning him and his work, and about the Research Institute which he has founded in Calcutta.

Already a B.A. of the University of Calcutta, possessing a fair knowledge of physics and chemistry, Sir Jagadis Bose came to England in 1880 for the purpose of studying medicine, and entered University College, London, where he made his first acquaintance with biology in the course of instruction given by Sir E. Ray Lankester. However, he soon found that his health, then somewhat precarious, could not stand the strains peculiar to medical study, and decided to go to Cambridge in order to devote himself to natural science. Accordingly he presented himself as a candidate for an open scholarship at Christ's College, to which he was duly elected, and went into residence there in January 1881. At Cambridge he pursued the general course of work for the Natural Sciences Tripos: he studied chemistry, and especially spectroscopy, under Liveing; physics under Lord Rayleigh in the then newly erected Cavendish Laboratory; physiology under Michael Foster; embryology under Francis Balfour; botany under Vines, who was also his college tutor. He took his B.A. degree in 1883: in the meantime he had taken his B.Sc. at the University of London, and ten years later the D.Sc. degree was conferred upon him. He thus acquired a good all-round scientific education, with a special knowledge of physics.

On returning to India in 1884, Sir Jagadis was appointed officiating professor of physics in the Presidency College, Calcutta, on the recommendation of Lord Ripon, the then Viceroy. As the value of his work came to be appreciated, he was soon raised to full professorial rank. This office he continued to hold until 1915, when he retired with the distinction of emeritus professor.

Whilst adequately discharging the onerous duties of his office, Sir Jagadis carried on research as actively as circumstances permitted. He produced a series of papers on electrical subjects which were communicated to the Royal Society by the late Lord Rayleigh, his former teacher, and made his first appearance as a lecturer in England with a discourse on "Electric Waves" at the Royal Institution in 1896, which he soon afterwards repeated in Paris and in Berlin.

At this point came the widening of Sir Jagadis' horizon to include living as well as non-living matter. He incidentally observed, in the course of his researches, that the metallic receivers of the electric waves showed 'fatigue' after prolonged service, and regained their activity after a period of rest; and conversely, that they became inert after too long a rest, but could be revived by an electric shock. He was so struck by the close resemblance of these phenomena to those presented by living muscle and nerve under similar conditions, that he proceeded to make a series of comparative experiments, the results of which were embodied in his book, "Response in the Living and Non-Living" (1902). It is there established beyond doubt that metals (but apparently no other form of non-living matter) possess to a certain degree the 'irritability' which had hitherto been regarded as peculiar to living protoplasm. When a nerve is stimulated, whether electrically, mechanically, or thermally, it gives an electrical response of negative variation. The amplitude of the response can be made to vary by changes in the conditions; it is increased, within limits, by a stronger stimulus, by a rise of temperature, or by treatment with stimulant substances; it is decreased by weakening the stimulus, by lowering the temperature, or by treatment with depressant substances; it can be altogether arrested, either temporarily or permanently, by excessive heat or cold, or by treatment with poisons. All these reactions Sir J. C. Bose obtained with strips of metal. This leads to the remarkable conclusions that 'irritability' is not exclusively the property of living matter; that the 'negative variation' response to stimulation is not a sign of 'life.' Irritability would appear to indicate a certain unstable molecular constitution common to metals and to protoplasm: the negative electric variation, to be the expression of molecular disturbance due to stimulation.

In the book to which reference has been made, the first evidence was given that not only the 'sensitive' plants, as was already known, give this electric response, but also that all plants, and all parts of plants, do so. It was made clear that all plants are sensitive, though only the so-called 'sensitives' are conspicuously motile. The novelty of the idea led Sir Jagadis to devote himself more to the biological than to the physical side in his further investigations; and rather to plants than to animals, because the physiology of animals had advanced much further than that of plants. Progress in the study of the physiology of plants had been hindered by the too mechanical conception of it that had prevailed: it seemed to have been forgotten that both animals and plants consist essentially of protoplasm, and that they must therefore present essentially the same reactions, though modified by special adaptations.

Inspired by this principle, Sir Jagadis proceeded to investigate the irritability and movements of plants by applying the methods that had yielded such fruitful results when applied to animals, and devised apparatus of special sensitiveness for the detection and automatic record of their less vigorous response. His results and conclusions have been published in a series of books, in a number of papers in the *Proceedings*, and in the *Transactions of the Royal Society*, of which he was elected a fellow in 1920; and in the *Transactions of the Bose Research Institute*, of which four volumes have appeared (1918–21).

Without going into too much detail, a few of Sir Jagadis' most striking researches and discoveries may be mentioned. For example, his book "The Physiology of Photosynthesis" (1924) gives the most satisfactory extant account of a process which is of cosmic importance. In his "Physiology of the Ascent of Sap" (1923), he brings forward convincing experimental evidence that the sap is raised in the tree-trunk by the active contraction of special propulsive cells, the position of which he was able to localise by the electric probe, which he originally devised for the detection of the geo-perceptive layer of cells in stems and roots, a conclusion which is still strongly contested by the adherents of the traditional physical explanation of the process. His most recent book, "The Nervous Mechanism of Plants" (1926), brings together all the evidence scattered throughout previous works that the conduction or transmission of excitatory impulse in plants is a physiological process and is limited to a particular tissue, certain elongated tubular cells of the bast in the vascular bundle, which may justly be termed 'nerve,' in opposition to the current view that the process is purely mechanical and that the tissue concerned is the wood. The conducting tissue in the stem and leaf was located by the electric probe, which again did good service, and the physiological nature of conduction is established by the observation that, in the plant as in the animal nerve, conduction is affected by changes of temperature, by blocking and by stimulating agents, which could not have any such effect upon it were it merely mechanical. A special account is given of the nervous arrangements in the motile leaf of the sensitive *Mimosa pudica*, in which reflex action is demonstrated.

Taking together this book and that on the ascent of sap, it may be generally stated that Sir J. C. Bose's researches have established the existence in the vascular plants, at least, of a circulatory and of a nervous system, using the terms in a loose general way. The 'circulatory system' includes neither heart nor veins, consisting entirely of strands of propulsive cells distributed throughout the plant, representing a contractile arterial system: similarly, in the 'nervous system' there are no central organs, such as brain, spinal cord, or even ganglia, only nerves, of which some have been shown to be sensory, others to be motor. No doubt there remains much yet to be discovered along these various lines of research.

The Research Institute at Calcutta (Fig. 1) was founded and built by Sir J. C. Bose as a place where he and his students and their successors might continue to carry on the researches of which some account has been given above. It was publicly inaugurated on November 30, 1917, and has been in active operation ever since. It is a beautiful and commodious building, standing in its own spacious grounds, with all the details of its construction and arrangements carefully thought out to ensure its perfect adaptation to its purposes. There is a large auditorium capable of accommodating 1500 persons, a library, and rooms and laboratories for work of various kinds. No elementary teaching is undertaken: the only object in view is post-graduate research. The carefully selected scholars, of whom there are at present about sixteen, are admitted on the condition that they devote themselves wholly to the prosecution of research, not as a means of livelihood or for the satisfaction of personal ambition, but, in the words of the founder, "in order to realise an inner call to devote one's whole life to the infinite struggle to win knowledge for its own sake and to see Truth face to face." They receive a modest allowance for their maintenance so that they may be free from distracting cares. The line of research pursued is essentially physiological in its direction, and includes both animal and plant in its scope, though so far the plant has received more

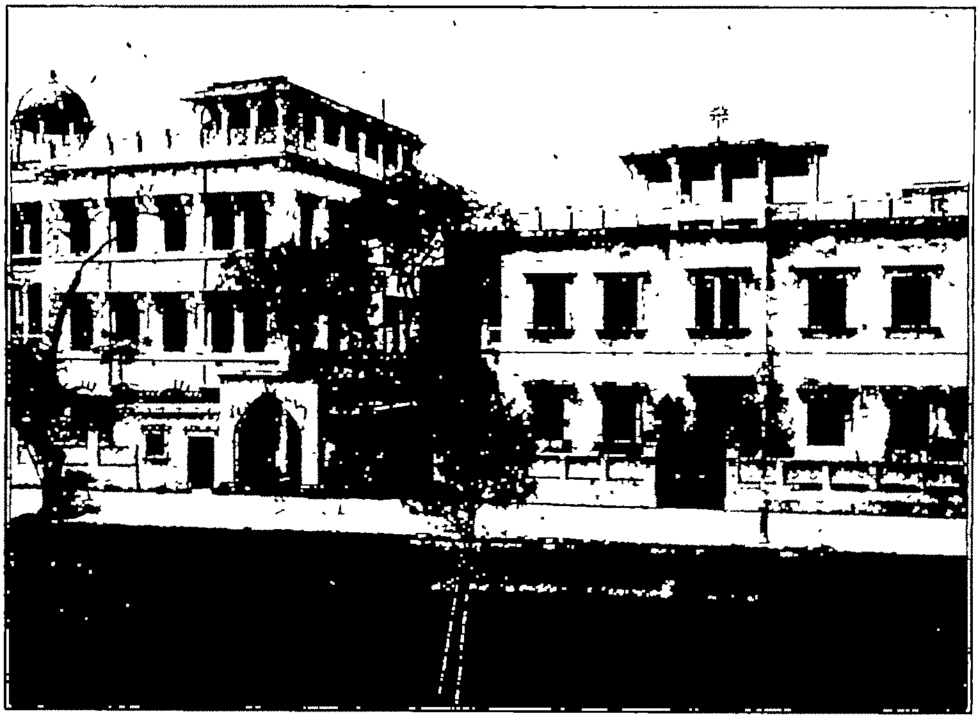


FIG. 1.—The Bose Research Institute, Calcutta.

attention than the animal. But it is physiological in the widest sense, encroaching, as occasion arises, on physics, on bio-chemistry, on botany and zoology, and on histology. At the present time there are no workers at the Institute other than the staff and the scholars, but it is the hope and desire of the founder that it may be frequented by students from all parts of the world, who are assured beforehand of a hearty welcome and of a hospitable reception.

The foundation of the Research Institute in Calcutta, as well as of the branch, Mayapuri, situated at Darjiling at 7000 ft. elevation, in an altogether different climate, was due, in the first instance, to the munificence of Sir J. C. Bose; since then, considerable sums have been contributed by Indian princes and others for extensions and for endowment. The Imperial Government of India has recognised the value of the services rendered by the Institute to the advancement of science by making an annual grant out of public funds for its upkeep. The Institute has continued from the beginning to expand both materially and intellectually. It has shown what important results can be obtained by the combination of the logic and the scientific methods of the West with the imagination and the idealism of the East. Even now it is still only at the beginning of its career, a career, let us hope, of ever-increasing usefulness and brilliance, which ought to be assured by the principles of self-abnegation upon which its constitution is based, more than fulfilling the most sanguine expectations of its founder and reviving the ancient reputation of India as a home of learning.

The Lewis Evans Collection at Oxford.

RECENT ADDITIONS.

WHEN the oldest of British museums was re-opened for the scientific treasures presented to the University of Oxford by Dr. Lewis Evans, it was foreseen that that fine collection must act as a lodestone and attract cognate objects to itself. This expectation has been realised in a remarkable measure by gifts and loans of apparatus, and by the discovery and reconstruction of long-forgotten instruments. The first fruits of the reversion of a part of the Old Ashmolean building to its original use as a Science Museum are now on exhibition.

Several colleges have contributed apparatus that is second to none for illustrating the early history of many scientific inventions. Both Merton and Oriel Colleges have proved themselves faithful custodians of the quadrants and astrolabes of their astronomer-fellows of the fourteenth century. No other educational institution can boast continuous possession of scientific appliances for so many centuries. Contemporary manuscripts written about these very instruments, describing their use, collected when the instruments to which they refer were three centuries old, were given by Ashmole to be "preserved in the presses" of his Science Museum, that his good name might endure "for all time." There they remained for yet another two hundred years, while the instruments, to the use of which they supplied the key, languished in college chests and cupboards. To-day the instruments are on exhibition in Ashmole's building, while Ashmole's own books about them have been put away out of sight in hidden recesses in buildings other than those named in his will. If both books and instruments were once again placed side by side, we should have visible proof of the scientific pre-eminence of the Merton School in the fourteenth century.

To a distinguished fellow of Merton we owe the beginning of our technical scientific literature. Richard, the son of a blacksmith at Wallingford, received a practical education that enabled him in 1326 to compose in terms as clear as those of a proposition of Euclid, a model treatise, the first of its kind known to have been written by an Englishman, upon "How to Make" a scientific instrument. He prescribed the exact dimensions of the metal parts, both in the rough and in the finished state; and he illustrated the shaping and fitting by working diagrams, so that it is possible to interpret his meaning after six hundred years. His distinction as a man of science led to ecclesiastical preferment. Richard, the maker of our first recorded astronomical clock, became abbot of St. Albans. His 'rectangulus,' figured in NATURE for January 12, 1924, has been partly reconstructed this very year in honour of the sixth centenary of his original invention.

Two centuries later the needs of Elizabethan navigators and gunners advanced the skill of the instrument maker to higher levels, both of execution and of invention. By the generosity of the University Court of St. Andrews, there is on view the finest astrolabe known to have been made by an English craftsman. It is 2 feet in diameter, and 33 pounds in weight. It is inscribed with the name of its maker, Humphrey Cole of London, and is dated with the day of the month, May 21, 1575, the very year when he was getting ready the instrumental outfit for Martin Frobisher's first expedition in search of the North-west Passage to Cathay, an enterprise in which Elizabeth herself was financially interested to the extent of 1000*l*. By the finding of Cole's great astrolabe we have proof for the first time that there were in London craftsmen capable of executing work equal in quality to that of the instrumental equipment of the best-endowed observatory in the world, the astronomical observatory of Tycho Brahe at Uraniborg. Nor was this Cole's only claim to a place in our memory. He was the first Englishman to engrave a copperplate map for the illustration of a book, the Bishops' Bible of 1572. The advent of the Lewis Evans collection has also led to the discovery of one of Cole's early theodolites in the Library of St. John's College. This discovery proves him to have been the maker and improver, if not the original designer, of our premier surveying instrument, an invention usually associated with the name of Leonard Digges of University College.

A century later and we come to the epoch of the great experimenters, too soon to be followed by the epoch of the great destroyers. The Royal Society, finely equipped in the days of Daniel Colwall and Grew with a repository of scientific apparatus that would now have the utmost historical value, has neglected and scattered the instruments of its great alumni, Boyle, Wren, Hooke. A fashion has been set of undervaluing scientific treasures left in trust, the latest examples being the dispersal of the Crisp collection of Microscopes, of the Howard Library (by the Royal Society), and of a part of the Library of Sir Isaac Newton.

The Lewis Evans collection has afforded an opportunity of trying to stem the current of our losses, and by the construction of models illustrating certain aspects of the work of the first Oxford fellows of the Royal Society. Models of Wren's perspectograph and level recall his method of dealing with problems presented by the devastated areas in the Metropolis after the Great Fire of 1666. A model of Hooke's microscope recalls what was perhaps the greatest achievement of that universally inventive genius, the first discovery of cell structure in living beings. In another case is an exhibit illustrating the first discovery of oxygen in 1668 by John Mayow of Wadham College. A model of Boyle's first airpump reminds us that it was the High Street in Oxford that produced the first English engine to demonstrate the possibility of harnessing the force exerted by atmospheric pressure, the "spring of the air," as Boyle called it. Other models show how the dwellers in an inland town have been able to teach and assist navigators; Hooke's reflecting instrument, Gunter's cross-staff and sector, the magnetic compasses of 1269 of Peter Peregrinus, and of 1750 of Gowin Knight of Magdalen College being notable examples, paralleled in our own time by the instruments invented for seamen by Lord Kelvin.

Space will not permit us to rehearse all the exhibits in our small Museum, but in truth we may define it as a school of gratitude to the great men who have increased the knowledge and the power of the human race. The most recent of the reconstructions is a beautifully made astrolabe designed by Prof. Frewen Jenkin, for making known the virtues and uses of that 'mathematical jewel' to a wider public than the favoured few who possess original examples. In this regenerated form, the astrolabe again becomes an instrument of great educational value.

The enterprise of museum founding has not been without its disappointments. First and foremost was the dispersal of the collection formed by Sir Frank Crisp to illustrate the evolution of the microscope. Through the kindness of Sir John Findlay, one of the masterpieces of that collection, a superb silver instrument by Adams, is on view in Oxford for the meeting of the British Association. But the general disappearance of much good apparatus in Oxford itself is deplorable. Only a few months ago there were in existence things of great scientific interest which have vanished. A model with which Bradley illustrated his discovery of the aberration of light is not now forthcoming. Antique microscopes, barometers, the paraphernalia of the educational methods of a century of preparation for the great scientific advances of to-day, have gone to the scrap heap—destroyed in many cases by the urgent needs of research in hand. In the modern laboratory there is no place in which to store the apparatus of bygone experimenters, even if there were a desire to keep it intact, rather than to make use of its parts.

It is our plea that scientific instruments that are of value, either for beauty of design, for achievement in the laboratory or lecture-room, or for some other good cause, should at least be treated with the respect that is accorded to early editions of printed books in a library, or to pictures in a gallery of art. The destruction of a copy of an old book that has been printed in hundreds and reprinted in tens of thousands, inflicts no great harm on the world of letters, but the loss of a unique instrument obscures the whole meaning of early work. Only by contemporary scientific appliances can we hope to show to future generations the ever-varying fashions and phases of our natural philosophy: and few objects are better worth the effort, for in our northern civilisation, natural science has become of greater consequence than art. To traverse the long galleries of the museums of arts and crafts, and to study their masterpieces, is a dispiriting pilgrimage, for it brings home to one how slight is the influence that such exhibitions exercise in elevating the art of a modern people. Scientific instruments, too, show regression in respect of their art; but they show continuous advance in respect of their science.

All work of preservation is of the utmost value in that it helps to check a tendency to destroy evidences of our own early civilisation, and to remind us that with our now diminished resources, instead of spending large sums on the conservation of relics of antiquity abroad, it may pay better to honour the prophets of our own country.

R. T. G.

The Oxford Meeting of the British Association.

MEMBERS of the British Association visiting Oxford during the forthcoming meeting will find themselves in the midst of a south-midland district which is, from the naturalist's point of view, possessed of great and varied interest. Opportunities will be given by means of sectional excursions for gaining such acquaintance as may be possible with the geology of the surrounding country, and with noteworthy features of its characteristic fauna and flora. It is obvious that no extended study of the district can be undertaken in the short time at the disposal of those attending the meeting, but the "Handbook" which will be distributed to all visiting members of the Association will provide them with a summary, under various heads, of what the neighbourhood of Oxford can show in the way of natural features of interest.

This handbook, the work of several authors, each of them a first-rate authority on the subject with which he deals, is being produced under the editorship of Commander J. J. Walker, R.N., and will no doubt take rank as a volume of permanent value. It begins with an account by Mr. H. O. Beckit, director of the School of Geography, of the physiography of the Oxford region, including a definition of its boundaries, and describing its land forms and physical history. Sections are added by Mr. W. G. Kendrew on its climate, by

Mr. E. T. Leeds on its early and by Mr. H. O. Beckit on its modern settlement. The geology of the area is dealt with by Prof. W. J. Sollas, who devotes his attention mainly to the parts of the great Jurassic system which lie within easy reach of Oxford. Dr. K. S. Sandford contributes an account of superficial deposits, and Mr. A. J. Arkell an appendix on the Corallian Period. Articles follow on the botany, ornithology and entomology of the Oxford country; these have been treated with great thoroughness by Dr. G. Claridge Druce, the Rev. F. C. R. Jourdain, and Commander J. J. Walker respectively; the latter having as collaborators Messrs. W. J. Lucas, A. H. Hamm, E. G. R. Waters, and J. Collins. The spiders have been attended to by Mr. A. W. Pickard-Cambridge, and the land and fresh-water mollusca by the Rev. L. W. Grensted. Among the institutions for which Oxford is famous there are three of special importance for the members of the British Association. The first of these, the great entomological department, which takes its name from the late F. W. Hope, is described by Prof. E. B. Poulton; the Pitt-Rivers Museum of Ethnology is treated of by its curator, Mr. Henry Balfour; and the whole series of these valuable memoirs is wound up by Dr. R. T. Gunther's account of the Old Ashmolean Museum and the Lewis Evans collection of scientific instruments therein housed under his curatorship.

The general excursions to Swindon, Stratford-on-Avon, Warwick and Kenilworth, Burford, Fairford and the Cotswolds, Blenheim Palace, and the expeditions by river to Day's Lock, to Abington and to Reading, all have their own objects of interest; but for the special purposes of the naturalist the sectional visits to Fawler, Hanborough and Stonesfield; Kirtlington; Culham, Abingdon and Radley; Aylesbury and Wheatley; Swindon, Faringdon, etc.; Boar's Hill; Shotover and Headington (geology); Tring (zoology); and Swinford Bridge; the Berkshire Downs; Lord Parmoor's beechwoods; Bagley Wood (botany and forestry), will provide the best opportunities for studying the natural features of the district.

Apart from the excursions and exhibits which appeal more directly to the geologist and biologist, there is much in Oxford to engage the attention of visiting members. A special selection of rare and interesting works will be on view in the Bodleian Library, by the courtesy of the librarian; and a similar courtesy will be shown by the authorities of the Radcliffe Library now housed at the Museum. Special visits to colleges have been arranged, each under the direction of a guide competent to explain the historical and architectural interest of these institutions, which are such distinctive constituents of the older Universities. The Lewis Evans collection of historic scientific instruments will be shown and discoursed on by the curator; the Pitt-Rivers ethnological collection will be open to inspection, and a visit will be undertaken to the printing works of the famous Clarendon Press. Not the least popular amongst other attractions will be a demonstration on Port Meadow by the Royal Air Force. Machines of several types, with instruments and other apparatus of special interest, will be parked for inspection; a flying display will take place, and the machines will be seen to leave park and take off by flight for return to their home aerodromes.

Much interest will naturally centre round the University Museum, the early history of which structure has been graphically related by Dr. and Mrs. Vernon in an excellent little book published soon after the jubilee celebration held on October 8, 1908. To those whose recollections go back to the days when Acland and Ruskin were prominent figures in the University, the main building of the Museum is eloquent of the generous ideals of those distinguished enthusiasts. Nor should it be forgotten that without the support of Pusey and his Tractarian friends the scheme for giving the natural sciences a worthy home in the University might have been indefinitely delayed. It is true that the ideal proposed to himself by Acland, that of ensuring that every one leaving Oxford with a degree should at least have had given to him "a general view of the planet on which he lives, of its constituent parts, and of the relations which it occupies as a world among worlds," has never been realised; the growing necessity for specialisation, together with other reasons, forbade its accomplishment. But the tree planted with so much hope by Acland, Daubeny and Buckland has borne good fruit, though of a kind scarcely contemplated by its original cultivators. Of late years opposition to the growth of the Museum and its departments has usually taken the form of protest against encroachments on the open space of the University park. But a delimitation of frontier has at last been established by general agreement, and the question may now be taken as settled for very many years to come. On the present occasion the Sections of Mathematics and Physics, Geology, Zoology and Engineering, will be housed in the Museum and its annexes, while Botany will find an appropriate home in the neighbourhood of the venerable "Physic Garden."

F. A. D.

DISTINGUISHED GUESTS FROM ABROAD.

Usually a number of eminent scientific workers from countries outside the British Empire are invited to be guests of the Association at its annual meeting. We print below some particulars of those who have accepted invitations for the Oxford meeting.

Prof. **GEORGE DAVID BIRKOFF**, who has occupied the chair of mathematics in Harvard University since 1919, was born at Overisal, Michigan, in 1884. He early engaged in teaching mathematics in the University of Wisconsin; next at Princeton, until 1912, when he became an assistant professor at Harvard, taking up later the major post. President, in 1925, of the American Mathematical Society, he has been editor of its *Transactions* since 1920. He is a member of the National Academy of Sciences, Washington. In 1918 Prof. Birkhoff was awarded the Querini-Stampalia prize of the Royal Institute of Science and Arts, Venice, for researches in dynamics. He is the author of "Relativity and Modern Physics" (1923).

Dr. **MAX BORN**, professor of theoretical physics in the University of Göttingen, is one of the chief exponents of the conceptions of modern physics. A recent work of his, "Vorlesungen über Atommechanik" (1925), has received wide attention and appreciation, and an English translation is in course of preparation.

The **ABBÉ BREUIL**, D.Litt. (Cambridge), is chief professor at the Institute of Human Palæontology, Paris, the foundation of the late Prince Albert of Monaco. He is the foremost authority on the art and technique of the palæolithic epoch. Prof. Breuil has collaborated in many important works on prehistoric art, and in general archæology, with MM. Capitan and Peyrony. One of the most illuminating and suggestive of his memoirs (1905) is "La Dégénérescence de Figures d'Animaux en Motifs Ornementaux à l'Époque du Renne." Prof. Breuil made lately a tour through Central Europe, Poland, and Hungary, accounts of which have appeared in *L'Anthropologie*.

Prof. DOUGLAS HOUGHTON CAMPBELL, botanist, was born at Detroit, U.S.A., in 1859. He is a foreign member of the Linnean Society, and a member of the National Academy of Sciences, Washington. Professor of botany in the University of Indiana from 1888 until 1891, he has since then occupied a similar chair in the Leland Stanford University, California. Prof. Campbell is the author of several botanical text-books.

Prof. CONSTANTIN CARATHÉODORY, University of Munich, mathematician, was born in 1873. Originally professor of mathematics in the Technical Institute, Hanover, next at Breslau, he afterwards successively occupied professorial chairs in the Universities of Gottingen, Berlin, Smyrna, and Athens. He is Ph.D. Gottingen.

M. MAURICE CAULLERY, who was born in 1868, has been professor of zoology at the Sorbonne, Paris, since 1909; formerly he occupied a similar chair in the University of Marseilles. He is director at the Sorbonne of the Laboratoire d'Évolution des êtres organisés et embryologie générale. A publicist of note, he has written on the universities of the United States, and connected scientific life. Prof. Caullery is a foreign member of the Linnean Society of London.

Prof. FRANK WIGGLESWORTH CLARKE, chemist, was born at Boston, U.S.A., in 1847. He was professor of chemistry in Harvard University, 1873–74; afterwards, down to 1883, he held the chair of chemistry and physics in the University of Cincinnati. From that date Prof. Clarke has been Chief Chemist to the United States Geological Survey, and Honorary Curator of Minerals, United States National Museum. A Chevalier of the Legion of Honour, he is a foreign member of the Geological Society of London, LL.D. Aberdeen, and D.Sc. Manchester. In 1903 the Literary and Philosophical Society of Manchester awarded him its Wilde medal. Prof. Clarke is the author of many papers on geo-chemistry in the U.S. Geological Survey's publications.

Prof. EDWIN GRANT CONKLIN, biologist, was born at Waldo, Ohio, in 1863. He graduated at Ohio Wesleyan University, and was (1891–94) professor of biology there. Since 1908 he has occupied the chair of zoology in the University of Princeton. He is a member of the National Academy of Sciences, Washington. Prof. Conklin is the author of "Heredity and Environment," "Biology and Democracy," and other works.

M. PIERRE DANGEARD is professor of botany at the Sorbonne, Paris, and director of the Botanical Laboratory there. He is a member of the Academy of Sciences, Paris, and an Officer of the Legion of Honour. Prof. Dangeard has been responsible, during many years, for an ever-constant series of memoirs and observations in general botany.

Dr. WALTHER VON DYCK, rector of the Bayerische Technische Hochschule, Munich, is also professor of mathematics in the Institute. He is the author of numerous papers on analysis, differential equations, and the theory of functions, and has interested himself in the work of the German Museum at Munich.

Prof. PAUL EHRENFEST, born in 1880 at Vienna, has been, since 1912, professor of theoretical physics in the University of Leyden. He holds a high position in the ranks of mathematical physicists, and has published many valuable memoirs, particularly ou spectra in relation to atomic structure. He is Ph.D. Vienna.

Prof. JAMES FRANCK, occupant of the chair of physics in the University of Gottingen, and director of the Physical Laboratory there, is the author of many memoirs of distinction on the atomic theory and its issues. He has collaborated with Dr. Max Born in some of these contributions in the *Zeitschrift für Physik.*

Prof. OTTO JAEKAL, Ph.D. Munich, occupant of the chair of geology and palæontology in the University of Greifswald, was born in 1863. He is well known in English geological circles, and recently was elected a Foreign Associate of the Geological Society of London. Formerly on the teaching staff of the University of Strassburg, he was afterwards curator of the Geological and Palæontological Museum, Berlin. Prof. Jaekal long rendered signal service as editor of the *Palaeontologische Zeitschrift.*

Prof. ARTHUR EDWIN KENNELLY, who has occupied the chair of electrical engineering in Harvard University since 1902, was born at Bombay in 1861. Educated at University College School, London, he early trained for service with the Eastern Telegraph Company and was engaged on cable-repairing work in many seas; also at one time he was engineer in charge of submarine cable laying for the Mexican Government. Prof. Kennelly was principal electrical assistant to Mr. T. A. Edison from 1887 until 1892. He is a Chevalier of the Legion of Honour, an honorary member of the Institution of Electrical Engineers, London, and a member of the National Academy of Sciences, Washington.

Prof. HENRY FAIRFIELD OSBORN, president of the American Museum of Natural History, was born at Fairfield, Connecticut, in 1857. He graduated at Princeton University, U.S.A. Early in his career he studied at Cambridge under F. M. Balfour, and for some time under Huxley, at the Royal School of Mines, London. Prof. Osborn was this year awarded the Wollaston medal of the Geological Society, when reference was made to his long record of researches on the palæontology of vertebrates. Important publications of his include "The Age of Mammals in Europe, Asia, and North America," and "Men of the Old Stone Age." Prof. Osborn is a foreign member of the Royal Society of London, and a Darwin medallist.

Prof. CARL RUNGE, of Göttingen, was born in 1856. Originally one of the professors at the Technical Institute, Hanover, he was appointed (1904) to the chair of applied mathematics in the University of Gottingen. He is eminent for his classical researches in spectroscopy. In 1909–10, Prof. Runge was at Columbia University, New York, as interchange lecturer.

Prof. G. **MANNE SIEGBAHN**, who has held the chair of physics in the University of Upsala since 1923, was born in 1886. Formerly he was a professor in the University of Lund. Nobel laureate in physics for 1924, an experimentalist of great refinement of method, his chief researches have been in the field of X-ray spectroscopy. He has made a special study of the soft radiations which lie between the ultra-violet and the ordinary X-ray region. Prof. Siegbahn is the author of "The Spectroscopy of X-rays" (Oxford Press, 1925). Published originally (1923) at Berlin, it was translated by Mr. George A. Lindsay, assistant professor of physics in the University of Michigan.

Prof. **FRANK LINCOLN STEVENS**, botanist, was born at Syracuse, N.Y., in 1871. He studied at Ohio State University and the University of Chicago. He occupied the chair of botany and vegetable pathology in North Carolina College of Agriculture and Mechanical Arts from 1902 until 1912, and shortly afterwards was elected professor of plant pathology in the University of Illinois, a post he still fills. He has been for many years head of the department of plant diseases and biologist in North Carolina Agricultural Experimental Station. Prof. Stevens is the author of a standard work, "Plant Disease Fungi."

Dr. **JOHANNES WALTHER**, who was born in 1860, occupies the chair of geology in the University of Halle-Wittenberg, Halle. Formerly he held a similar chair in the University of Jena. Dr. Walther is a foreign member of the Geological Society of London.

Prof. **HENRY BALDWIN WARD**, zoologist, was born at Troy, N.Y., in 1865. He is a graduate of Williams College, U.S.A., and he was a post-graduate student at the Universities of Göttingen, Freiburg, and Leipzig. He was professor of zoology in the University of Michigan from 1899 until 1909, and has since that date occupied the chair of zoology in the University of Illinois. He has long been in charge of the biological work of the Michigan Fish Commission on Lake Michigan, and has rendered good service to the United States Fish Commission. Prof. Ward is the author of "Freshwater Biology" (1917), and of many monographs and papers, especially in regard to animal parasites and the relations of animals to disease.

Geheimrat **WILHELM WIEN**, the distinguished physicist, rector of the University of Munich, was born in 1864. Formerly he was professor of physics in the University of Würzburg, having succeeded Rontgen in 1900. Whilst working there, Prof. Wien was awarded the Nobel prize for physics (1911); in that year Madame Curie was given the Nobel prize for chemistry. Prof. Wien accepted the chair of experimental physics at Munich, on leaving Wurzburg. It may be recalled that at the meeting of the Association held in Cambridge in 1904, Prof. Wien attended and read a paper entitled "Experiments to decide whether the Ether moves with the Earth."

Prof. **PIETER ZEEMAN**, of Amsterdam, was born in 1865. He is a foreign member of the Royal Society of London, and in 1922 was awarded the Rumford medal for his researches in optics. Earlier (1902) Prof. Zeeman was Nobel laureate in physics, jointly with Prof. H. A. Lorentz.

Limitations of space do not allow extension of the above brief notices, but we may add that other prominent European men of science attending the meeting include M. von Frey, professor of psychology, University of Würzburg, Dr. D. Nys A. Michotte, professor of psychology in the University of Louvain, Prof. E. Rignano, Milan, Prof. H. Kniep, occupant of the chair of botany in the University of Berlin, Dr. Bosch Gimpera, University of Barcelona, the leading archæologist of northern Spain, M. Champy, professor of histology in the University of Paris, Dr. J. A. Christiansen, professor of chemistry in the University of Copenhagen, and Prof. H. ter Meulen, of Delft.

Obituary.

SIR PETER SCOTT LANG.

WE learn with regret that Sir Peter Redford Scott Lang died on July 5 at his residence at Mansefield, St. Andrews. Owing to failing health, in 1921 he had retired from the chair of Regius professor of mathematics in the United College at the University of St. Andrews, being given the title of emeritus professor, while he ever continued to show an alert and sympathetic interest in the town and college which he loved and served.

Born in Edinburgh on October 8, 1850, Sir Peter received his early education at the Institution and then studied at the University there, where he performed brilliantly in spite of the interruptions to his college work caused by the need to spend considerable time in an office. As a student so circumstanced and yet so successfully overcoming the difficulties of his twofold task, he won first the notice and later the esteem and lasting friendship of the late Prof. P. G. Tait, who appointed him in 1872 to be his assistant in natural philosophy at the University of Edinburgh.

In those days the graduate in arts was seldom proficient or even interested in the sciences; and it was notable how this youthful assistant soon acquired a wide and accurate knowledge of these fields, inspired as he was by the example of Prof. Tait. These two friends co-operated both in classroom and in the work of the Royal Society of Edinburgh, where under this guidance the younger man received much useful experience, and where in 1878 he was made a fellow.

The next year Sir Peter was called to the chair of mathematics in St. Andrews, which had just been vacated by Chrystal, who was migrating to Edinburgh. From 1879 until 1921 Scott Lang held this post with marked distinction. He devoted himself both to his teaching and also to the wider interests of college life. In this venerable University, affiliated indeed to Bologna, the oldest of medieval universities, new life was wanting. Chrystal had scarcely spent long enough time there to make his influence felt; but during the service of his successor a regeneration took place. He sought to regain that spirit of comradeship among the students which was lacking, and, thanks very largely to his unsparing energies, St. Andrews regained much of the charm and distinction which are the incidental gifts that one of the older universities bestows on its students. He earned the honours which King and College gave to him at the close of his active career.

MISS GERTRUDE LOWTHIAN BELL.

ARCHÆOLOGICAL studies in the Near East have suffered a great, indeed an almost irreparable, loss by the death of Miss Gertrude Lowthian Bell, which took place at Baghdad on July 11, at the age of fifty-seven years. The eldest daughter of Sir Hugh Bell, she was educated at Queen's College, London, and at the University of Oxford, where she took a first class in the History Schools. She then went to Teheran and later began her travels in Arab countries, travels in which—a remarkable achievement for a woman—she crossed the deserts of Arabia, thereby winning for herself the gold medal of the Royal Geographical Society, and visited the Shammar stronghold at Hayil, to which no European had penetrated for twenty years. Here a detention, virtually as a prisoner, gave her a remarkable insight into Arab customs, the Arab temperament, and an acquaintance with Ibn Saud, which were to prove later of the greatest value to Great Britain. It was very largely this knowledge of Arab character which was responsible for her successful achievement as a political officer at Baghdad during the War in the Political Department of the Government of India, which was then in charge of Mesopotamian affairs.

Miss Bell was not interested in geographical exploration alone; her knowledge of eastern archæology was both wide and deep. She was particularly interested in the study of early Christian and Islamic architecture, and in 1905 and 1907 she was associated with Sir William Ramsay in an examination of the churches of Lycaonia. The results were published in "The Thousand and One Churches," of which she wrote the greater part. Perhaps her greatest service to archæology was after the War, when she had taken up her residence as a member of the Government service in Baghdad. It was largely through her efforts that excavations were so promptly resumed after the War by the British Museum at Ur and the University of Oxford at Kish, and she founded and organised the Museum of Antiquities at Iraq, in which she worked hard as a labour of love until the time of her death.

Miss Bell's knowledge of the Arab and Arab politics played a large part in the settlement of Iraq after the War. How great this knowledge was, and the qualities upon which it was based, may perhaps best be gathered by those who did not know her personally from her books. In "The Desert and the Sown" (1906) and "Amurath to Amurath" (1910) she revealed the indomitable courage, backed as it was by an iron constitution, which had enabled her to endure the hardships of the desert; but she also showed what were her most striking qualities—penetration, sympathy, and a wide knowledge of Eastern human nature, permeated with a humorous and tolerant appreciation of its foibles.

MR. F. HARRISON GLEW, M.B.E.

WE regret to record the death of Mr. F. H. Glew, M.B.E., which took place on July 10, at the age of sixty-eight years. Mr. Glew was educated at Wakefield Grammar School and entered engineering works in that town, but soon changed over to pharmaceutical studies and, in due course, became a member of the Pharmaceutical Society. Soon after the discovery of X-rays he became one of the pioneers of their use in medical work in England, and, for many years, he did the X-ray work for the Lambeth Infirmary, for the Belgrave Hospital for Children, and for medical men in that district.

As a pharmacist, Mr. Glew's interest was aroused by the medical uses of radium, and he occupied an important position in the radium world for many years, where his manipulative skill and chemical knowledge were put to very severe tests. During the War he was chief adviser on radium technique to the Ministry of (Optical) Munitions, his services being rewarded by an M.B.E. When the War was over, a large quantity of radium was put at the disposal of the Medical Research Council for medical investigations, and here again the services of Mr. Glew were requisitioned to deal with the technical problems involved in its use.

Mr. Glew was one of the original members of the Röntgen Society, and contributed several papers to its proceedings, but he wrote little beyond these articles and parts of the section on radiology and radium in the "Extra Pharmacopœia." He was also a fellow of the Institute of Physics and member of the Physical Society, and he served on the Board of Visitors of the Royal Institution, at all of which he gave not infrequent demonstrations. By these demonstrations, always exhibiting something novel in an ingenious way, Mr. Glew became known to a very wide scientific public; he had indeed made for himself a unique place in scientific work. His loss will be felt very much, especially by those who had learnt to look upon him with something akin to affection. S. RUSS.

WE regret to announce the following deaths:

Mr. E. T Cresson, founder of the Entomological Society of Philadelphia, later the American Entomological Society, and an authority on North American Hymenoptera, on April 19, aged eighty-seven years.

Mr G. A. Keartland, for more than forty years a member and in 1907 president of the Field Naturalists' Club of Victoria, who took part as naturalist in several expeditions to Central Australia, notably the Horn Expedition of 1894, and was known for his interest in bird-life

Prof. Geo. D. Shepardson, professor of electrical engineering in the University of Minnesota since 1892, distinguished for his work on problems of electric lighting and telephone disturbances, on May 26, aged sixty-one years.

Prof. J. C. Smock, assistant in charge of the New York State Museum and afterwards (1890–1900) State geologist of New Jersey, on April 21, aged eighty-three years.

Dr. Henry M. Whelpley, dean of the St. Louis College of Pharmacy, secretary of the United States Pharmacopœial Convention and formerly president of the American Pharmaceutical Association, on June 26, aged sixty-five years.

News and Views.

IN his speech at the opening of the exhibition of British chemical plant, held last week at the Central Hall, Westminster, in connexion with the Society of Chemical Industry's Congress of Chemists, Sir Max Muspratt referred to the ever-changing nature of the chemical industry and to the great part which chemical engineering plays in the changes. The life of the Le Blanc soda process, now extinct, was greatly prolonged by engineering, and it is that branch of the industry to which we must look to keep us abreast of the times, and more particularly in regard to the artificial fibre industry and to what is known as 'high-pressure' chemistry. As an illustration of the radical changes now taking place, Sir Max referred to a large sulphuric acid works, using the lead-chamber process, which is producing 1000-1200 tons of acid per week solely by electric power. We must learn to dispense with coal, he said. British chemical industry was built upon cheap coal and the German industry upon dear coal, now the positions are reversed, and all our old problems must be attacked from this new point of view.

THE exhibition, which was organised by the British Chemical Plant Manufacturers' Association, may be described as small but good. Owing to the restricted dimensions of the hall, it was impossible to show any large plant, but the exhibits of plant parts, constructional materials, and accessories, were so numerous and so well selected, that they presented a convincing picture of the resourcefulness and constructive ability of British plant manufacturers. From careful inquiries we have made, we can endorse the claim that at the present time practically all the requirements of British chemical manufacturers can be met at home; in a few respects, such as plant for high-pressure work, it may be necessary to go abroad, but we are gradually accumulating our own experiences in this direction and can look forward to complete independence of foreign makers within a comparatively short time.

AMONG the novelties exhibited was the Webb colloid mill, which consists of a spherical shell with three arms or beaters, circular in section and revolving at different speeds. The emulsified material is withdrawn in such a way that only the extremely finely divided material is removed. Another exhibit of a similar kind was a copper-lined machine for breaking down cotton linters in the manufacture of acetylcellulose silk. Excellent centrifugal machines, such as are used in the home beet-sugar industry, were shown, together with a clutch-pulley which enables the cage-motor to start against full-load torque. The Ruths steam-accumular was too large to be shown *en bloc*, but illustrations and plant parts testified to the value of this type of plant for eliminating the peak-load on boiler-plants, especially in works where large quantities of low-pressure steam are required in process work; the boiler can be worked for the average demand, and the pressure, as well as the temperature, of the steam can be maintained at uniform levels. A 300-gallon aluminium still formed an attractive exhibit, and other interesting exhibits included heat-exchangers, crushing machines, compressors of various types, mixers, electrolytic cells, filters, evaporators, film-dryers, scrubbers, and excellent enamelled cast-iron ware. Constructional materials were shown in abundance, non-corroding metals and alloys being particularly conspicuous. Acid-resisting, long-fibred asbestos from the Transvaal, silica-ware, and 'Prodorite,' the new pitch-cement, were among the more noticeable non-metallic resistant materials. No fewer than forty firms were represented at the exhibition, which left a most favourable impression of the quality and diversity of British chemical plant.

ALL interested in technology from whatever point of view will welcome the news that Italy has fallen into line with others of the leading countries of the world, and has commenced the printing *in extenso* and in separate numbers of the specifications of patented inventions. All patents granted after October 1 of last year are, we understand, to come under the new regulation, but it may be hoped that perhaps some day the earlier period will be similarly dealt with so that the record may be complete. The gap is not so large. The old Kingdom of Sardinia printed the specifications and drawings of patents granted under the basic law of 1855 in a publication entitled *Descrizione delle macchine*, which appeared in semi-annual volumes until 1864, when it was replaced by the *Bollettino Industriale del Regno d' Italia*, which continued except for a short period until 1896. Since the latter year, however, those concerned have had to be content with classified lists of inventions from which only the meagre information supplied by the bare titles is obtainable. The new regime is to be congratulated on the revival of the original practice in the more modern style adopted by so many patent offices. Belgium, Spain, and Portugal are the chief European countries that still have to take this step.

AN unofficial committee of twelve members of various points of view, and no doubt of divergent opinions, on economic problems, has drawn up a report which, under the title of "The Facts of Industry," has been published by Messrs. Macmillan and Co. Ltd, (price 1*s*.). The committee included among others Lord Astor, Prof. Bowley, Mr. W. L. Hichens, Mr. W. T. Layton, Mr. Kenneth Lee, Mr. B. Seebohm Rowntree, Mr. F. Hodges, Mr. A. Pugh, Mr. J. T. Brownlie, and Mr. J. J. Mallon. In other words, it represented employers, employees, professional economists, and trade union officials. The purpose of the committee was to investigate the possibilities of increased statistical publicity, and to ascertain what statistical information is required and how it can be obtained. The committee, agreeing that it is impossible to formulate a wise policy in industrial problems without knowing the facts of the case, has drawn up a series of recommendations, not with the aim of introducing changes in industrial relations, but in the hope of obtaining an adequate basis of facts on which to discuss any problem that may arise. In problems of industrial relations, information additional to that which is already available should be collected on total production, cost of material and cost of labour. For the study of industrial fluctuations, figures should be provided by each industry as regards stocks, deliveries, and orders on hand. From the point of view of the investor a number of recommendations are also made. The pamphlet indicates reforms which are outside the scope of political controversy, many that have already been put into effect in the United States and none that could fail to throw light on the difficult problems of the day.

DURING the last twenty years the electric pressures used for testing the material and apparatus used by electricians have been steadily rising. Owing to the much wider areas over which power is transmitted, and the greatly increased demand for it, economical considerations make it necessary to increase the pressure. The pressure required in the test room has to be at least double the working pressure. This necessitates the use of very large transformers which need to be housed in special laboratories. A paper on high voltage laboratories by Mr. A. P. M. Fleming, which has appeared in *World Power* for July, is therefore a timely one. Mr. Fleming points out that in order to keep ahead of developments it is necessary that facilities for producing a million volts should be provided. Several million-volt transformers are in daily use in the United States and on the Continent. At the National Physical Laboratory the high-pressure laboratory has been built but the apparatus has not yet been constructed. The Soviet Government at Moscow has similar plant under consideration. With these high-pressure transformers, it is very difficult to avoid producing brush discharges and this renders the measurement of the applied pressure very difficult. Mr. Fleming points out that the sphere-gap method of measurement is the one that is almost universally used. In our opinion the radiations from brush discharges must seriously affect the pressure at which the disruptive discharge ensues and so must make the readings very uncertain. It is scarcely fair to say that the method is dependent on purely empirical data. One of the data is the value of the maximum potential gradient between the spherical electrodes and the other is purely experimental. The first is computed by advanced theory, the second is got from concordant experimental results obtained in almost every laboratory in the world. For many tests, high voltage direct current is necessary. This is readily obtained by rectifying high voltage alternating current by a thermionic valve rectifier.

THE First Report of the commission appointed to further the study of solar and terrestrial relationships (Étienne Chiron: Paris, 1926), has recently been circulated by the International Research Council, setting out the statements and recommendations made by the committee which met in Brussels last July. Statements are given (1) of the principal terrestrial phenomena definitely known to be affected by intrinsic changes in the state of the sun or by the sun's rotation, such as (*a*) the magnetic state of the earth and earth currents; (*b*) auroræ; (*c*) meteorological and climatic changes; (2) terrestrial phenomena not improbably affected by solar changes but requiring further investigation to establish a definite relationship, such as (*d*) atmospheric electricity (potential gradient and general ionisation of the atmosphere); (*e*) radio-telegraphic transmission; and (3) terrestrial phenomena likely to be affected by solar changes and therefore requiring investigation from this point of view, such as (*f*) the amount of ozone in the upper air; (*g*) the extra-polar auroral light; (*h*) high-level atmospheric absorption; (*i*) penetrating radiation in the atmosphere; (*j*) the light of the night sky. The recommendations of the committee are then given, indicating clearly the particular matters requiring research and co-operation in observation. Memoranda contributed by members of the committee (C. G. Abbot, G. Abetti, S. Chapman, C. Chree, H. Deslandres, G. Ferrié, G. C. Simpson, C. E. St. John, and C. Størmer) and by a few other investigators make an admirable commentary on the foregoing recommendations. The report concludes with a comprehensive summary of literature up to 1924 dealing with the relations of solar and meteorological phenomena. A French version of the complete report is appended.

ABOUT eighteen years ago, Lippmann indicated the possibility of the preparation of a photographic plate that should contain in itself the image-forming elements, and by a single exposure, etc., give a result that would show a picture of the original in stereoscopic relief, adopting the principle of an insect's multiple eye, and Dr. E. Estanave shortly afterwards deposited a sealed communication with the Paris Academy. Dr. Estanave has only recently been able to demonstrate experimentally the possibility of the process, and he describes his method in *La Nature* of June 26, p. 409. The attempt to make it commercially practical by moulding the glass plate so that it shall have one side covered with small, regularly placed, spherically curved projections the principal focal points of which lie on the other surface, which is coated with a fine-grain gelatine emulsion, appears to have failed because the small lenses so obtained were not good enough. The demonstration that the principle is correct was done by making a block of closely packed Stanhope lenses of about 6 mm. focal length each with a square base of about 2 mm. × 2 mm. A photographic plate was placed with its film side in contact with the surface made by the bases of these small lenses, the exposure made and developed, etc., and the plate then attached to the block of lenses exactly in its original position. The composite plate is viewed by looking through it (as a transparency) with the lens surface towards the eyes. The picture of the original object is then seen in stereoscopic relief.

A REPORT issued by the Smithsonian Institution states that news has been received from Dr. Matthew

W. Sterling that the expedition to New Guinea of which he is the leader has started up the Memberamo River. This expedition, which is a joint undertaking of the United States and the Dutch East India Government, is very completely equipped, and has with it an aeroplane for scouting, exploration and cartography. Including carriers and Indonesian troops, the expedition numbers nearly four hundred individuals. Its purpose is the exploration and mapping of the country which lies between the coast line and the range of mountains which forms the backbone of Dutch New Guinea. The members of the expedition are Dr. Sterling, leader and anthropologist, R. H. Peck, photographer, Hans R. Hoyte, chief pilot, A. E. Hamer, assistant photographer and mechanic, S. A. Hadberg, historian of the expedition, Dr. Van Leeuwen, botanist, and M. Leroux, cartographer and surveyor. It is hoped to secure an extensive collection of bird skins in addition to the scientific data for which provision is made in the personnel of the expedition. A special effort will be made to obtain information concerning the pygmy people of the forests on the mountain slopes, of whom comparatively little is known. It is possible that unknown peoples may be discovered in the interior, of whom the existence is at present only suspected.

BEFORE the War the wood-distillation industry in what is now the eastern part of Czechoslovakia was in a very flourishing condition on account of the abundant supplies of beech-wood. But the industry has received a severe set-back on account of the rapid development of improved industrial processes for producing both acetic acid and methyl alcohol synthetically. Acetic acid is now manufactured from acetylene by oxidation with oxygen in the presence of vanadium pentoxide and mercuric sulphate as catalysts. More recently methyl alcohol has been made from water-gas, and it is stated in the *Chemiker Zeitung* that the new process may ultimately lead to the abandonment of the older process, although the synthetic product is much less suitable than wood-spirit for the denaturation of fermented spirit. The success of the method depends upon the careful control of external conditions, namely, temperature, pressure, nature of the catalyst, and the relative masses of the reacting gases, since methane, carbon dioxide, and water may be obtained as by-products if conditions are not well adjusted. The water-gas needs to be carefully freed from certain impurities, particularly from sulphur compounds.

UNDER the rather curious title of *The Cancer Review*, the British Empire Cancer Campaign has begun to issue a journal of abstracts of the voluminous literature of cancer in its various aspects. The mass of matter printed on the subject of malignant disease is so great and its quality so varied that some such critical collation is most desirable, and we do not doubt that the present journal will be useful. We hope, however, that it will be possible to arrange and group the material more effectively and to supplement the arid abstracts with the critical surveys which may more properly be called 'reviews,' and in these connexions we would commend the admirable *Tropical Diseases Bulletin* to the consideration of Dr. Francis Cavers and his editorial committee. The form is not so good as the substance: it is printed on heavy art paper (illustrations may be contemplated, but there are none in this first issue), and the line is too long (4½ inches) for convenient rapid reading—a point on which publishers and physiologists might collaborate with advantage.

A MEETING of the Society for Experimental Biology was held at Edinburgh University on July 17-19. A variety of papers was presented, including one on the growth of fish by Mr. J. Gray, the anterior pituitary and metamorphosis by Mr. E. A. Spaul, the fertilisation membrane of Echinus by Mr. A. D. Hobson, the kinetics of hæmolytic and bacteriolytic reactions by Dr. Ponder, and a demonstration of new methods for studying early stages of cell injury by Dr. Rettie. At a session held in the Botanical Gardens, Dr. K. Blackburn discussed the relation of plant chromosomes to sex, Dr. Philip Smith the effect of acidity on regeneration in Coleus, while Prof. Priestley considered the conceptions of stimulus-transmission and hormones in plants. One session was devoted to a visit to Dr. Crew's laboratory, where breeding experiments with many domestic animals were demonstrated and discussed. This was followed by a dinner which was well attended. The next conference will be held in London in December.

THE Report of the Director-General of Public Health, New South Wales, for the year 1924, recently received, contains details of the public health administration of the State and of investigations carried out for the Board of Health. In industrial hygiene an investigation has been made of the sandstone dust hazard among miners, quarrymen, and stonemasons. It is recommended that a standard of not more than 200 dust particles per c.c. of air, as determined by the Owens' dust counter, should be adopted for the air of the workings, a figure which can easily be attained by proper methods and ventilation. No cases of plague occurred among human beings or rats. Of the latter, 16,351 were examined, and the species and number of fleas upon the rodents are recorded. Interesting details are given of cases of snake-bite and of paralysis following the bite of ticks

A NUMBER of scientific expeditions to Arctic Russia and Siberia are announced in the *Weekly News Bulletin* of the U.S.S.R. Society of Cultural Relations, No. 22, vol. 3. The Hydrographical Board has begun the exploration of Maligena Strait which separates Byeli Island from the north of the Yamal peninsula, on the northern sea route to Siberia. Another expedition has left Perm to study the flora and fauna of the Kara Sea, the Ob estuary and the Gulf of Taz. A third expedition, based on Muzhinskoe on the River Ob, is to study the northern Urals, particularly the valleys of the Sosva and Lyapin. Lastly, a geological examination of the coal and oil deposits of northern Sakhalien is promised.

THE Library of the Chemical Society will be closed for stocktaking from Monday, August 2, until Saturday, August 14, inclusive, and will close each evening at 5 o'clock from August 16 until September 11.

THE following have been elected officers of the Institution of Electrical Engineers for the year 1926–1927: *President*, Dr. W. H. Eccles; *Vice-President*, Colonel T. F Purves; *Hon. Treasurer*, Lieut.-Col. F. A. Cortez Leigh.

APPLICATIONS are invited by the Dorset Field Club for the Cecil medal and prize of 10*l*. for the best essay on "The Wireless Transmission of Power, its Position and Prospects." The competition is open to persons between the ages of seventeen and thirty-five on May 31, 1927, and either born in Dorset or resident in the county not less than one year between May 1, 1925, and May 1, 1927. Particulars may be obtained from Mr. F. H Haines, Appleslade, Ringwood, Hants.

AT a meeting of the Council of the Royal Society of Arts held last week at Clarence House, H.R.H. the Duke of Connaught, President of the Society, presented the Society's Albert Medal for 1926 to Prof. Paul Sabatier, "in recognition of his distinguished work in science and of the eminent services to industry rendered by his renowned researches in physics and chemistry, which laid the foundation of important industrial processes."

NOTICES have been issued of a class in marine biology to be held at the Millport Marine Biological Station during the fortnight August 17-31. Facilities will be provided for collecting and the examination of living specimens, and those attending will be encouraged to investigate some particular problem. Lectures will be given by the Station staff and others on special subjects. Improved facilities for research workers are now available at Millport Laboratory, following the recent installation of electric plant.

THE following are among the recipients of Civil List pensions recently announced: Mrs. Marian Dibdin (125*l*.), in recognition of the scientific work of her husband, the late Mr. W. J. Dibdin; Lady Dorothea Hosie (100*l*.), in recognition of the public, literary, and scientific services rendered by her husband, the late Sir Alexander Hosie; Mrs. Elizabeth Japp (100*l*.), in recognition of the services rendered by her husband, the late Prof. F. R. Japp, to the advancement of organic chemistry and chemical education.

IN our issue of July 24, p. 126, we referred to the retirement of Prof. J. A. Fleming from the chair of electrical engineering in the University of London (University College), which he has occupied with distinction since 1885. In recognition of his services to electrical science it has been decided, by a committee presided over by Mr. A. A. Campbell Swinton, to invite subscriptions for a portrait to be placed in University College, and a replica for Prof. Fleming himself, who wishes to offer it to the Institution of Electrical Engineers. Subscriptions should be sent to Prof. W. C. Clinton, University College, Gower Street, London, W.C.1.

WE have received a copy of Circular 279 of the U.S. Bureau of Standards on the relations between the temperatures, pressures, and densities of gases, prepared by S. F. Pickering of the Bureau. It is the purpose of the circular to explain simple methods of making calculations and solving problems involving the properties of gases. Detailed explanations of the gas laws and equations of state are presented together with a large number of charts, tables of data for various gases, and an extensive bibliography.

Natural History, the journal of the American Museum of Natural History, does much to popularise zoology and keep the public informed of discoveries in natural history as they are revealed by study and by exploration in various lands. Its issue for March-April 1926 (vol. 26, No. 2) is devoted to insects and contains a number of general articles admirably illustrated by coloured and half-tone figures. Among the contributors to this issue are Dr. L. O. Howard, who discusses the great economic waste occasioned by insects; Dr. J. Bequaert, who writes on insects and man in tropical America; and Dr. V. L. Kellogg, who describes the structure and functions of the wing-scales of butterflies.

THE British Museum (Natural History), South Kensington, London, S.W.7, has recently issued a fourth edition of the "Guide to the Exhibited Series of Insects" (price 1*s*.). It is a reprint of the previous edition except that a few slight alterations and corrections in the text have been made. Some idea of the magnitude of the main collection of insects that is contained in the Museum may be gathered from the fact that it is now estimated at 3,500,000 specimens comprised in about 250,000 named species. Only a very small representative series of these is exhibited in the public galleries, but the exhibit is sufficiently complete to give the public a general idea of the classification, forms, and habits of all the chief groups of these animals. The present guide serves as a useful brochure on the subject, and should be used by all who wish to make intelligent use of the specimens that are displayed for their benefit in the galleries. It is fully illustrated, and can be obtained either at the Museum or through booksellers.

THE latest catalogue (No. 484) of Mr. F. Edwards, 83A High Street, Marylebone, W.1, will be interesting to those on the look-out for books relating to the Far East, seeing that it gives particulars of many works on China, Formosa, the Indian Archipelago, Japan, Korea, and the Philippines.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A small live-stock instructress and an assistant for general agricultural instruction and dairying under the Surrey Agricultural Committee—C. R. Harding, County

Agricultural Officer and Secretary to the Agricultural Committee, County Hall Annexe, Kingston-on-Thames (August 4). Inspectors under the Ministry of Agriculture and Fisheries for the purposes of the Diseases of Animals Acts 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (August 9). A lecturer in agriculture at the Agricultural Institute, Plumpton—The Director of Agriculture, County Hall, Lewes (August 10). A lecturer in pathology at the Welsh National School of Medicine—The Secretary, University College, Cardiff (August 21). A senior metallurgist under the British Cast Iron Research Association—The Director, 75 New Street, Birmingham (August 27). A reader in physics at King's College, Strand—The Academic Registrar, University of London, South Kensington, S.W.7 (September 17). A male junior assistant under the directorate of explosives research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18. A taxidermist for Public Museum—Prof. Carr, University College, Nottingham. A physics mistress at the Cowley Girls' School, St. Helens—The Secretary to the Governors, 17 Cotham Street, St. Helens.

Our Astronomical Column.

JULY METEORS.—Mr. W. F. Denning writes: "A few observations were made at Bristol between July 12 and 22, but meteors seemed somewhat scarce. The coming Perseid shower gave evidence of its presence on July 13 and 16, and several rather bright meteors were seen, presumably from radiants near α and ζ in Cygnus. These are well-known showers at about 314° + 48° and 317° + 31° and appear to be pretty regular in their annual returns. On July 16 and 20, meteors were recorded from a shower directed from a point near α Capricorni (304° − 12°). A rather fine object, belonging probably to this stream, appeared on July 20, $2^h\ 25^m$ G.M.T., moving along a path of about 45° approximately between Jupiter and Mars and towards Mars. This meteor was seen by an assistant, who pointed out the position, but no other observations have as yet come to hand. This shower of Capricornids is one of considerable activity and seems possibly connected with comet 1881V. Its meteors were numerous in 1908 and 1916, but their chief abundance seems to occur a fortnight before the earth's nearest approach to the comet's orbit."

CHANGES IN THE EARTH'S RATE OF ROTATION.—Prof. Newcomb was the first to suggest that the unexplained oscillations in the moon's position might really be changes in the earth's rotation. Support was given to the suggestion by Glauert, Innes, and others, the test being that other rapidly moving bodies should show similar oscillations, agreeing in phase but differing in amplitude proportionally to their motion.

Prof. E. W. Brown contributes a paper to the *Proc. Nat. Acad. of Sciences*, U.S.A. (June 1926), on the subject. He strongly supports the hypothesis, finding, *inter alia*, confirmation from the observations of the sun: there has been a marked deviation from the tables since 1900, which now amounts to 1″. He considers that an oscillation in the earth's radius appears to be the only way of producing such changes in the rotation. Such oscillations were already postulated by Joly ("The Surface of the Earth"), but these are of much longer period than those required for the present research. The chief unexplained lunar term has a period of some 2½ centuries, found by Prof. Turner to be about the same as a period indicated by Chinese earthquakes. The amount of oscillation in the radius required by Brown lies between 5 inches and 12 feet according to the depth of the source, which he estimates to be at least 80 kilometres.

MUTUAL ECLIPSES OF JUPITER'S SATELLITES.—Once in six years the orbit planes of Jupiter's satellites are turned edgewise to the sun, and mutual eclipses of one satellite by another occur. These phenomena have very seldom been observed, for they last so short a time that, unless notice is given beforehand, they are likely to escape detection. The Computing Section of the British Astronomical Association has now undertaken the computation of these phenomena, and gives lists of them for June, July, and August in the March and April issues of its journal. Unfortunately, after July 6, none is visible in England until Aug. 4, when III. is eclipsed by II. at $21^h\ 28^m$. Mr. B. M. Peek described at the June meeting of the Association his observations of three of these phenomena. On June 17, I. was partially eclipsed by II.; at mid eclipse their magnitude was equal, I. having been ¼ mag. brighter before eclipse. On June 23, III. was eclipsed by II., the loss of light being very appreciable, so that III. became equal to II. On June 28 there was an annular eclipse of II. by I., of very brief duration, since the motion of the satellites was in opposite directions. Fading began at $23^h\ 46^m\ 15^s$, centrality occurred $23^h\ 46^m\ 45^s$, and II. suddenly brightened at $23^h\ 47^m\ 10^s$.

THE REFLECTION EFFECT IN ECLIPSING VARIABLES.—In some cases of eclipsing binaries the light is not constant during the period between two eclipses, owing to reflection of the brighter star's light by the secondary. The hemispheres of the fainter stars facing and remote from the primary are of unequal luminosity and produce a well-recognised effect on the light curve of the system. The theory of this reflection effect is discussed by Eddington in the *Monthly Notices, Roy. Ast. Soc.*, vol. 86, p. 320 (March 1926). He considers primarily the case of the reflection of heat energy, which is greatly simplified by the fact that the 'heat albedo' = 1 (*i.e.* a star re-emits completely the radiation falling on it). The phenomenon considered in the theoretical case is not strictly one of reflection, but of absorption and re-emission of radiation, and the conclusions obtained are translated into terms of light reflection by means of simple assumptions. It is shown that the 'reflection' coefficient for heat will not be greater than that for light, and calculated theoretical values are compared with observed values of the reflection effect, in the case of systems of known orbits. Good agreement is shown between the calculated heat reflection and the observed light reflection in seven systems out of twelve, and (contrary to expectation) in only one case is the light reflection the greater of the two. The assumption that the incident radiation is re-emitted in amalgamation with the natural radiation of the fainter star as black body radiation would imply a large increase of the luminous efficiency of this star. The absence of this effect in observed systems suggests that the incident light retains its original quality after 'reflection.'

Research Items.

SANATORIUM TREATMENT OF PULMONARY TUBERCULOSIS.—"Although it was at one time believed that sanatoria were effective in curing phthisis, and at the present time it is tacitly assumed that they are at least effective in favourably influencing the progress of the disease, it has never been satisfactorily proved that such is really the case." With the assistance of M. Noel Karn, Dr. Percy Stocks has made an elaborate study of the first 2794 consecutive cases of undoubted pulmonary tuberculosis brought under the survey of the Belfast Tuberculosis Dispensaries from 1914 onwards. His results, published in *Annals of Eugenics*, vol. 1, parts 3 and 4, show that the average ultimate progress, as estimated over a period of six years unless the patient had been previously lost to view, was undoubtedly worse in the case of the sanatorium-treated than in the case of patients otherwise treated, for cases first seen in the incipient stage, but was not significantly different for patients first seen in advanced stages. Judged by the proportion in whom the disease became arrested or apparently cured, sanatorium treatment showed a temporary superiority during the first two or three years which was lost in subsequent years. While length of stay at a sanatorium was not found to be correlated with ultimate progress, there was an appreciable relation between regularity of dispensary treatment and progress. No consistent evidence was found that bad housing conditions, as judged by rent, class of house, state or cleanliness of rooms, or overcrowding, had any influence on ultimate progress or rate of recovery. The authors suggest that sanatorium treatment should be reserved for patients diagnosed *very early*, those so ill as to require hospital treatment, or those whose circumstances demand their removal from home.

LOUISIANA MOUND BUILDERS.—Dr. J. Walter Fewkes, Bureau of American Ethnology, has been engaged during last winter in excavating on the Red River mounds near Marchville, Louisiana, which are, it would appear, of an origin entirely obscure. Breastworks two-thirds of a mile long and 20 mounds, of which the largest, flat on top, is 12 feet high and covers 3 acres of ground, suggest a population of some considerable size. Yet the archæological evidence which has been obtained by excavation suggests a culture of low standard precariously existing in an unfavourable environment. The structure of the mounds varies considerably from that of the Mississippi tribes, Natchez, Choctaw, and others east of the river, or of the Caddo, to the west. The mounds appear to be older than those of the Mississippi Valley, and contain no evidence of contact with the white man. They are very poor in artefacts, and it is clear that the living afforded by the area was precarious and meagre. The larger of the mounds contains remains of many skeletons. There are 8 lodge-sights, circular excavations supported by a low embankment. When settlers first visited the country the site of the mounds was occupied by a small tribe of Avoyelle Indians.

LUMINESCENCE IN EARTHWORMS.—G. E. Gates (*Records Indian Mus.*, vol. 27, part 6) has observed that four species of earthworms which occur in Rangoon eject from the dorsal pores, after mechanical or chemical stimulation (*e.g.* weak ammonia solution), a mucoid substance which is luminous in various degrees according to the species of worm from which it has issued. The light is not immediately forthcoming on the discharge of the mucus, but appears after a short interval and gradually increases to a maximum. The earthworms are respectively three species of Eutyphœus and one species of Megascolex; no species of either genus has hitherto been reported as luminous.

THE PREVENTION OF DAMAGE BY TERMITES.—Termites or 'white ants' are among the most destructive pests in tropical and subtropical countries. They are well known in these lands to cause serious injuries to woodwork and foundations of buildings, and to furniture and other manufactured articles, as well as injuring trees, crops, and other vegetation. At one time it was believed that the life of a termite colony was dependent upon the presence of the greatly enlarged queen individual, and if she were destroyed, the community would be quickly exterminated. We now know that in the event of her destruction, the life and reproduction of the colony is maintained by other types of queens which, although showing little increase in size, make up in fecundity by their numbers. In *Farmers' Bulletin*, No 1472 of the U.S. Department of Agriculture, Dr. T. E. Snyder has provided a useful brochure dealing with combating these insects. He recommends that the foundation of buildings should be made of stone, brick, or concrete, including stone or metal columns in the basement to support the floor above. Walls and flooring in basements or cellars should be of concrete, and in no case should untreated timbers be sunk into the ground. Where timber is the only practicable material, it should be first impregnated with coal-tar creosote. Complete dryness of foundations of basement flooring is an important means for rendering buildings safe from attack. Many details referring to termite attacks under various conditions will be found in this bulletin, together with recommendations concerning their elimination from cultivated lands

GENETICS OF THE SWEET PEA.—The sweet pea, *Lathyrus odoratus*, was one of the earliest objects of genetical study in the beginning of the neo-Mendelian period. The first case of what is now known as linkage and crossing-over was described in this material. As the genetical work with this plant proceeds, the number of linkage groups of characters is still, in the work of Punnett, fluctuating about the haploid number (7) of chromosomes. Partial studies of the pollen development have been made, but the first thorough cytological investigation has recently been published by Miss J. Latter (*Annals of Botany*, April 1926). Several discoveries of much interest are recorded; no more critical paper has appeared in cytology for several years. During the thread stages of meiosis in the pollen mother cell, a definite dark-staining body is discovered in the nucleolus, and it is shown to be invariably connected with a loop of the spireme. It grows in size and apparently serves to pass elaborated material from the nucleolus on to the thread. There is some evidence that it is derived from a crystalline body which is constantly present in the nucleolus at an earlier stage. The spireme thread shows a telosynaptic history, which is traced with great accuracy. Finally, seven loops are formed radiating from the centre of the nucleus. This is the stage which Gates has called brochonema. During this stage the two arms of each loop, representing a pair of chromosomes, are frequently twisted about each other, thus providing a possible basis for genetical crossing over. Hitherto such crossing over has only been considered to occur in connexion with parasynapsis or side-by-side pairing of the chromosome threads.

Rainfall and Vegetation in Nigeria.—"The Physiography of Southern Nigeria and its effect on the Forest Flora of the Country," by Mr. J. R. Ainslie, is the title of No. 5 of the Oxford Forestry Memoirs (Oxford: Clarendon Press; London: Oxford University Press, 1926. Price 4s. net). After a summary of the main physical features of the country, Mr. Ainslie shows that three physiographical regions can be distinguished—the littoral, the plain, and the upland. The distribution of rainfall decreases from the littoral region, where it is more than 100 in., to the uplands, with less than 50 in. These three physical divisions closely correspond with the forest types. The littoral region, apart from mangrove swamps, is characterised by tropical rain forests of a more or less hygrophilous type with much undergrowth. Beyond this most of the plains were originally covered with deciduous forest of large trees with a good deal of evergreen undergrowth. In the small areas of upland that occur this gives way to savannah forest opening out to the grasslands of the north. Apart from these climatic formations Mr. Ainslie recognises certain edaphic formations due to ground water. As a rule these follow rivers and entail the invasion of the drier by the wetter formations. Contrary to the general rule in Nigeria of a decrease of moistures with increasing distance from the coast, in one area the loss of rainfall is partly counterbalanced by frequent mists, with the result that in the north of Ondo a neck of rain forest projects into Northern Nigeria. The paper is well illustrated.

Cold Weather Rains in India.—A discussion on "Rainfall Types in India in the Cold Weather Period, December 1 to March 15," by Sir Gilbert T. Walker and Dr. J. C. Kamesvara Rav is given in *Memoirs of the Indian Meteorological Department*, vol. 24, Part 11. It is agreed as essential for progress in weather forecasting that existing knowledge should be kept on record so that time should not be wasted in discovering facts familiar to predecessors. For the present inquiry, the occurrence of appreciable rainfall of more than 2 inches at stations in the Daily Weather Report is the only meteorological effect considered, and that is collated for the twenty-one winter seasons, December 1900–March 1921. The bursts of rainfall are classed according as they are associated with a late monsoon or with a western disturbance. The rainfall types are classified in different tables and subdivided where distinction is possible. From the analysis, such facts as the following are obtainable: "A fall of pressure at a northern station occurred 67 times and was succeeded by a northern track 55 times and a southern track 5 times, while 7 were neutral; after 25 falls of pressure at southern stations there are 12 northern tracks and 6 southern."

The New Atomic Theory.—In his address to the Scandinavian Mathematical Association last August, Prof Niels Bohr intimated (Nature, December 5, 1925, p. 845) that the atomic theory of the moment required re-editing as a branch of the mathematical theory of quadratic or bilinear forms. How far this process has been effected during the year may be judged from a summary of it by Prof. Leon Brillouin in the May issue of the *Journal de Physique*. He shows that the representation of the quantities which specify the atom as bordered matrices leads directly without further hypotheses to the same results as the older quantum theory with its special hypotheses known as the principles of 'selection' and of 'correspondence,' and he anticipates great advances in our knowledge of the atom from this method of attack. A shorter article dealing with the same subject, but entitled "The New Quantum Theory," by Dr H. T. Flint, is to be found in the July issue of *Science Progress*. The author adopts a vector notation as being more familiar to physicists than the notation of matrices. He points out that the new theory gets rid of the anomalous half quantum which it has been necessary to introduce into the old quantum theory to explain band spectra.

The Coupling between Elementary Radiation Processes.—In a communication from the Reichsanstalt, published in the *Zeitschrift für Physik*, June 16, Dr. W. Bothe describes a series of experiments in which a piece of thin copper or iron foil placed in a narrow space between the front surfaces of two Geiger counters was caused to fluoresce by means of a beam of molybdenum $K\alpha$ radiation. The K fluorescence radiation from the foil passed through two thin aluminium windows into the counters, L radiation and photoelectrons given off from the foil being kept back by the aluminium. The interior of the counters was filled with argon, which greatly increased the number of photoelectrons recorded by the counters. Air does not absorb the K-radiations of copper and iron very much, and when it is used the deflexions are mainly due to electrons from the walls of the counters. The sensitiveness of the apparatus was such that according to the absorption statistical theory of Bohr, Kramers, and Slater, a considerable number of coincidences between the deflexions in the two counters should have been observed. In the first set of experiments such coincidences were seen, but it was shown that they were due to radioactivity of the brass of which the counters were made and not to the K-radiation from the foil. When the counters were reconstructed using zinc of low radioactivity, the number of coincidences was no greater than was to be expected with a haphazard distribution of the deflexions. The results indicate that quanta given out by the foil travel in one direction only and are absorbed in a single elementary act.

The Discovery of Oxygen.—In his presidential address to the Indian Chemical Society, printed in the Society's journal (vol. 3, No. 1), Sir P. C. Rây gives an account of the parts played in the discovery of oxygen by Priestley and Lavoisier. He emphasises the great service rendered to chemistry by Lavoisier, who alone of contemporary chemists was able to see the real meaning of Priestley's work, and by his own experiments and reasoning to lay the foundations of chemistry as it exists to-day. The services of Lavoisier have never seriously been called into question, but his claim to the discovery of oxygen can scarcely be entertained. Nothing which Sir P. C. Rây brings forward in the slightest degree alters the position, which has been most exhaustively studied by former historians of chemistry. That Lavoisier had any claim to be an independent discoverer of oxygen cannot be maintained on the evidence available and the important services of the great French man of science neither require nor justify any such claim. It is not clear from his paper whether Sir P. C. Rây wishes to reassert this claim, but his concluding sentence seems to indicate that he does not. "It is not necessary to belittle the one in order to magnify the other. Each was great in his own way and has extended the boundaries of our science."

Society of Chemical Industry: Annual Meeting and Congress of Chemists.

SINCE its foundation in 1881, the Society of Chemical Industry has held its annual meeting in one or other of the many geographical centres where its sections are located. This year's meeting—the forty-fifth—was held in London on July 19–23, and differed from all previous meetings in taking the form of a congress of chemists, no fewer than seventeen chemical organisations taking part in it. For this reason, everything was done on an unusually large scale, and save for the physical weariness which inevitably follows from such an orgy of conferences, dinners, excursions, and social functions, the week must have been one of unmitigated profit and enjoyment to the very large number of chemists and their friends who attended.

The United States was well represented by Drs. F. G. Cottrell and E. Hendrick, Mr. T. H. Norton, and Profs J Kendall, H. R. Moody, and R. Stevenson; Profs. P. Sabatier and E. Fourneau came from France, Dr. J P. Arend from Luxembourg, Prof. L. F. Goodwin from Canada, and Prof. K. Matsubara from far Japan. The Hotel Great Central made an excellent headquarters, its spacious rooms and lounges providing all the accommodation required, whilst the exhibitions of chemical plant and of chemical apparatus were shown at the Central Hall, Westminster, and at the Institute of Chemistry, respectively, and club facilities were generously provided by the Chemical Industry Club in Whitehall Court. Nothing but praise is due to those who were responsible for the general organisation, and the president, Mr. W. J. U. Woolcock, the chairman of the London Section and the Chemical Engineering Group, Mr. C. S Garland, and the general secretary, Dr. J. P. Longstaff, must have been gratified at the undoubted success which attended their efforts.

For the first time in the history of the Society, an organised attempt was made, through the agency of a publicity committee, to interest the lay as well as the technical press, and although competition for 'space' was severe owing to the vagaries of the franc, the meeting of the British Medical Association at Nottingham, and innumerable sporting events, the results obtained were very encouraging. The presence of H.R.H. the Duke of York, the Earl of Balfour, and the Lord Mayor on the opening day made an excellent *lever du rideau*, whilst the speeches of Sir Alfred Mond at the conference on hormones and at the Society's annual dinner, the address of Sir Josiah Stamp, who spoke on "The Economics of Monopolies, with particular reference to America," and that of Sir Max Muspratt at the opening of the exhibition of chemical plant, provided the press with favourable opportunities to direct attention to the importance of chemistry through the mouths of well-known public men.

The increasing growth of the chemical industry proper is a fact that was emphasised by several speakers, but of even more significance is the manner in which chemistry has penetrated into a large number of industries which are not specifically chemical. No body is more suited to advance the welfare of chemistry in industry than the Society of Chemical Industry In recent times many smaller societies, essentially chemical in nature, have been formed to serve the needs of branches of applied chemistry, but this Society is in a sense the mother of all, and although it has suffered from the competition of these smaller communities, and is still feeling the full blast of financial stringency, there yet remains to it a most important sphere of influence in co-ordinating the activities of all societies devoted to the advancement of applied chemistry. Substantial progress has been made in this direction during the past two years: joint conferences and joint social functions have become the order of the day, and a valuable step forward has been made in the formation of a Fuel Section of the Society.

This centripetal tendency within the industry and profession of chemistry is well shown in the project to establish a central home for chemistry in London, which was taken up by the Federal Council for Pure and Applied Chemistry some six years ago, but, unfortunately, has been held up for financial reasons. The subject was discussed at a special meeting of the Congress, but no solution was found. One group favours a policy of 'masterful inactivity' until the industry is in a position to subscribe a sum of the order of 250,000*l.* for acquiring a home large enough to house the offices of existing societies, and to provide accommodation for large meetings, a library, and a club. The other group is weary of waiting and would embark upon a much smaller scheme involving the expenditure of 35,000*l.*-40,000*l* If such a sum could be raised, the latter scheme would appear preferable, provided that it were carried out in such a way as not to exclude the ultimate realisation of the more ambitious project

Concurrently with a conference on hormones (see p. 174 of this issue), a symposium on corrosion was held under the auspices of four societies. Mr. U R. Evans led off with an able summary of the main facts and hypotheses connected with the corrosion of metals by air and by chemical agents. He was followed by Dr. W. H. Hatfield with a paper on resistant steels for chemical engineering, in which were described the action of various chemicals on chromium steels (12-14 per cent. chromium) and on a nickel-chromium steel (18 per cent. chromium, 8 per cent. nickel); the latter steel is now used extensively in chemical manufacture. A similar subject was treated by Messrs. T. G. Elliot and G. B. Willey, who outlined the properties of certain Hadfield steels that are remarkably resistant at very high and very low temperatures. Two papers by Mr. P. Parrish completed the series, the first dealing with the corrosion and erosion of plant used in the manufacture of ammonium sulphate at gas and coke-oven works, and the second with the corrosion and erosion of chemical sheet-lead.

Among the most interesting and best-delivered contributions were those by Dr. W. R. Ormandy in connexion with power alcohol. In the first he described the development of a process for making glucose from waste wood, by which the cellulose of dried sawdust is treated with concentrated hydrochloric acid and converted into hexose sugars (92 per cent.) and pentose sugars (8 per cent.) Very many technical difficulties impeded the elaboration of the process, not the least of which was to find a material capable of withstanding the action of the acid. The material now successfully used ('Prodorite') is a high-melting pitch mixed with mineral matter of carefully graded particle-sizes; it shows no tendency to 'creep,' behaving like a solid up to 125° C. About 250,000*l.* has been expended in elaborating the process, which is now a technical success, and it is hoped to produce large quantities of high-grade glucose together with inferior sugar suitable for conversion into alcohol. As about 20 per cent. of all timber hewn is lost as waste wood, it is obvious that there is great scope for this process in such countries as Canada and Scandinavia.

In their paper on "Experiences with Alcohol Motor

Fuels," Dr. Ormandy and Mr. D. Ross dealt with the use of alcohol as a motor fuel when mixed with petrol or benzol. Alcohol has the great advantage that it allows the use of a much higher compression ratio in the engine than petrol or any constituent of petrol, thereby obviating premature detonation ('pinking'). Commercial (95 per cent. vol.) alcohol does not mix well with petrol, but now that alcohol can be easily and economically dehydrated by distilling azeotropic mixtures, this difficulty has disappeared. Road tests carried out by the London General Omnibus Co. using petrol with a small proportion of 99 per cent. alcohol, and a mixture of 65 per cent. denatured alcohol, 30 per cent. benzol, and 5 per cent. ether gave quite satisfactory results and showed that, owing to its anti-detonating action, alcohol can advantageously be added to low-grade petrols to improve their value.

The great importance of the size of particles of pigment and compounding powders used in the paint and rubber industries, was discussed at a conference presided over by Sir William Bragg. After Dr. D. F. Twiss and Mr. C. A. Klein had outlined the main problems, specialised papers were read by Dr. S. S. Pickles, Dr. P. Schidrowitz, Mr. T. R. Dawson, Mr. Noel Heaton, Mr. E. A. Murphy, Mr. H. Green (U.S.A.), and by Messrs. G. Gallie and B. D. Porritt. At the concluding sessions Mr. L. J. Simon and Prof. J. W. Hinchley contributed a paper on fat-extraction by solvents, in which they described a new large-scale process for extracting fat from seeds which involves a very short period of extraction, economy in the consumption of solvent, and low capital cost; and Dr. E. W. Smith presented a very useful summary of recent discussions concerning solid smokeless fuel. Low-temperature processes, said the author, are at present both technically and economically unproven and the immediate problem consists in improving high-temperature coke for industrial and domestic uses. Such coke must be dry, and contain as low an ash-content as is compatible with economic production. It must be suitably graded, and the grades standardised.

The attendance at all the conferences was very good, and the papers were of a high standard, although there were so many of them that little time was left for discussion. Considered as a whole, the meeting was remarkable not only for its magnitude, but also for the diversity and interest of the subjects discussed.

The Commercial Production of Hormones.

AT a joint meeting of the Biochemical Society and the London Section of the Society of Chemical Industry on July 20, a series of papers on "The Scientific and Industrial Problems presented by the Hormones—the Natural Drugs of the Body," was read. The chair was taken by Sir Alfred Mond, who, in the course of his introductory remarks, referred to the work done by the British school on this subject and to the success which has followed the co-operation of the biochemist, the manufacturer and the physiologist, especially in the commercial production of insulin. The financier, though doubtless an essential member of the team, should occupy a subsidiary position to the research worker. Dr. H. H. Dale followed with a paper on the experimental study and use of hormones; Dr. H. W. Dudley described the chemistry of the pituitary gland and of insulin, and Mr. F. H. Carr the commercial production of hormones; Dr. H. A. D. Jowett gave an account of the history of adrenaline, and Prof. G. Barger discussed the recent progress in the chemistry of thyroxine. Dr. J. W. Trevan's paper on the biological assay of hormones was not read, but in the following account of the main parts brought out by the various speakers, use has been made of an abstract with which we have been furnished.

Only one of the hormones has, so far, been synthesised in the laboratory. Although the presence of a pressor principle in the suprarenal gland was first shown by Oliver and Schafer in 1894, it was not until 1901 that it was obtained in the crystalline state by Takamine, who, with greater courage than was shown by previous investigators, added strong ammonia in excess to the purified aqueous extract of the gland and so precipitated the base. In the same year Aldrich assigned it the formula $C_9H_{13}O_3N$, and this was afterwards confirmed: its structure was definitely proved by Jowett in 1904, who, by exhaustive methylation and subsequent oxidation, obtained veratric acid and trimethylamine, and about the same time the compound was also synthesised by Stolz. The synthetic product was of course the racemic form: in 1908 Flacher separated the dextro- from the lævo- variety, by treating the bitartrate with methyl alcohol, which dissolves the former and leaves the latter behind. The pressor effect of the lævo- naturally occurring form is fifteen times greater than that of its isomer.

Although the chemist may have finished with adrenaline, to the biochemist and physiologist it is still the central figure in many unsolved problems. How does the body make it? What is its function under ordinary conditions of life? To the first question there is as yet no answer: to the second a tentative reply may be given, but it is a curious fact that, although adrenaline has so simple a chemical constitution, and such a powerful physiological action when injected, yet its presence in the body under ordinary conditions, except in the suprarenal glands themselves, has been extremely difficult to demonstrate satisfactorily: in fact it has even been denied that it has any function in ordinary circumstances. It is probable, however, that it plays a part in the maintenance of the tone of the small blood-vessels, and also is secreted into the blood stream in larger quantities under conditions of emotional and physical stress.

It is interesting to contrast with the history of adrenaline that of thyroxine. The administration of thyroid gland in myxœdema was the first example of a successful substitution therapy: it is still the main example of this type of treatment, and, excepting possibly the oxytocic principle of the pituitary gland, the only example of a successful result being obtained by administration by the mouth. It is stated to have been used in China for this purpose more than a thousand years ago. But the active principle was not isolated until a few years since, when Kendall was successful in preparing it. Within the last year Harington has been able to synthesise desiodo-thyroxine, the compound formed when the iodine is removed from the molecule of thyroxine. An account of Harington's work has been recently given in these columns (July 10, p. 65), so that it will not be further discussed here: it may be assumed that the final synthesis is now only a matter of time.

The commercial production of other hormones, of which the chemical constitution is unknown, requires the supervision of skilled chemists in the process of manufacture, and the co-operation of the research biochemist in the improvement of existing processes or the discovery of new ones; the physiologist is also required, since the detection of the presence of the hormone and its quantitative estimation require the use of animal tests in the absence of satisfactory chemical reactions. The usefulness of this co-operation has never been more successfully shown than in the commercial production of insulin. At the present time firms in Great Britain satisfy all home requirements, and have a large balance available for export, whilst the price is low enough to bring the remedy within the means of the poorest diabetic. Of the hormones of, at present, unknown chemical constitution, insulin and those of the posterior lobe of the pituitary gland are the best known. Secretin, the hormone which arouses the secretion of pancreatic juice at the inflow of the partially digested food from the stomach into the duodenum, from the mucous membrane of which it is absorbed into the blood stream, has been recently obtained in a very pure form by J. Mellanby. The active principle of the parathyroid glands and the œstrus-producing hormone of the ovary have been extracted and partially purified, and methods of biological assay, which are probably roughly quantitative, worked out. Of the active principles of the testes, the cortex of the suprarenal glands and the anterior lobe of the pituitary, almost nothing is known; but our ignorance is not due to their non-essentiality, since both the suprarenal cortex and the anterior pituitary are essential to life, whilst an inkling of their functions has been obtained from human and experimental pathology.

An insight into the manufacturing problems is given by a knowledge of the properties of these hormones: insulin and the pituitary hormones may serve as a basis for the following short description. It is probable that the active principles exist in the glands in a combined form, from which they are set free by appropriate treatment; this is certainly the case with thyroxine and probably also with adrenaline. Under certain conditions the hormones will even stand boiling, but, apart from this, their main characteristic is their exceeding sensitiveness to even quite mild reagents. They are rapidly destroyed by autolysis after the death of the animal, being attacked by proteolytic enzymes, though to varying degrees.

This is also probably the reason why the majority are inactive when taken by the mouth, except in relatively enormous doses. They are extremely sensitive to alkalies, but are stable in the presence of weak acids. They appear to be either themselves simple proteins such as an albumose or polypeptide or are closely associated with them. They adhere tenaciously to precipitates formed in their aqueous solutions. Thus Dudley obtained a crystalline picrate from a concentrated aqueous solution of the pituitary hormones, which retained in full its physiological activity when re-crystallised from water: but on re-crystallisation from dilute alcohol, the activity remained behind in the mother liquor, whilst the crystals were identified as potassium creatinine picrate. Abel has recently announced the isolation of a crystalline insulin, the activity of which is two to four times greater than that of ordinary commercial insulin; the crystals bear a remarkable resemblance to cystine. Now it is known that if edestin is allowed to crystallise in a solution of insulin a great part of the activity adheres to the crystals, so that, until further evidence is forthcoming, caution should be exercised in accepting Abel's conclusion.

The principles to be followed in the production of hormones on the large scale must therefore be the inhibition of enzyme action, and the avoidance of the use of destructive reagents or the production of precipitates which remove the activity, except where the latter can be used as a method of purification with recovery of the active principles from the precipitate. The prevention of autolytic changes is best ensured by the freezing of the glands immediately after removal from the animal. The material can then be worked up at leisure and in convenient quantities, though slow changes occur in time in the frozen state, leading to lowered yields. In working up the glands, every means should be taken to prevent enzyme action: thus in the case of the pancreas, the frozen glands are minced, the acid and alcohol incorporated at a temperature of 0° C., and the whole thoroughly ground; filtration and clarification follow to remove, so far as possible, traces of adhering enzymes, and the subsequent concentration is carried out at a low pressure and temperature. In the case of the pituitary gland, dehydration with acetone at a low temperature destroys the autolytic enzymes, leaving a stable powder from which the activity can be extracted by water or dilute acid. The acidity of the solution is of great importance in the case of both insulin and the pituitary hormones. Moreover, use is made of the fact that insulin is insoluble at pH of about 5·0 in the later stages of the purification, so that it is essential that those working on the insulin plant should be able to determine the hydrogen ion concentration of the solutions with which they are dealing: a colorimetric method is easy to learn and gives sufficiently accurate information. In the final stages of the preparation of insulin, use is made of Dudley's method, precipitation with picric acid followed by addition of alcoholic hydrochloric acid, by which treatment the insulin hydrochloride is formed and can be precipitated with acetone as a uniform white powder.

In conclusion, reference may be made to one further point in which the co-operation of the manufacturer, the biochemist, and the physiologist may lead to important results. To obtain further insight into the chemical nature of these unknown active principles requires the provision of a moderately large quantity of relatively pure material as the starting point for further analysis. The posterior lobe of the pituitary gland of the ox weighs about 0·5 gm., of which 0·1 gm. is solid matter. Probably less than 0·1 per cent. of this represents the active principles: in other words, to obtain 100 gm. of 'pure' hormone would require the working up of glands from 1,000,000 oxen, with the probability that this material would still be a mixture of active principles and contaminating substances. Large scale working, over a course of years probably, seems the only way to accumulate sufficient material on which the biochemist can commence his research, and until the principles have been isolated in a pure condition, identified and synthesised.

The co-operation of the physiologist will be essential in tracing the course of the hormone through the necessary chemical manipulations. Moreover, until our chemical knowledge of these hormones is complete, quantitative estimation of them can only be carried out by the aid of animal tests. By the use of suitable preparations or a sufficiently large number of animals, the errors in this method of assay can be reduced within reasonable limits: thus for pituitary standardisation (on the virgin guinea-pig's uterus), the error of a single test is ±20 per cent., and for insulin assay ±5-10 per cent. Such differences as these would scarcely be detected in clinical medicine, so that the method of biological assay sufficiently safeguards both the physician and the patient.

University and Educational Intelligence.

CAMBRIDGE.—Mr. T. C. Hodson has been appointed reader in ethnology in succession to Dr. A. C. Haddon.

EDINBURGH.—At the graduation ceremonial on July 20, the following, among others, were presented for the honorary degree of Doctor of Laws: The Earl of Crawford and Balcarres, Chancellor of the University of Manchester, a trustee of the British Museum, and president in 1916 of the Board of Agriculture and Fisheries; emeritus Prof. J. S. Nicholson, formerly professor of political economy in the University of Edinburgh; Lord Salvesen, formerly president of the Zoological Society of Scotland and of the Royal Scottish Geographical Society.

The degree of Doctor of Science was conferred on Dr. D. A. W. Fairweather for a thesis on "Electrosynthesis"; Dr. S. R Khastgir for a thesis on "Studies in the *J*-transformation of Scattered X-radiation"; Dr. J. Muir for a thesis on "The Flora of Riversdale, South Africa"; Mr. J. D. M'B. Ross for a thesis on "A Relationship between the Associating Power of Optical Isomers, and the Formation of Racemic Compounds"; Dr G. Shearer for a thesis on "The Application of the Method of X-ray Analysis to the Study of the Organic Aliphatic Series."

At the medical graduation ceremonial on July 23, intimation was made of the award of the Cameron Prize in practical therapeutics to Dr. H. H. Dale, head of the Department of Biochemistry and Pharmacology under the Medical Research Council, for important investigations on the pharmacological and therapeutic action of a series of substances which have effects on the functional activity of nerve, muscle, ductless glands, and other tissues.

LEEDS.—Mr. A. E. Ingham, Fellow of Trinity College, Cambridge, has been appointed reader in mathematical analysis in succession to Dr. W. E. H. Berwick. Mr. Leonard R. Johnson has been appointed assistant lecturer in agricultural zoology

LONDON.—Mr. E. B. Verney has been appointed as from August 1 to the University chair of pharmacology tenable at University College. Mr. Verney was educated at Tonbridge School, and at Downing College, Cambridge. He was assistant in the Department of Physiology at University College from 1921 until 1924, and since 1924 has been assistant in the Medical Unit at University College Hospital. In July 1922 he was awarded a Beit Memorial Fellowship and was re-elected for a 4th year in 1925.

Mr. S. J. Davies has been appointed as from August 1 to the University readership in mechanical engineering tenable at King's College. He was educated at H.M. Dockyard School and the Technical College, Portsmouth Since 1920, Mr. Davies has been senior lecturer in engineering at Armstrong College, Newcastle-upon-Tyne; he has also lectured at the Technische Hochschule in Charlottenburg and in Dusseldorf and Essen.

The title of emeritus professor of electrical engineering in the University has been conferred on Prof J. A. Fleming, on his retirement from the University chair of electrical engineering at University College.

THE honorary degree of D.Sc. of the University of Wales has been conferred on Sir T. W. Edgworth David, professor of geology in the University of Sydney, for distinction as a geologist and his eminent position in the university life of Australia; and on Dr. A. H. Church, University lecturer in botany, Oxford, for his distinguished contributions to botanical science.

NOTICE is given by the Huddersfield Technical College of the forthcoming award of the two following research scholarships, each of which is of the yearly value of 100*l*., with remission of fees: The Joseph Blamires' (for research in colour chemistry), and the Drapers' Company's (tenable in the dyeing department). Particulars of the scholarships are obtainable from the principal of the college.

THE College Research Committee of Armstrong College, Newcastle-upon-Tyne, has recently initiated a new scheme under the title of Senior Research Fellowship. A member of the staff elected to a fellowship is released from teaching duties for one year, the Research Committee providing the salary of a temporary lecturer from the funds at its disposal. A first appointment has been made of Dr. G. R. Goldsbrough, lecturer in applied mathematics.

THE Trustees of the Beit Fellowships for Scientific Research at their annual meeting extended the fellowship awarded a year ago to Mr. Rudolf Kingslake for mathematical and experimental researches on the properties of optical instruments. Three new fellows were elected: Mr. J. Topping for research on the calculation of the equilibrium configuration and energy of crystals from the mutual electrostatic and repulsive forces, in particular Al_2O_3 and Fe_2O_3; further extension of the research upon which he is at present engaged and the calculation of the repulsive forces for the nitrate crystals and further comparisons of calcite and aragonite; Mr. J. W. Maccoll for research in aerodynamics; and Mr. G. H. Mitchell for research on the Borrowdale volcanic rocks of the eastern part of the Lake District, more especially in the Kentmere and Troutbeck areas, in continuance of research now being pursued. For the first time in the history of the Trust, the appointments are for the definite period of two years instead of for one year as hitherto.

THE Education Committee of the London County Council, on the advice of its Consultative Committee on Engineering, has awarded Robert Blair Fellowships to Mr. Malcolm D. Bone and Mr. Eric W. Fell. These fellowships, which are of the value of 450*l*., are awarded to young engineers of high promise to enable them to undertake research overseas. Mr. Malcolm Bone, who is a student-assistant with the Consett Iron Co., is the son of Prof. W. A. Bone, of the Imperial College of Science and Technology, South Kensington. He was educated at St. Albans Grammar School, Mill Hill School, the Friends' School, Sidcot, and the Imperial College. He will now study iron and steel manufacture in continental works, mainly in Germany. Mr. Eric Fell is a research student in the University of Birmingham who was previously educated at St. Aubyns School and Haileybury. Like Mr. Bone, he also proposes to study in Germany and to undertake research in the metallurgy of steel at the Technische Hochschule, Aachen. Four Robert Blair Fellowships have already been awarded for research in the United States, Canada, and in Germany. The first research report written as the result of these awards has recently been received from Mr. George Bird, who gained a fellowship two years ago. This report has been forwarded to the Institution of Mechanical Engineers, with the result that Mr. Bird has now been invited to write a paper, dealing with some particular phase of his investigations, for publication in the proceedings of the Institution.

Contemporary Birthdays.

July 28, 1864.	Prof. Charles Herbert Lees, F.R.S.
July 30, 1856.	Viscount Haldane, K.T., O.M., F.R.S.
Aug. 2, 1876.	Prof. James Wesley Jobling.
Aug. 5, 1878.	Prof. Louis C. Karpinski.
Aug. 7, 1864.	Mr. Oswald H. Latter
Aug. 8, 1845.	Mr. William Barlow, F.R.S.
Aug. 8, 1859.	Sir Alfred G. Bourne, K.C.I.E., F.R.S
Aug. 8, 1857.	Prof. Henry Fairfield Osborn, For Mem. R.S. (see page 163).
Aug. 8, 1858.	Sir Francis G. Ogilvie.

Prof. LEES, who occupies the chair of physics in the University of London (East London College), was born at Glodwick, Oldham. He was educated privately, then at Owens College, Manchester, and at the University of Strasbourg. Before engaging in professorial work in London he was lecturer in physics in the University of Manchester.

Lord HALDANE, Chancellor of the University of Bristol since 1909, was educated at Edinburgh Academy, the University of Edinburgh (of which he was rector, 1905-8), and at Göttingen. He is Hon. D.C.L. (Oxon). Among many critical expositions, he is the author of "The Philosophy of Humanism" (1922). Lord Haldane is president of the British Institute of Adult Education.

Prof. J. WESLEY JOBLING was born in Ohio. Originally on the teaching staff of Columbia University, he was professor of pathology from 1914 until 1918 in the medical department of Vanderbilt University, Nashville (Tennessee), returning then to Columbia to occupy the chair of pathology there.

Prof. LOUIS C KARPINSKI, mathematician, was born at Rochester, N.Y. He was educated at the State Normal and Training School, Oswego, N.Y., and the University of Strasbourg Since 1919 he has been professor of mathematics in the University of Michigan. He is joint author with H. Y Benedict and J. W. Calhoun of "Unified Mathematics" (1918).

Mr. OSWALD LATTER, who has been for many years science master at Charterhouse School, was born at Fulham From Charterhouse he went to Keble College, Oxford. Sometime Berkeley fellow of Owens College, Manchester, he was also a tutor of Keble before returning to his old school to take up science teaching.

Mr. WILLIAM BARLOW is a Londoner. He is specially identified with researches on crystal structure and related problems. Mr. Barlow is a past president of the Mineralogical Society.

Sir ALFRED BOURNE, a native of Lowestoft, was educated at University College School, London. His services to the Indian Empire have been varied and distinctive. Successively he has been registrar of the University of Madras, botanist to the Madras Government, and professor of biology in the Presidency College, Madras.

Sir FRANCIS OGILVIE, an Aberdonian, graduated at the University of Aberdeen, and, early in his career, was on its teaching staff. In Edinburgh he had, later, various important interests. He was principal of the Heriot-Watt College there from 1886 until 1900, thereafter, for three years, director of the Edinburgh Museum of Science and Art. Transferred to London, he was Secretary of the Board of Education for the Science Museum and Geological Survey from 1910 until 1920, holding also the directorship of the Science Museum. Sir Francis was principal assistant-secretary, Department of Scientific and Industrial Research, 1920–22. He is Hon. LL.D., Edinburgh.

Societies and Academies.

DUBLIN

Royal Irish Academy, June 28.—**H. Ryan**, **J Keane**, and **B. O'Donoghue**: Some derivatives of γ-piperonylidene-methylethylketone. The present communication describes the results of experiments carried out with this substance and some aromatic aldehydes. The starting substance, $C_2H_5 . CO . C(CH_3) = CH . C_6H_3 . O_2CH_2$, was prepared by the condensation of piperonal and methylethylketone in the presence of hydrochloric acid. By the action of piperonal on γ-piperonylidene-methylethylketone in the presence of alkali, a compound having the formula $C_{20}H_{16}O_5$ was obtained. This dicondensation derivative did not react with a further quantity of piperonal in the presence of alkali, and it was regarded as being 1-methyl-4·5-dipiperonyl-cyclopenten (3)-one (2). On treating this compound with alcoholic hydrochloric acid, it was converted into the isomeric 1-methyl-4·5-dipiperonyl-cyclopenten (4)-one (2). This substance reacted with piperonal in the presence of alkali to form a tricondensation compound $C_{28}H_{20}O_7$. By the action of piperonal on γ-piperonylidene-methylethylketone or on the $C_{20}H_{16}O_5$ body in the presence of hydrochloric acid, the same tricondensation compound $C_{28}H_{20}O_7$ was obtained. This derivative is regarded as being 3-piperonylidene 1-methyl-4·5-dipiperonyl-cyclopenten (4)-one (2). The results obtained in this research are similar to those found by Ryan and Lennon in their investigation on the condensations of aldehydes with methylethylketone.—**H. Ryan**, **J. Keane**, and **B. O'Donoghue**: Some derivatives of α-piperonylidene-methylethylketone. The results of the interaction of α-piperonylidene-methylethylketone and some aromatic aldehydes are described. By the action of piperonal on the starting substance, a compound having the formula $C_{20}H_{16}O_5$ was obtained. This dicondensation derivative of methylethylketone and piperonal was not identical with either of compounds having the same molecular formula obtained by the action of piperonal on γ-piperonylidene-methylethylketone. The last-mentioned derivatives are regarded as isomeric cyclopentenones. The $C_{20}H_{16}O_5$ body prepared by the action of piperonal on α-piperonylidene-methylethylketone formed a tetrabromide and did not react with a further quantity of piperonal. It is regarded as α-γ-dipiperonylidene-methylethylketone. By the action of piperonal on α-piperonylidene-methylethylketone in the presence of hydrochloric acid; a tricondensation compound $C_{28}H_{20}O_7$ was obtained. This body was also prepared by the action of piperonal on γ-piperonylidene-methylethylketone and was proved to be 3-piperonylidene-1-methyl 4·5-dipiperonyl-cyclopenten (4)-one (2).—**R. K. Boylan**: Atmospheric dust and condensation nuclei. As a result of observations made in Dublin between October 1925 and June 1926, using Owens' jet dust counter and Aitken's apparatus, the following average values were obtained: dust particles per c.c. 1580, nuclei per c.c. 23,800. The correlation coefficient between the concentrations of the two bodies was 0·73 ± 0·056. It was found, in confirmation of the results of Wigand, that dust particles would not act as centres for cloudy condensation even in the absence of the ordinary nuclei.

EDINBURGH.

Royal Society, July 5.—**J. Tait**: Experiments and observations on Crustacea (Pt. vii.). Some structural and physiological features of the valviferous isopod Chiridotea. This isopod is found along the eastern shores of America. It is peculiar among its kind in that it combines the activity of swimming, walking, and tunnelling in sand, and the position and arrangement of its limbs may be interpreted in relation to each of these purposes as well as in relation to its habits of feeding.—Norman **Maclaren**: Development of Cavia. Implantation. The theory put forward by Graf von Spee, that in the guinea-pig the ovum is implanted in the uterine mucosa after the manner of a parasite in virtue of the destructive action of its surface cells, has been generally accepted. An alternative theory for the primary phases of implantation here discussed brings the process in Cavia more into line with what is known to occur in other mammals. Instead of eating its own way through the epithelium, the egg becomes lodged in one of the crypts which normally occur at the antemesometral end of the uterine lumen. This crypt becomes closed by the overgrowth of its lips, while the epithelium which originally formed its floor disappears. With the disappearance of the epithelium, destructive changes supervene in which the whole antemesometral part of the lumen is involved. The primary implantation cavity is thus a part of the uterine lumen, and the process does not, in principle, differ from that which occurs in certain other rodents such as the mouse and rat.—W. L. **Ferrar**: On the cardinal function of interpolation theory. Interpolation over a set of equi-distant points by cardinal function formula is 'consistent,' *i.e.* a function which is given accurately by the interpolation formula applied to the values of the function at points $0, \pm nw$ is also given accurately if w be replaced by any smaller w'. The formula consists of an infinite series; its relation with a corresponding infinite integral is considered.—E. L. **Ince**: Researches into the characteristic numbers of the Mathieu equation. (Second paper.)

SHEFFIELD

Society of Glass Technology, June 1 and 2.—Sir W. Flinders **Petrie**: Glass in early ages. No glass was made in Egypt prior to about 1500 B.C., all earlier specimens being imported, probably from the Syrians. Examples of glass had been found in Syria, in the Euphrates region, which can definitely be dated back to 2500 B.C. Only fifty years or so elapsed between a time when glass was a comparatively rare commodity in Egypt and a time when it was possibly the commonest commodity of all. Glass vases and glass beads rapidly came into everyday use. At first it was not a liquid glass which was produced, but a glass paste which could be moulded in the plastic state. No blown glass was found in Egypt until one came to an examination of the products of the Christian period. The whole of the earliest glasswares discovered in Egypt were coloured. It was not until about 1200 B.C. that the Egyptians began to make glass by pressing it into moulds, and from thence onwards, until the seventh century B.C., the colour of their glasswares got worse and worse, although the patterns became more and more composite. From the year 350 A.D. the Egyptian glass-makers resorted to the moulding of glass in the production of standard weights for gold coins, a practice which was later copied by the Arabs. The glazing of stones began in Egypt about the twelfth century B.C. Some of the tiles covering the walls of early Egyptian chambers are magnificent examples of colouring; not only single colours were achieved, but also polychromes.—J. W. **Ryde**: Opal glass. A number of commercial and experimental glasses have been examined by the X-ray method in order to determine the nature of the opacifying material which separated out. Sodium fluoride and calcium fluoride had separated out from the glasses examined. The rates of cooling were controlled, and varied so that the effect of the rate of cooling on the depth of opal produced could be investigated. With slow cooling the size of particles which separated out increased until a certain limiting size was reached. In bulbs made of opals in which the opacifying particles are relatively large, very little light is scattered back to traverse the bulb again.—F. F. S. **Bryson**: The electrical conductivity of glasses at high temperatures. The electrical conductivity of several series of glasses was determined at temperatures between the softening point and 1150° C. The glass was heated in a small cylindrical crucible in a platinum wound electric furnace. The temperature-resistance curves for several glasses bear a close relationship to the temperature-viscosity curves for similar glasses, and suggest the possibility of using conductivity measurements as a method of determining changes in the viscosity of a glass immediately before being worked.—Edith M. **Firth**, F. W. **Hodkin**, M. **Parkin** and W. E. S. **Turner**: The influence of moisture on the rate of melting and on the properties of soda-lime glasses. Moisture was present in amounts ranging from 0·25 to 15 per cent. in different batches. In general, when present to the extent of not more than 1-2 per cent. in soda ash batches and not more than 3-4 per cent. in batches containing both soda ash and saltcake, moisture has a beneficial effect on the rate of melting. The glasses which were made from batches containing saltcake, were refined more easily, and were freer from waviness than those prepared from batches containing soda ash only. Glasses prepared from batches containing more than 5-6 per cent. of moisture were more viscous and had a shorter working range than those prepared from ordinary dry batches.

PARIS.

Academy of Sciences, June 21.—A. **Lacroix**: Preliminary note on an aerolith discovered in the Department of the Côte-d'Or and remarks on the classification and nomenclature of the chondrites.—Charles **Richet** and P. **Lassablière**: The protective effects of preliminary saline injections on chloroform anæsthesia. Experiments on dogs have proved that the injection of a solution of common salt into the veins before administering chloroform increases the resisting power of the heart. The amount of chloroform can be increased to six times the normal without collapse.—Gabriel **Bertrand** and M. **Mâchebœuf**: The influence of nickel and cobalt on the action produced by insulin in the rabbit. It has been shown previously that the pancreas is one of the organs containing the largest proportions of nickel and cobalt, and preparations of insulin are even richer in these two metals. This suggested the study of the effect of adding nickel or cobalt or both to preparations of insulin and examining the physiological effect. The effects, which are marked, are shown in a series of graphs.—E. **Bataillon**: The membranogen process and the regular development provoked in virgin eggs of Echinus by hypertonic treatment alone.—Pierre **Weiss** was elected a non-resident member in succession to the late G. Gouy.—A. **Buhl**: The integration of Maurer's equations by series of homogeneous functions.—Armand **Cahen**: Differential equations of the first order linear with respect to the function and the variable.—Renato **Caccioppoli**: Linear functionals.—A. **Tychonoff**: Abstract spaces.—N. **Lusin**: An arithmetical example of a function not forming part of the classification of M. René Baire.—Henri **Bénard**: The inexactitude, for real liquids, of the theoretical laws of Kármán relating to the stability of alternate vortices.—**Garsaux**: The provision of aeroplanes with oxygen. A device is described in which a specially constructed Dewar vessel containing liquid oxygen replaces the usual cylinder of compressed oxygen: the weight of the apparatus is reduced to one-tenth of that when an oxygen cylinder is carried.—**Dumanois**: The retarded inflammation effect produced by antidetonants. The effect of the addition of such substances as lead tetraethyl to petrol is to retard ignition.—L. **Cagniard**: The use of the quadrant electrometer in high-frequency measurements of precision.—R. **Forrer**: The structure of the atomic magnet. The deformation of the multiplet by the field. The triplet in iron.—F. **Wolfers**: Interferences by diffusion.—R. de **Mallemann**: The dispersion of electrical double refraction of camphor. The specific double refraction of active camphor and of inactive camphor are sensibly identical. The dispersion is normal.—H. **Jedrzejowski**: The method of preparation of sources of RaB + RaC.—Pierre **Achalme** and Jacques **Achalme**: The influence of the viscosity on the specific rotatory power of certain active bodies. Two series of experiments are described, one in which the concentration was kept constant and the viscosity varied by the addition of solution of citric acid, the other in which the viscosity was kept constant and the concentration varied. In the first case the calculated specific rotatory power varied from 13·6 to 6·2; with concentration variable from 3·75 per cent. to 60 per cent tartaric acid, viscosity constant, the calculated specific rotatory power was practically constant, 8·3 to 8·5. It is pointed out that this new fact of the effect of viscosity is of importance as affecting deductions on the molecular structure of active bodies.—Edmond **Bauer**: The electric structure of the molecules, particularly mesomorph bodies (anisotropic fluids).—P. **Surun**: The adsorption of some organic acids by two activated carbons of different origin. The data given are not in accord with the conclusions of Fromageot and Wurmser, which were based on experiments with Urbain carbon.—F. **Bourion** and E. **Rouyer**: Discussion of the results obtained in the quantitative study of the association of mercuric chloride. Reviewing the work of Linhart, Beckmann, together with the results of their own experiments, the authors conclude that there is equilibrium between simple and double molecules of mercuric chloride at 25° to 40° C. for concentrations not greater than 0·37 mol. There is equilibrium between simple and triple molecules at 100° C. and for concentrations higher than 0·5 mol. —E. **Sterkers** and R. **Bredeau**: Contribution to the study of reactions between solid bodies reduced to the colloidal state. Details of the preparation of calcium resinate in a colloidal mill. Zinc oleate and magnesium stearate can be prepared in a similar manner. —Ch. **Maurain**: The relations between terrestrial magnetic disturbances and solar activity.—Alb. **Frey**: The pigments of *Sterigmatocystis nigra*.—Ph. **Joyet-Lavergne**: The heterogamy of the spores of the horse-tail and the characters of sexualisation of the cytoplasm.—R. **Combes** and R. **Echevin**: The variations in the organic matter, mineral matter, and especially calcium, in the leaves of trees during the autumnal yellowing.—H. **Prophète**: Contribution to the study of the waxes of flowers: rose wax. The results of a detailed chemical examination are given.—E. **Chemin**: The development of the spores of *Colaconema Bonnemaisonia*.—Mme. L. **Randoin** and R. **Lecoq**: Do the water-soluble vitamins (B) contained in beer yeast exist beforehand in the culture medium? It has been shown in an earlier communication that beer yeast and extracts of beer yeast, so far as concerns the water-soluble vitamins, have a higher value than that of other Saccharomyces or of other yeast extracts of different origin. It is now shown that the source of these vitamins is the malt extract used as the culture medium.—Jules **Amar**: Cellular pigments and physico-chemical actions.—Maurice **Piettre**: Some physical and chemical influences in hæmolysis by hæmolytic immunoserums.—J. **Benoit**: Differentiations, spontaneous and provoked, in the genital glands of the Gallinaceæ.—René **Fabre**: A spectrophotometric method for the study of hæmolysis.—L. **Mercier** and Raymond **Poisson**: Parasitic microsporidia of Mysis.—Edm. **Plantureux**: An antirabies vaccine containing formaldehyde.

CAPE TOWN.

Royal Society of South Africa, April 21.—C. von **Bonde**: The chorology of the S. African Heterosomata with some relative problems. The zoogeographical distribution of the S. African flat-fishes is dealt with. Part I. deals with ecology or environment of the species, and Part II. with chorology or their distribution in space. A comparison of the distribution of the Heterosomata with that of other marine faunas shows a remarkable agreement in the ratio of their occurrence in deep sea or in shallow water, the number of endemic species and the preponderance of east coast species.—A. **Ogg**: The structure of the sulphates.—W. A. **Humphrey**: (1) An occurrence of diamonds near Port Nolloth. This occurrence is the first to be discovered on the coastal belt south of the Orange River. The gravel is disposed in alternating layers of loose gravel and thin partings of hard conglomerate in which the constituents of the gravel are cemented together by a calcareous cement. This points to a seasonal deposition of gravel by a stream which was intermittent in its flow. The gravel shows signs of long-continued transport and the diamonds also show slight traces of wear. The source of the diamonds is probably somewhere within the basin of the Kammas River, with which the watercourse containing the gravel was once connected. The diamonds are very brilliant, white and well crystallised. (2) The changed conditions of Namaqualand. The river valleys of Little Bushmanland immediately south of the Orange River have been formed by the action of streams of considerable volume, which cut their way through masses of mountains during some far-distant pluvial period. The upper courses of the shorter tributaries of the Orange in this neighbourhood have been gradually filled up with drift sand which has encroached from the north and obliterated the stream valleys altogether; in some cases mountain ranges are in the process of being buried. The climate has changed from one with a comparatively heavy rainfall to its present semi-arid character. Similarly the Kammas River now no longer carries water to the sea, but is in course of filling up its own bed by its summer floods, which now spread the detritus from the Klipfontein Mountains in wide alluvial flats. This portion of Namaqualand represents an exceedingly old land surface in which valleys are gradually being filled up owing to a decrease in the humidity of the climate.—R. C. **McGaffin** and E. **Newbery**: Single potential of the copper electrode. Very varied results have been obtained by different workers for the single potential of copper in solutions of its salts. One, at least, of the main factors producing this variation is the formation of an insoluble film of basic salt by the action of the electrolyte upon the metallic copper. Attempts have been made to obtain concordant and trustworthy values (*a*) by careful cleaning of the electrode and measurement of the potential immediately after immersion, and (*b*) by retarding or, if possible, preventing the formation of the film either by rapid rotation of the electrode or by violent stirring of the electrolyte.

Official Publications Received.

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 16, Part 1: (i) Über die qualitativen Methoden zur Methylpentosanbestimmung, von Kintaro Oshima und Kinsuke Kondo; (ii) Über die quantitative Bestimmung von Pentosan und Methylpentosan, von Kintaro Oshima und Kinsuke Kondo. Pp. 71. Vol. 17, Part 1: Studies in Plasmopara Halstedii, II. By Prof. Makoto Nishimura. Pp. 61+5 plates. Vol. 18, Part 1: On the Five Species of Dendrolimus injurious to Conifers in Japan, with their Parasitic and Predaceous Insects. By Prof. S. Matsumura. Pp. 42+5 plates. (Tokyo: Maruzen Co., Ltd.)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 37, Part 2, June 25th. Pp. 117-250. (London: Edward Stanford, Ltd.) 5s.

Royal College of Surgeons of England. Annual Report on the Museum, by the Conservator, June 17th, 1926. Pp. 24. (London.)

Canada. Department of Mines: Mines Branch. Investigations of Mineral Resources and the Mining Industry, 1924. (No. 642.) Pp. ii+113+5 plates. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), 1924. (No. 643.) Pp. 115. Investigations of Fuels and Fuel Testing (Testing and Research Laboratories), 1924. (No. 644.) Pp. ii+81+4 plates. (Ottawa: F. A. Acland.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 47: Physical and Chemical Analyses of Papers employed for Wrapping Fruit. By Dr. Francois J. de Villiers. Pp. 19. (Pretoria: Government Printing and Stationery Office.)

Bulletin International de l'Académie Polonaise des Sciences et des Lettres: Classe des Sciences mathématiques et naturelles. Série B: Sciences naturelles. No. 3-4B, Mars-Avril, 1925. Pp. 277-508+planches 15-23. 4·50 zł. No. 5-6B, Mai-Juin, 1925. Pp. 509-622+planches 24-32. No. 7B, Juillet, 1925. Pp. 623-727+planches 33-36. No. 8B, Octobre, 1925. Pp. 729-800+planches 37-48. Série A: Sciences mathématiques. No. 8-10A, Octobre-Décembre, 1925. Pp. 259-375+planches 3-9. No. 1-2A, Janvier-Février, 1926. Pp. 101. No. 3-4A, Mars-Avril, 1926. Pp. 103-182. (Cracovie: Gebethner et Wolff.)

The Institute of Chemistry of Great Britain and Ireland. Register of Fellows, Associates and Students, corrected to 31st March 1926. Pp. 352. (London.)

Bishop's Stortford College. Report of the Proceedings of the Natural History Society, 1925. Pp. 21. (Bishop's Stortford.)

Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Five Years 1921–1925. Vol. 54. Pp. xvi+101. (London: Oxford University Press.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1925. Pp. 24. (Weltevreden: Landsdrukkerij.)

Memoirs of the Department of Agriculture in India. Botanical Series, Vol. 14, No. 2: Studies in Gujarat Cottons, Part 3. The Wagad Cotton of Upper Gujarat, Kathiawad and Kutch. By Maganlal L. Patel and D. P. Mankad. Pp. iv+59-112+8 plates. (Calcutta: Government of India Central Publication Branch.) 1.4 rupees; 2s. 3d.

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report (Thirteenth Year). 1: General, East Malling Research Station, 1st January 1925 to 31st December 1925. Pp. 100. (East Malling.) 2s. 3d.

Board of Education. Syllabus of the Science Scholarships Examination, 1927. Pp. 24. (London: H.M. Stationery Office.) 4d. net.

Subject Index of the *Transactions of the Optical Society*, Vols. 1-25. By Prof. A. F. C. Pollard. Pp. iv+89. (London: Optical Society, Imperial College of Science.)

The Decimal Bibliographical Classification of the Institut International de Bibliographie. Partly translated for the Formation and Use of a Universal Bibliographical Repertory concerning Optics, Light and cognate Subjects. By Prof. A. F. C. Pollard. Pp. viii+109. (London: Optical Society, Imperial College of Science.)

The Midland Agricultural and Dairy College, Sutton Bonington, Loughborough. Bulletin No. 9: County and Inter-County Clean Milk Competitions, organised by the College and the County Agricultural Education Authorities; Report on the Inter-County Competition, 1925–26. Pp. 12. (Loughborough.)

Philosophical Transactions of the Royal Society of London. Series A, Vol. 226: The Behaviour of Single Crystals of Aluminium under Static and Repeated Stresses. By H. J. Gough, Dr. D. Hanson and S. J. Wright. Pp. 30+8 plates. (London: Harrison and Sons, Ltd.)

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 6, No. 1: Studies of a Tropical Jungle, One Quarter of a Square Mile of Jungle at Kartabo, British Guiana. By William Beebe. (Department of Tropical Research, Contribution No. 190.) Pp. 193. (New York.) 1 dollar.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 57-58: On the Plasticity of Metals, Part 1, by Hikoroku Shōji; On the Plasticity of Metals at High Temperatures, Part 2, by Hikoroku Shōji and Yoshio Mashiyama. Pp. 189-206. 25 sen. No. 59: Über die Konstitution der durch Hydrolyse von Rohcrymanin entstehenden β-Säure (Dioxychinolin-Carbonsäure). Von Yoshikazu Sahashi. Pp. 207-234. 30 sen. No. 60: The Influence of Cholesterol upon the Reproductive Potency of White Rats. By Umetaro Suzuki and Nabetaro Hashimoto. Pp. 235-256. 25 sen. No. 61: About the Transference of Active States and the Mechanism of Catalytic Action. By Susumu Miyamoto. Pp. 257-262. 15 sen. No. 62: Analysis of the Alkali Group. By Sunao Ato and Isaburo Wada. Pp. 263-294. 35 sen. (Tokyo.)

New York Zoological Society. Report of the Director of the Aquarium. (Reprinted from the Thirtieth Annual Report of the New York Zoological Society.) Pp. 14. (New York City.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards. No. 523: Wind Pressures on Structures. Part 1: General Discussion on Wind Pressure Data; Part 2: Distribution of Pressure over a Model of a Tall Building. By Hugh L. Dryden and George C. Hill. Pp. 697-732. 20 cents. No. 524: Measurements on the Thermal Expansion of Fused Silica. By Wilmer Souder and Peter Hidnert. Pp. 23. 10 cents. No. 526: Transmission and Absorption of Sound by some Building Materials. By E. A. Eckhardt and V. L. Chrisler. Pp. 37-63. 15 cents. (Washington, D.C.: Government Printing Office.)

Annals of the Natal Museum. Edited by Dr. Ernest Warren. Vol. 5, Part 3, May. Pp. 235-448+plates 15-25. (London: Adlard and Son and West Newman, Ltd.) 17s. 6d. net.

Edinburgh and East of Scotland College of Agriculture. New Series, No. 1: A Pure Milk Supply. By A. Cunningham and T. Gibson. Pp. 24. (Edinburgh.)

Proceedings of the United States National Museum. Vol. 68, Art. 25: Amphipods of the Family *Bateidae* in the Collection of the United State National Museum. By Clarence R. Shoemaker. (No. 2626.) Pp. 2 Vol. 69, Art. 1: A new Species of Fluke, *Parametorchis noveboracensis*, from the Cat in the United States. By Hsü-Lu Hung. Pp. 2. (Washington, D.C.: Government Printing Office.)

The Physical Society of London. Proceedings, Vol. 38, Part 4, June 15. Pp. 277-336. (London: Fleetway Press, Ltd.) 6s. net.

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 9: Nutrients required for Milk Production with Indian Foodstuffs. By F. J. Warth, Asst.-Prof. Labh Singh and S. M. Husain. Pp. 153-187. (Calcutta: Government of India Central Publication Branch.) 14 annas; 1s. 6d.

Government of Madras: Local Self-Government Department (Public Health). Report of the Chemical Examiner's Department for the Year 1925. Pp. 12. (Madras: Government Press.)

Report of the Department of Industries, Madras, for the Year ended 31st March 1925. Pp. v+102. (Madras: Government Press.) 6 annas.

Meddelanden från Statens Skogsförsöksanstalt. Hafte 22, Nr. 3: Till Kottklängningens teori och praxis (Zur Theorie und Praxis des Klengprozesses). Av Lars-Gunnar Romell. Pp. 125-144. Hafte 22, Nr. 4: Tillväxtprocentens Beräknande (The Calculation of the Increment percent with the Method of Compound Interest). Av Sven Petrini. Pp. 145-168. Hafte 22, Nr. 5: Studier över Barrskogens Humustäcke, dess Egenskaper och Beroende av Skogsvården (Studien über die Humusdecke des Nadelwaldes, ihre Eigenschaften und deren Abhängigkeit vom Waldbau). Av Henrik Hesselman. Pp. 169-552. Hafte 22, Nr. 6: Om Uppskattningen på Försöksparkerna, av Sven Petrini; Redogörelse för Verksamheten vid Statens Skogsförsöksanstalt under år 1925. Pp. 553-590. (Stockholm: Centraltryckeriet.)

Diary of Societies.

AUGUST 4 TO 11.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Oxford).

Wednesday, August 4 (in Sheldonian Theatre), at 8.30 P.M.—H.R.H. The Prince of Wales: Presidential Address.

Thursday, August 5.—At 10 A.M.—Addresses by Sectional Presidents: B.—Prof. J. F. Thorpe, F.R.S.: The Scope of Organic Chemistry.—C.—Prof. S. H. Reynolds: Progress in the Study of the Lower Carboniferous (Avonian) Rocks of England and Wales.—F.—Sir Josiah Stamp: Inheritance as an Economic Factor.—K.—Prof. F. O. Bower. 1860-1894-1926.

At 11 A.M.—Addresses by Sectional Presidents: E.—Hon. W. Ormsby-Gore: The Economic Development of Africa and its effect on the Native Population.—I.—Prof. J. B. Leathes: Function and Design.—Discussion (Section M): Cultivation Methods.

At 2.—Conference of Delegates of Corresponding Societies.—Sir John Russell: Regional Survey (Presidential Address).

At 2.15.—Dr. F. A. Dixey: Recent Criticisms of the Theory of Mimicry (Lecture).

At 2.30.—Discussion (Sections E, H): The Effect on African Native Races of Contact with European Civilisation.—Discussion (Section M): Soil Classification.

At 5.—Discussion: (Sections L, M): Educational Training for Overseas Life.

Friday, August 6.—At 10 A.M.—Addresses by Sectional Presidents: G.—Sir John Snell: The Present and Future Development of Electricity Supply.—L.—Sir Thomas Holland. Discussion (Section C): Problems of the Thames Gravels.—Discussion (Section M). Agricultural Education.

At 11 A.M.—Discussion (Section L): Scholarships.

At 11.30 A.M.—Addresses by Sectional Presidents: D.—Prof. J. Graham Kerr: Biology and the Training of the Citizen.—J.—Dr. J. Drever: Psychological Aspects of our Penal System.—Discussion (Section K): Sex Determination in Plants.

At 2.30.—Discussion (Section I): The Relationship of Vitamin B to Bios.—Discussion (Section L): The Cinema in Education.

At 3-15.—Discussion (Section I): The Meaning of the Symptoms of Beri-beri.

At 3-30.—Discussion (Section L): Wireless in Education.

At 8.—Prof. A. S. Eddington: Stars and Atoms (Evening Discourse).

Monday, August 9.—At 10 A.M.—Addresses by Sectional Presidents: A.—Prof. A. Fowler: The Analysis of Spectra.—H.—Prof. H. J. Fleure. The Regional Balance of Racial Evolution.—M.—Sir Daniel Hall: The Limits of Agricultural Expansion.—Discussion (Section B): Tautomerism.—Discussion (Section L): Recent Advances in Educational Science.

At 11 A.M.—Discussion (Section K): Vegetative Propagation.—Discussion (Section D): The Training of a Zoologist.

At 2.—Discussion (Sections D, H, J): Heredity in its Physical and Mental Aspects.

At 8.—Prof. H. F. Osborn: Discoveries in the Gobi Desert by the American Museum Expeditions (Evening Discourse).

Tuesday, August 10.—At 10 A.M.—Prof. J. S. Huxley. The Study of Growth and its bearings upon Morphology (Lecture).—Discussion (Section L): The Public School System.

At 11 A.M.—Discussion (Sections C, D, K): The Conception of a Species.

At 11.30 A.M.—Discussion (Section M). The Feeding of the Dairy Cow.

At 12 noon.—(Section I) by Dr. J. S. Haldane: Acclimatisation to High Altitudes (Lecture).

At 2.—Conference of Delegates of Corresponding Societies.

At 2.30.—(Section J) by Miss W. Spielman: Recent Progress in Vocational Selection (Lecture).

At 5.—Sir F. Keeble: The Nervous System of Plants (Lecture).

Wednesday, August 11.—At 11 A.M.—Discussion (Section E): Regional Work in Geography.

At 12 noon.—Concluding General Meeting.

SATURDAY, AUGUST 7, 1926.

CONTENTS.

PAGE
The State and Science 181
Bacteriophage 183
The Science of Photography. By T. S. P. . . 185
History and Evolution. By F. S. Marvin . . 187
Our Bookshelf 188
Letters to the Editor:
Lightning.—Dr. N. Ernest Dorsey; Dr. G. C. Simpson, C.B., F.R.S. 190
Butterfly Migration.—Frank Cramer . . . 191
The Inheritance of Brachypterous and Macropterous Wings in *Sitona hispidula*.—Dorothy J. Jackson 192
The Stone Age of Ceylon.—E. J. Wayland . . 193
Equations for Thermionic Emission.—P. Freedman 193
Seasonal Sunshine in Great Britain.—L. C. W. Bonacina 194
Spatial Relations in a Dream.—Dr. J. H. Kenneth 194
Television or Teleoptics?—The Right Hon. Sir Herbert Maxwell, Bart, F.R.S . . . 194
Rotation and Relativity.—A. Jaques and J. S. Morgan 194
Meteors and the Constitution of the Upper Air. By Prof. F. A. Lindemann, F.R.S. 195
Methods and Results of the American Museum Expedition in the Gobi Desert, 1922–25. By Prof. Henry Fairfield Osborn, For. Mem. R.S. . . 198
The British Association at Oxford. By F. A. D. . 199
Obituary:
Rev. T. R. R. Stebbing, F.R.S. By Dr. W. T. Calman, F.R.S. 202
News and Views 201
Our Astronomical Column 205
Research Items 206
Kammerer's Alytes. By Dr. G. K. Noble; Dr. Hans Przibram 209
The Progress of Geological Survey in Great Britain 211
Air Pollution and its Prevention 212
University and Educational Intelligence . . . 213
Contemporary Birthdays 213
Societies and Academies 214
Official Publications Received 216
Diary of Societies 216
SUPPLEMENT: BRITISH ASSOCIATION—
Scientific Research and Service. By H.R.H. The Prince of Wales, K.G., D.C.L., F.R.S. . Supp. 9
Views and Reviews. SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS . . . . Supp. 15

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

The State and Science.

IN electing the Heir to the Throne to fill its highest office, the British Association has honoured both science and itself. Since the Prince Consort filled this position in 1859, no member of the Royal Family has presided at its functions, and in succeeding his great-grandfather, H.R.H. the Prince of Wales has followed worthily in the footsteps of one who revealed an extraordinary insight into the possibilities of science, and initiated proposals that have led not only to the wide dissemination of scientific knowledge, but also to the harmonious co-operation of Science and the State.

The British Association has long been regarded as the mother of scientific parliaments, among the most important duties of which is that of bringing home to our people the significance and value of science to human life. No more effective spokesman could have been chosen than His Royal Highness, who, by virtue of his great experience as a traveller and interest in world-affairs, and of his immense popularity among all classes of the population, is pre-eminently qualified to convey the message of science to the nation and to the Empire. The onlooker, he says, sees a great deal of the game, and his experiences of things military and naval, his contacts with industry, education, public health, land-settlement, agriculture, transport, and housing, have convinced him that the future of civilisation lies "along a road of which the foundations have been laid by scientific thought and research." He has also come to realise that the future solution of practically all our industrial and social difficulties will only be found by scientific methods.

However divergent men's views may be on the course of human progress, whether it is rectilinear, or gyratory with frequent interruptions (like the recent traffic in Piccadilly Circus), the most pessimistic will admit that the thoughts, interests and achievements of men have appreciably expanded within modern times, and that this development has been attended by a noticeable growth in the spirit of toleration. Our universities are now open to all classes, creeds, and nationalities; the social 'cat' can not only look at the social 'king,' but rub shoulders with him on the playing field and at charitable functions; we no longer consign to the stake those who practise the profession of necromancy, or to the gallows those who unlawfully prey upon their fellow-citizens: instead, we give them 'space' in our popular newspapers, and leave them to the verdict of 'time.' This unfolding of the spirit of toleration is especially marked in the attitude of conservative interests towards science, and the Prince is very happy in his allusion to the Oxford Meeting of the British Association in 1832, when there was strong opposition to conferring honorary degrees on such distinguished men of science as Brewster, Robert Brown, Dalton, and Faraday, whom Keble stigmatised as a "hodge-podge of philosophers"; and in his reference to the memorable meeting in 1860 when Bishop Wilberforce, at his famous encounter with Huxley, displayed an attitude of mind toward science that is rarely found nowadays, although, as Tennessee has taught us, it is not yet quite extinct. Such times are happily past, and even our most ancient and orthodox institutions are doing their best to march to the syncopated strains of modern civilisation. We must not, however, forget that feeling of 'dumb hostility' toward science and its works, referred to by Prof. Lamb in his presidential address last year, and again by the Prince on the present occasion; or the even more blighting feeling of apathy which still stalks in the land. Both these negative forces are the consequences of that ignorance and lack of imagination which instigated Voltaire to remark that although we had a hundred different religions, we had only one way of cooking a potato.

The history of the relations between science and the State in Great Britain, which is one of the principal themes of the presidential address, was sketched with a masterly hand, and nothing in it is more remarkable than the long period of delay—more than eighty years—which elapsed between the conception of a State department of science and its realisation when the Department of Scientific and Industrial Research was established during the late War. The time-lag between thinking and doing is ascribed by the Prince to lack of prevision of successive Governments, and to mutual distrust between science and the State; to these causes we would add ignorance of science and its methods, and the conservative attitude of the governing classes toward any disciplines which might compete with the study of the humanities and with orthodox religion. Many of us can well remember the bitter controversies which took place during the latter part of the last century between the respective champions of individualism and collectivism, and whilst the contention of the former that the genius of our people is ill-adapted to wholesale measures of nationalisation or widespread State control, is still held by the majority, it is evident that the ultra-individualism advocated by J. S. Mill, Herbert Spencer, and others is equally unsuitable as a practical creed. At any rate, time has largely solved the problem by the parliamentary method of compromise, and if we are not 'all socialists now,' we recognise that in certain matters affecting the welfare, and even the existence of our people, there is a legitimate field of State intervention; not necessarily for the purpose of assuming control, but rather for that of rendering assistance and giving advice.

Opinions will, of course, vary concerning the nature and extent of the fields into which the State can usefully penetrate. Those leaders of modern thought who are not obsessed by the mechanical and material aspects of Western civilisation, conceive progress to lie in a sense of values, and the majority of them admit that the cultivation of science, the broad and imaginative outlook which that cultivation engenders, and the application of scientific discoveries to human ends, are among the things that really matter to-day. Security in time of war, industrial progress in time of peace, education and national health at all times, cannot be left entirely to individual effort and initiative; and the only question that arises is the nature and range of the help which the State should give. In this connexion, the views recently expressed by the Earl of Balfour to the Society of Chemical Industry, which are evidently the views of the Department of Scientific and Industrial Research, over which he presides, are of interest. Apart from allocating grants to universities and the Royal Society, Lord Balfour holds that the State should not concern itself directly with promoting or assisting fundamental research work. Nor should it travel to the other end of the scale by finding capital for building factories and acquiring markets. Its legitimate sphere lies in helping to bridge the gap between laboratory experimentation and full-scale industrial operation, and in maintaining institutions like the National Physical Laboratory and the Fuel Research Station which, among other duties, pursue investigations of fundamental problems that are common to many industries, and therefore of great national importance.

In the recent attitude of the State toward science, the Prince discerns "a definite step in human progress," which is both novel and teeming with possibilities for Great Britain, the Empire, and the relations subsisting between them. Few, if any, of us know as much about the conditions in, and the needs of, our great overseas dominions as does the Prince; and none can speak with greater prestige. His remarks on the importance of extending knowledge of our overseas territories, on the value of co-ordinating the results of research work throughout the Empire, and on the good that results from personal contact between scientific workers from its various parts, require no emphasis from us; but we would point out that much as men of science may strive to serve the needs of Empire in the manner indicated, their services can only be small compared with those rendered by H.M. the King and H.R.H. the Prince of Wales, who, by their repeated visits to the Dominions, have strengthened beyond measure the natural ties of kinship that attach the motherland to her children beyond the seas.

Bacteriophage.

The Bacteriophage and its Behaviour. By Dr. F. d'Herelle. Translated by Dr. George H. Smith. Pp. xiv+629. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 36*s*. net.

AN indication of the appeal that the subject of bacteriophage has made to the interest of bacteriologists is afforded by the fact that, in this second book of d'Herelle's, the bibliography contains more than six hundred papers, of which more than five hundred have appeared during the last five years. In taking up the book one has in mind not only the importance of the bacteriophage in relation to fundamental problems of bacteriology, but also that the author was the first to make extensive investigations on the subject, under this name, and to demonstrate the phenomena by the striking and easily learnt technique which made it at once widely known. From the beginning of his publications in 1917, he has maintained the view that the bacteriophage is a living nonvisible virus that exists as a parasite upon bacteria. All the facts discovered since that time have been interpreted by him on the basis of this hypothesis and, as was to have been expected, it is in the light of this interpretation that the book has been written.

All those who have worked at the bacteriophage are not, however, adherents to this view. The phenomena produced by the bacteriophage and such properties of the active principle (bacteriophage itself) as can be determined by controlled experiments, are generally accepted. But to many the significance of these facts is chiefly in their relation to the possibilities afforded for further investigation of the nature and causes of bacterial variation and further analysis of bacterial metabolism. To these fields bacteriophage has opened new and valuable approaches, none the less valuable because numerous scientific investigators are unable to accept the hypothesis of a living virus. Amongst other contributions to the discussion written with less advocacy of a particular point of view, those of Bordet (*Annales de l'Institut Pasteur*, 1925, 39, 717) and Otto and Munter (*Ergebnisse d. Hyg., Bakteriol., Immunitatsforsch., u. exp. Therapie*, 1923, 6, 1) may be noted. The book under discussion is more than a review of the subject, it is as well an argumentative exposition of the author's views of the nature of the bacteriophage, his interpretation of the phenomena produced by it and his claim to priority in its discovery.

The larger part of the introduction of thirty-four pages is taken up with mention of observations of others so far back as 1892, in which, in the light of present knowledge, bacteriophage may have played a part. In several instances it is impossible to be certain whether this is a correct surmise, but it appears highly probable that the irregular forms of colonies described by Gildemeister (1917) in cultures of *B. typhosus* and *B. coli* were the result of the action of bacteriophage. Gildemeister himself is of this opinion. Five pages are occupied with a detailed consideration of a paper by Twort (1915) which appeared two years before d'Herelle's first publication and of which he was at that time unaware. The contention is that the phenomena described by Twort were not due to bacteriophage, although this view is not held by most of those who have studied the question and written on it. Indeed, though the class of bacteria was different and the ease of demonstration was less, it is generally accepted that the main characters of the two phenomena are identical and that Twort recognised the essential facts though uncertain as to the interpretation. The point in continuing these arguments for priority is not clear. It seems quite certain that d'Herelle was not the first to observe the phenomena due to the action of what we now term 'bacteriophage,' but, on the other hand, no one wishes to detract from the work of d'Herelle, who was the first to make extensive systematic investigations in the subject, and was chiefly responsible for bringing it forcibly to the attention of the scientific world.

The book itself is divided into three parts: (1) The phenomenon of bacteriophagy, (2) the bacteriophage, (3) the behaviour of the bacteriophage protobe. A lengthy discussion of these matters would lead one into highly technical fields of bacteriology into which it is not possible to enter here or necessary for those who are acquainted with the subject. For those who may wish to inquire further, d'Herelle's book or the reviews that have been mentioned will be of value.

In general terms the phenomenon of bacteriophagy consists of bacterial lysis transmissible in series. If one puts a small amount of 'bacteriophage' with a culture of a susceptible bacterium in a liquid medium, in the course of a few hours the turbidity of the culture decreases. Not all the bacteria are destroyed, however, and from the lysed culture, subcultures can be obtained of bacteria that resist lysis when exposed again in a similar way to bacteriophage. If the lysed culture be filtered through a Chamberland or similar filter, and all the bacteria removed, the filtrate contains a much greater amount of bacteriophage than was originally put in; the increase may be as much as ten thousand times in the course of six or eight hours. This process can be repeated indefinitely, the bacteriophage increasing in association with living susceptible bacteria upon which it has a lytic action. A similar lytic phenomenon may be obtained on solid media if inoculation is made with a mixture of bacteriophage and susceptible bacteria. In place of normal bacterial growth there will develop, according to the conditions of the experiment, small clear areas devoid of growth, larger irregular areas, or almost complete absence of growth. If inoculation be made sparsely to allow isolated colonies of bacteria to be seen, some of them will be deformed by the absence of growth in part of the area they would normally have covered.

The bacteriophage is therefore an 'agent' or 'principle' that passes readily through filters that retain bacteria, that increases in association with living bacteria which are susceptible to lysis by it; its action upon a susceptible culture shows that all the organisms in the culture are not equally susceptible but that some are resistant, and if isolated are neither lysed by bacteriophage nor permit its increase in association with them.

The bacteriophage was first obtained by d'Herelle from the intestinal contents of patients recovering from dysentery. A Chamberland candle filtrate of a culture of intestinal contents added to a culture of a suitable organism produced clearing of the turbidity. Since then bacteriophage has been found widely distributed. It is present in the intestinal contents of healthy individuals and animals, in purulent discharges, in sewage, in river water, in soil, etc. In discussing the "ubiquity of the bacteriophage," p. 37, one would like to have seen set down along with these other sources the experiments of Bordet, who obtained bacteriophage from the exudate that formed after guinea-pigs were inoculated intraperitoneally with *B. coli*. One notes also that the experiments of Otto and Munter, who found that bacteriophage appeared spontaneously in some of the cultures in their laboratory, are dismissed with brevity. It is a question of fundamental importance whether the phenomena associated with bacteriophage are accentuations of processes that normally occur in bacteria. To dismiss these experiments with the statement that the strains from which bacteriophage had been directly derived had been "contaminated" with it from the time of their isolation, that is, that the bacteria and the bacteriophage virus had been isolated together from the body is, to say the least, a one-sided account and is, in fact, begging the question.

The explanations given of the phenomena of bacteriophagy are all based on the author's view that the bacteriophage is composed of individual living 'corpuscles.' For example, the mechanism of dissolution of a bacterial cell by bacteriophage as seen by the author under dark-ground illumination is summed up in a paragraph on p. 115, ". . . the single fact that the phenomenon of rupture is 'explosive' in nature shows that the bacteriophage corpuscle certainly penetrates to the interior of the bacterium, and that it is in this location that multiplication takes place." It is stated without any qualifications in the context, p. 18, that "the science of immunity has been held back for more than twenty years by the equivocation created in the subject by the term 'lysis,' which as a matter of fact has entirely lost its real significance." For this reason the destruction of the bacterial cell by bacteriophage is termed 'dissolution.'

One notes also the manner of mentioning the work of others whose results have been difficult to assimilate into the author's thesis. In particular, a sentence on p. 212, referring to one whose work is well known and accepted, which reads: "the contribution is absolutely incomprehensible, and it would seem that he has no idea of what in reality is the phenomenon of bacteriophagy," is an illustration of the author's attitude of mind.

The second part of the book deals with the characters of the bacteriophage itself. Its behaviour towards physical and chemical agents is discussed and a chapter is devoted to hypotheses concerning its nature, in which this aspect of the subject is extensively presented.

A point of some interest is the introduction of a new term to indicate a class or genus which is to include several of the so-called filterable viruses. The definition is as follows (p. 359):

> "Up to the present time the infravisible agents of rabies, of variola, of vaccinia, of encephalitis lethargica, of the animal plagues and of the mosaics of plants, have been considered by the majority of biologists as living beings, but this point of view has been, however, disputed. Although the proof of the living nature of the bacteriophage is only valid for itself alone, it is none the less true that the living nature of all the beings which present the same characteristics is rendered the more probable by the facts disclosed in connexion with the bacteriophage. These infravisible beings have been termed 'invisible viruses,' 'ultraviruses,' 'ultramicrobes,' etc. This does not give them a name, for these terms are simply qualifying terms, designating their state of invisibility. In presenting the demonstration of the living nature of the bacteriophage I have proposed to designate this group of living 'micellar' beings by the name Protobes, a term which I have applied to the bacteriophage."

P. 357: "It is to this being, infravisible, parasite of bacteria, that I have given the name *Protobios bacteriophagus* (syn. *Bacteriophagum intestinale*) d'Herelle 1918."

The rôle of the bacteriophage in immunity is, broadly, the subject of the third part of the book. On p. 488 is found, "With plants, as with animals, antibacterial immunity is 'exogenous,' it is the bacteriophage protobe. This is a general fact throughout nature." If this were so one might expect important results from prophylactic immunisation with bacteriophage and its use in treatment. The final two chapters are taken up with these matters, but the enthusiasm of the author for his theme has produced an atmosphere of hope which will require much further work to be justified. Whatever view may be taken of the nature of the bacteriophage, it has undoubtedly a markedly destructive action on susceptible bacteria in the test-tube, but the principles involved in employing bacteriophage for prophylaxis or treatment of disease are as yet but little understood, and indeed further evidence is required to establish the reality of this branch of therapeutics.

The book, compared with the first one "Le bactériophage, son rôle dans l'immunité," 1921 (English translation, 1922), has increased in size. The presentation of almost every aspect of the subject has been expanded. A section on ultra-filtration is new. Much of the discussion concerning the various hypotheses that have been put forward to explain the nature of the bacteriophage is also new. This part of the subject has been given attention by most of those who have worked at bacteriophage. One is dealing with a filtrable, non-visible agent, possessing unique properties, of much interest in its relation, on one hand, to living viruses, and on the other, to bacterial and cellular lysins and to enzymes. In spite of much work, this exact relationship is still undetermined.

The Science of Photography.

(1) *The History of Three-Color Photography.* By E. J. Wall. Pp. x+747. (Boston, Mass.: American Photographic Publishing Co., 1925.) 15 dollars net.

(2) *Stereoscopic Photography: its Application to Science, Industry and Education.* By Arthur W. Judge. Pp. xv+240. (London: Chapman and Hall, Ltd., 1926.) 15*s.* net.

(3) *Die photographisch-chemische Industrie: die Erzeugung und Verarbeitung photographisch-chemischer Präparate.* (Technische Fortschrittsberichte, Fortschritte der chem. Technologie in Einzeldarstellungen, Band 10.) Pp. xvi+363. (Dresden und Leipzig: Theodor Steinkopff, 1926.) 18·50 gold marks.

PHOTOGRAPHY, in common with some other subjects, has the peculiarity of being both an art and a science. The manufacture of sensitive emulsions suitable for very variable requirements, the design of cameras and optical systems by the use of which the light impression is obtained on the sensitive film, and the processes of development, printing, etc., are essentially scientific, involving as they do, chemical and physical problems which are often of a very complicated nature. On the other hand, photography is commonly spoken of as an art, and it may be said that, with few exceptions, the best exponents of the art know very little of the science underlying the use and practice thereof. Even in connexion with the scientific side, it is true to say that the present high standard which has been reached in the manufacture of plates, films, and papers, which may be used for an infinite variety of purposes and in all climes, is due to empiricism and experience having far outstripped scientific knowledge; this is also true of developers and development, toning, sensitising and de-sensitising dyes, etc. At the same time, it must be emphasised that since the investigation of the scientific foundations of photography was initiated by Hurter and Driffield, increasing attention has been paid to this branch of applied science, and the effect of the results obtained has been very marked on the progress of manufacture and on the applications of photography.

In two of the branches of photography dealt with by the works under review, namely, colour photography and stereoscopic photography, it is self-evident that the scientific basis is all-important, and that any advances made must be dependent on progress made in our knowledge of colour and stereoscopy. At the same time, the necessity of satisfying artistic requirements has had a great influence in directing the course of scientific inquiry. The third book, "Die Photographisch-chemische Industrie," treats only of matters which are industrial and scientific in character.

(1) Mr. Wall has long been noted for his encyclopædic knowledge of the processes of photography, especially of colour photography, and it is not to be wondered at that he has produced a remarkable and unique book. It is the product of thirty years' study and search of the original literature of colour photography and allied subjects, and the author claims, with justification, that "there is no work in any language which has brought together a history and summary of colour photography comparable to this book." Reserving the Lippmann, Seebeck, and bleach-out processes and photo-mechanical reproduction for another volume, the attempt is made to record, even to the most minute detail, every step in the progress of colour photography of both still and moving subjects, from the earliest beginnings to the early part of 1925; detailed references to the original articles or patent specifications are given in every case. The first chapter gives the necessary "Historical and Theoretical Data," after which comes an extremely valuable chapter on colour filters and colour screens,

the use, preparation, and transmission factors of which are given in detail. In three succeeding chapters, still cameras and chromoscopes, bi-packs and tri-packs, and various optical devices are described. Colour sensitive plates, with the methods of sensitising and testing, de-sensitisation, and the preparation of photographic papers, are fully discussed and a list of sensitising dyes, together with their range of action, is given. Subtractive processes and screen plates are dealt with, each in five chapters, whilst other chapters give an account of three-colour transparencies, autochrome stereoscopy, dichromate printing, prismatic dispersion processes, etc. The chapter on colour kinematography is most valuable; this has necessitated a search of the patents of all countries, there being practically no literature on the subject.

The great value of this book lies in the fact that the practising photographer, the inventor, and the researcher will find therein complete records of what others have done; time will not be wasted in re-discovering ideas already known. In this respect it should be mentioned that numerous patents are reviewed which could not be found from the patent office indexes, as they are listed only under other classifications.

Very few errors and misprints have been noticed, but occasionally, as on pp. 55 and 544, the author's mathematical equations go wrong, although the right result is obtained in the end. It is stated that the edition is limited and the type will be distributed as soon as printing is completed, otherwise the reviewer would have suggested that the various and numerous data which are given in terms of the Fraunhofer lines should be expressed in wave-lengths in the next edition.

(2) On the Continent, stereoscopic photography seems to be practised much more than in England, and, for the most part, the literature has been chiefly in French and German. The appearance of an English book on the subject is therefore to be welcomed, not only because stereoscopic photography forms a fascinating hobby, but also because of the applications to which it is being put. The anaglyph is being utilised more and more for the stereoscopic illustration of commercial catalogues, books, and magazines.

The reader of the book will probably be surprised at the extensive applications of stereoscopy in science.

> "By its aid the microscopist, for example, is able to observe stereoscopically and to photograph the minute solid objects revealed under his microscope, and eventually, in the stereo-photographs, to obtain permanent records of these objects in relief. The astronomer employs stereoscopic principles not only to detect the presence of faint stars and binaries, but also to show in realistic relief the features of the moon, comets, certain of the planets, and also the proper positions in space of stars of greater magnitudes forming the constellations. The radiographer is enabled by stereoscopic X-ray pictures to locate exactly foreign bodies in the human system, to show the position of flaws, air-pockets, or defects in castings, metals, or other materials, and to reveal the internal structures of organic bodies and interiors of composite bodies and mechanisms."

It is becoming of increasing importance in aerial and land survey, and its possibilities in enabling the student to visualise complex diagrams and objects are being recognised more and more.

In order to maintain a popular as well as technical interest in stereoscopy, the theoretical and analytical sections have been reduced to the minimum proportions, but the treatment is sufficient for the end which the author has in view, namely, that of interesting both the advanced worker and the amateur. Stereoscopy with a single lens camera, the selection of stereoscopic cameras and accessories, the viewing of stereograms, photographic processes, and notes, etc., are all adequately described before the applications of stereoscopy are considered. For those who wish to pursue the subject there is an appendix giving a bibliography of the literature. There is no lack of illustrations, there being some 150 line and half-tone reproductions and 19 plates in stereoscopic pairs.

The author is to be congratulated on a book which will occupy a worthy position in English photographic literature.

(3) This book, as its title indicates, is mainly concerned with the manufacture of photographic material, and gives a literature summary covering the period from 1914 to the present time. There are four sections, which deal respectively with: (*a*) The manufacture and testing of photographic dry plates, (*b*) the manufacture and testing of films, (*c*) the manufacture and testing of photographic papers, and (*d*) the working of photographic materials. This last section occupies practically half of the book and deals with the testing of photographic materials and the usual operations of photography (exposure, development, etc.). Fundamental researches on the scientific basis of photography are not neglected, but are not dealt with in detail. The German aptitude for summarising literature is well in evidence, and if this book is used together with the various Reports on Photography which have been published by the Society of Chemical Industry, it will be invaluable to photographic workers, both those in the industry and in research laboratories.

There are occasional errors, and among these the names of English workers sometimes suffer considerably, as when "Fog" is written for "Toy."

T. S. P.

History and Evolution.

Theory of History. By Prof. Frederick J. Teggart. (Published on the Foundation established in Memory of Philip Hamilton McMillan of the Class of 1894, Yale College.) Pp. xix+231. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1925.) 14*s.* net.

PROF. TEGGART'S book is a useful and learned contribution to a very important contemporary discussion. What is the relation between historical method and the method in the natural sciences, and especially in that nearest to history, namely, biology? It would be difficult to find any statement so clear and pointed as Prof. Teggart's of the difference that has arisen, mainly in the last century and especially since Darwin, between what one may call the 'sociological' and the 'historical' school among the writers of history. Prof. Teggart states it clearly, truly, and forcibly, and traces it to its source; he gives apt and numerous quotations from representative thinkers; unfortunately, he does not work out his own solution in the same fulness. He points out the difficulties, but does not solve them: the solution, in fact, demands a prolonged and thorough philosophical treatment, far beyond the scope of his short essay, and still more of a shorter notice of it. However, we may be thankful to him for having cleared the ground, and await the more leisured cultivator who must come later.

To take two prominent names as representing the two philosophical poles in the discussion, Comte and Bergson: as Frenchmen they have the national gift of expressing logical extremes, though it would be easy in each case to quote amply from the author evidence that his own practice was not, and could not be, in accord with his own logical presumptions. Comte is fully, and on the whole justly, treated by Prof. Teggart as the most powerful voice in the nineteenth century in favour of the sociological, or generalising, view of history. That view maintains that in the limit, that is, if our knowledge were complete, and in proportion as our knowledge increases, we can formulate 'laws' for history and neglect particular events and personalities; that, in the limit, human history would become, like astronomy, a completely reasonable evolution of an idea, or set of ideas, which with adequate knowledge might always have been predicted beforehand as we predict the movements of the heavenly bodies. That is the extreme, logical or determinist point of view, and it was fortified in 1859 by Darwin's formulation of evolution as proceeding by an infinite and unceasing series of minute variations. Its extreme opposite can be found in M. Bergson's view that every human action is a new and creative thing, and that our actions become more perfectly human just in so far as they are free and undetermined by previous happenings. History, therefore, which is an account of human action, cannot be a science, because it deals with the particular and individual, whereas science is always making general conceptions from the recurrence of particulars. Prof. Teggart illustrates this attitude from the two leading thinkers in the nineteenth century who reacted against the generalising and intellectualist attitude in human affairs—Schopenhauer among philosophers and Ranke among historians. This part of his book is the most impressive.

Where is the plain man to take his stand, especially one who comes to history from the orderly discipline of the natural sciences? He will say, in the first place, that neither of the extreme philosophical points of view can be wholly true; he will deny, on one hand, that every human action or event can be properly treated as merely individual; he will be sure that there are, if not 'laws,' at least connexions, movements, and tendencies in history. On the other hand, he will be equally sure that exact formulation, as in the case of mathematics, or prediction, as in the case of astronomy, is out of the question in history or sociology. He will look in history for general similarities and general movements containing an infinite variety of individual difference and freedom of development. To reconcile this apparent contradiction is one of the greatest and noblest objects of human thought.

Two limited and definite suggestions may be made here, appropriate to Prof. Teggart's book. One is that he makes no allowance for the increasing importance of the history of thought in general history. This is the most characteristic and decisive thing in the history of history-writing in the nineteenth century. Whewell was its first exponent in Great Britain about a hundred years ago, one of the first exponents in the world of the history of science as a whole. This aspect of history has made increasing strides ever since, and has now several organs and a mass of literature in all leading educated communities in the world. Now in so far as we look on the history of scientific thought as a guiding thread in general history, so do we perceive an orderly advance and a community of mankind. Above all, it enables us to take a more decided line on the other and last point on which we will comment on Prof. Teggart. He ends his book by saying that the difficulty which he has been discussing will be largely solved "if we recognise the difference between a *belief in progress* and a *belief in the possibility of progress.*" The difference will not appear so great between the two attitudes if we reflect that a belief in the possibility of progress, that is, in the future, depends on the establishment, by history, of progress in the past: and, as the progress of science is the most obvious and measurable thing in history, those, like Prof. Teggart, who would build their faith on the 'possibility' of progress in general, must turn to the annals of systematic and objective thought. F. S. MARVIN.

Our Bookshelf.

Essex: an Outline Scientific Survey; including Geology, Botany and Zoology. By Members of the Essex Field Club and others. Prepared on the Occasion of the Congress of the South-Eastern Union of Scientific Societies at Colchester. Edited by G. E. Hutchings. Pp. 133+4 plates. (Colchester: Benham and Co., Ltd., 1926.) 3*s*. net.

THIS "Outline Scientific Survey," published in connexion with the recent Congress of the South-Eastern Union of Scientific Societies, at Colchester, should prove of wide and permanent interest. Consisting of a series of articles by well-known field naturalists, it provides a detailed account of past researches into the geology, botany, entomology, ornithology, crustacea, etc., of Essex, summarising the great volume of work accomplished by the Essex Field Club during the forty-six years since the club was founded, and work done by earlier Essex naturalists.

Covering a wide field, the articles are necessarily condensed, and will appeal to scientific workers rather than to the general public. The value of this survey is enhanced by the bibliographical notes appended to each article, and by the geological sketch map of the county. A useful index of the survey is also provided.

Owing to limitations of time and space, omissions could scarcely be avoided. One finds in the survey no mention of the mammals, reptiles, and fishes of Essex. These have been fully dealt with by the late Dr. Laver, past president of the Essex Field Club, in a special memoir published by the Club, and also in a report upon Essex and Kent sea fishes, compiled by the late Mr. E. A. Fitch, also a past president of the Essex Field Club, collaborating with the late Dr. Murie, published by the Essex and Kent Sea Fishery Board. Another special memoir of the Essex Field Club deserved attention, namely, the very complete report upon the Essex earthquake, by Meldola and White; and it is surprising to find no reference to the historic and world-renowned 'native oyster'—a variety of the oyster confined to the estuary of the Thames. The oyster fisheries of Essex have certainly been protected for more than seven centuries, probably for more than a thousand years, and possibly from Roman times. As the partridge and pheasant, similarly protected, are always included in British bird lists, we should have expected the Thames Estuary variety of oyster to figure in a scientific survey of Essex. An exhaustive account of this fishery by a member of the Essex Field Club appears in the Essex "Victoria History," and later a pamphlet was published, compiled by the late Dr. Laver, who took a keen interest in this fishery. The small but interesting pyrites industry formerly on the Essex coast, an account of which (by a member of the Club) is included in the Essex "Victoria History," also deserved mention. These omissions could be remedied, in later editions or reprints of the survey, by a brief editorial note.

Monumenta Medica. Under the General Editorship of Henry E. Sigerist. 3: *The Earliest Printed Literature on Syphilis; being Ten Tractates from the Years 1495–1498.* In complete Facsimile, with an Introduction and other accessory material by Karl Sudhoff, adapted by Charles Singer. Pp. xlviii+352. (London: D. Stanton, 90 North Road, N.6; Florence: R. Lier and Co., 1925.) n.p.

OWING to rearrangements, incorporations, and other changes, this beautifully printed and illustrated work, which forms the third volume in the series of "Monumenta Medica," of which the second was reviewed by us some months previously (NATURE, December 5, 1925, p. 811), is, as Dr. Singer remarks in the preface, almost a new work rather than a translation. The writers whose works are reproduced in facsimile are Konrad Schelling of Heidelberg, physician to Philip, Elector to the Palatinate and friend of the humanist Jakob Wimpheling, Joseph Grünpeck of Burckhausen, himself a sufferer from the disease, Niccolo Leoniceno of Vicenza, whose pamphlet was published by the great humanist printer Aldus Manutius at Venice, Hans Widmann of Tübingen, Caspare Torrella of Valencia, who was physician to Pope Alexander VI. and treated his son Cæsar Borgia for syphilis, Corradino Gilino, who recommended the heroic treatment of application of a red-hot iron to the head for curing the salivation caused by mercurial inunctions, Bartholomæus Steber of Vienna, Natali Montesauro of Verona, the first to describe clearly the ostescopic pains of syphilis, and Antonio Scanaroli of Modena. Their contributions to the history of syphilis, while none of them is without considerable interest, are of very unequal value. With the exception of Grünpeck's pamphlet entitled "Ein Hübscher Tractat von dem Ursprung des bosen Franzos," all the tracts are written in Latin.

Prof. Sudhoff regards the work of Torella entitled "Tractatus cum consiliis contra pudendagram seu morbum gallicum," as the most valuable of all the tracts, inasmuch as it is the least prejudiced, the freshest, and the least academic. Perhaps the next most interesting pamphlet in this collection is that entitled "De pustulis et morbo qui vulgo mal de franzos appellatur" by Hans Widmann, who distinguishes the French disease from leprosy, holds the breath of the sufferers to be contagious, and regards the rashes and, above all, the affection of the mouth, as characteristic of the disease.

As Prof. Sudhoff points out in his foreword, the works reproduced will prove of interest not only to epidemiologists and medical historians, but also to students of the history of culture and the art of printing.

Dialogues in Limbo. By George Santayana. Pp. vii+193. (London: Constable and Co., Ltd., 1925.) 10*s*. 6*d*. net.

THE dialogue form enjoys a mild vogue among American philosophers, and it is hard to imagine any more brilliant exponent of it than Mr. Santayana. It expresses admirably the subtle irony of his delicately perceptive intelligence. Of the literary success of his experiment there is no question. Yet interpretation is hard, for, as in all living discussion, the emphasis shifts and one cannot certainly infer what the message is. The scene is Limbo. The spirit of the earthbound stranger holds converse with the illustrious shades—Democritus, Aristippus, Alcibiades, Socrates and the rest—who manage to retain a stronger personal identity than even Mr. Broad's 'psychic factor' would explain; and much of their discourse is at variance with the 'Life of Reason.' For there, at all events, Mr. Santayana has declared himself on the side of reason, has shown how, from the raw material of human character, its diversity of impulse and of passion, reason has to create some kind of harmony; but here the issue is less certain.

Of all the shades, Democritus is endowed with the greatest power and energy of conviction; and he, as frank materialist, is clear enough that the life of reason is largely illusion, and that "the chief and most lasting illusion of the mind is the illusion of its own importance." True, the illusion is necessary and in its way beneficent; for the state of wisdom is "an evanescent madness when the dream still continues, but no longer deceives." Even Democritus, however, can scarce tell whether it is more important that the dream should continue or that it should not deceive. On one side, the practical business of life requires its endurance, since only so can we forbear the bewilderment of ultimate inquiry, and like Protagoras take the way of establishing, by the support of tradition and experience, a valid conventional distinction between sane beliefs and mad. Yet, when the deepest challenge comes, Democritus is impelled to the vow, "I will dismiss and expel every remnant of illusion, even in myself, in order that nothing of me may remain save the atoms that compose me"—truth before aught else. So, too, in a not dissimilar ethical discussion, the dialectic of Socrates can overthrow the vaguely emotional democratic theory of the stranger; but makes less headway against the stranger's version of the teaching of his prophet of human love and gentleness.

There is no finality here: no set conclusion, but a lively and sensitive handling of the issues, and a breathless brilliance of fine debate. H. J. W. H.

An Introduction to Historical Geology: with Special Reference to North America. By Prof. William J. Miller. Second edition. Pp. xvi+399. (London: Chapman and Hall, Ltd., 1925.) 13*s*. 6*d*. net.

PROF. MILLER'S "Introduction to Historical Geology" is not quite so successful as his "Physical Geology," recently reviewed in these columns. The fundamental principles of stratigraphy and the organic inferences are carefully dealt with, and the book contains very useful summaries of Palæozoic and Mesozoic life-forms. Indeed, throughout the book the palæontology is well done. But physical history is especially emphasised, and yet here the treatment follows the conventional lines of older text-books and fails to include the results of much modern work. In dealing with geological time the author is particularly old-fashioned. He writes, "the Cambrian period represents a long time, the best estimates ranging from 2,000,000 to 3,000,000 years. . . . Though the succeeding periods were by no means equal in duration, the best estimates would make no one of them less than 1,000,000 years long." The term 'best' evidently applies to the old estimates of Walcott, and implies ignorance of, or indifference to, the magnificent work of Barrell in this field. More attention might also have been devoted to the palæogeographical researches of Schuchert, which reveal at least eighteen great marine transgressions over the North American continent. The book is well printed and illustrated, but reveals no originality of either point of view or treatment.

Sahara. By Angus Buchanan. Pp. xv+301+78 plates. (London: John Murray, 1926.) 21*s*. net.

CAPT. BUCHANAN has added to his previous works on Africa another valuable book in which he shows his power of descriptive writing and his insight into the native mind. His journey on this occasion was across the Sahara from Kano by way of Ahaggar to Touggourt and Algiers. The main objects of his journey were to secure kinematograph films and make studies in natural history. Happily he avoids the monotonous iteration of daily marches and incidents of camp life, and succeeds in giving a series of vivid pictures of the Sahara, its animal life and its people. While the interest is mainly in natural history, there is a great deal of geographical value in the book. In fact, few volumes give better impressions of the vastness and solitude of the desert. It is a pity that the small map is wholly inadequate for a book of this importance.

Nature, Thought and Personal Experience. By Dr. W. Tudor Jones. Pp. xii+182. (London: Williams and Norgate, Ltd., 1926.) 7*s*. 6*d*. net.

DR. TUDOR JONES has consciously or unconsciously come under the influence of the new doctrine which is being preached in science under the descriptive title emergence. The theory of emergent evolution is an attempt to interpret the process of the cosmos as a succession of 'levels,' each level being characterised by new properties which, though the outcome of the conditions of the previous level, could not be predicted from it. With his well-known zeal for the recognition of moral and religious values, Dr. Tudor Jones applies this as a rationale of the relation of Nature and thought in personal experience. Though dealing with values, he never loses touch with the actualities of positive science.

My Flight to the Cape and Back. By Alan J. Cobham. Pp. vi+70. (London: A. and C. Black, Ltd., 1926.) 1*s*. 6*d*. net.

THIS small volume is a modestly told record of the great achievement of Mr. A. J. Cobham in flying from London to Cape Town and back last year. It was not a hurried flight, as lengthy halts were made at several places on the route via Italy, Greece, Egypt, the Nile, the Lake Plateau and Bulawayo, but it was most successful and singularly free from mishap. The reader may regret the lack of adventure, for Mr. Cobham does not even embroider his story, and makes slight of every incident. But the absence of sensation is a tribute to the skill of the pilot and the worth of his machine. There are several interesting aerial photographs.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Lightning.

IN a recent and very interesting article (*Proc. Roy. Soc.*, A, 111, 56-67, 1926, May 1), Dr. G. C. Simpson advances a theory of the method of advance of a lightning stroke. As he concludes that there can be no substantial stroke of negative charge, perhaps it would be better to say that he develops a theory of the advance of a positive stroke, meaning by this the advance of a stroke of positive charge. A short time ago, I proposed (*Journ. Franklin Inst*, 201, 485-496, 1926, April) a theory of the advance of a negative stroke. As the two theories are apparently conflicting, it is desirable to consider the conflict in order to see in how far it is real, and in how far the theories are merely complements one of the other.

Dr. Simpson regards the advance of the stroke as dependent upon the flight of free electrons. In this, the two theories agree He says nothing about the source of the electrons, but I imagine that no serious objection will be raised to the assumption that essentially all result from collisions of rapidly moving electrons, or ions, with molecules He pictures the positive stroke as the advance of a positively charged tongue extending from the cloud, the advance arising from a continuous sucking of electrons from an ionised region immediately ahead of the tip of the tongue, the branches of the stroke being formed in the same manner at places determined by the irregularities of the field

But what ionises these regions ? If the field at the tip of the tongue is sufficiently intense, the positive ions in it will be driven forward with such velocity that they will ionise the air. In such fields, the electrons so liberated will be very effective ionisers, thus increasing the supply of electrons and of positive ions. Thus the tongue will advance as a result of the repulsion of its constituent ions, and the progress will be continuous so long as the field at the tip remains sufficiently intense. If we regard the tip of the tongue as a region somewhat to the rear of the advance ions which produce the ionisation, this picture accords closely with what seems to be Dr Simpson's concept. Under favourable conditions, such an advance could certainly occur. But in order for branches to be formed by such a process, not only must the field be irregular, but also along the main spark the several regions of maximum lateral intensity must be small and quite definitely circumscribed

It is difficult to believe that the field can have the very fine-grained structure necessary for the wonderfully rich development of branches which is frequently observed. This seems to call for another explanation. Our present conceptions of the nature of the discharge of electricity through gases suggests that the branches are not outgrowths from the trunk, but ingrowths to it. In the region within which the intensity of the field is sufficient to confer upon a free electron the ionising velocity, there occurs, here and there, a stray free electron Each of these is sucked in by the field, and ionises the air along its path, and the electrons so freed join it in its flight. Thus each gives rise to an increasing swarm of electrons flying up the field. The number and distribution of the branches are determined, not by the irregularities of the field, but by the number and distribution of chance electrons. The trails of the electrons are positively charged; they are exactly similar to the tongue pictured by Dr. Simpson, but each arises from a negative stroke to the positive region, rather than as a positive stroke from that region. The trails extend the field, and may pick up other stray electrons which otherwise would not have been caught. Thus a branch may grow in length and may branch. In the same manner the main discharge, or tongue, may advance, not by pushing forward, but by successive negative strokes towards it. A much weaker field will suffice for this type of advance than for the other.

Even when there is ionisation by positive ions, there must in any actual case be ionisation by stray electrons also, and as the mobility of electrons far exceeds that of positive ions, it would seem that the path would be blazed by them rather than by the positive ions, and that the latter would merely enhance the charge of the blazed path and the current along it. In this case the path of the advance is determined by a succession of negative strokes, each starting from a stray electron at a distance from the tip of the tongue; and the effects of such a stroke will be similar to those produced by what I called an upward stroke of negative charge.

There seems to be no reason for doubting that a positively charged tongue, formed in either manner, might reach down into a region in which the field prior to its advent was very weak, or even adverse to the advance.

Dr. Simpson considers that the advance of a negatively charged tongue is impossible, because the mutual repulsion of the electrons would cause a continued broadening of the tip. This, however, depends upon the conditions of the problem. If the tongue consisted of a swarm of free electrons, and if it was not subjected to an external field, then it would certainly broaden out. But if it is subjected to a longitudinal field which is intense as compared with the cross-field due to the mutual repulsion of its constituent electrons, then the paths of the electrons will make only small angles with the axis of the tongue, and at the tip the path will be axial. In this case, the growth will be axial, but there will be a lateral wastage. The electrons passing away from the axis will soon reach a field which is so weak that they lose their ionising power, become ions, and cease to migrate with significant velocity.

There are also other difficulties. It is not clear how a negative tongue reaching some distance from a cloud can ever form if the field is not sufficiently intense to confer upon the positive residues an ionising velocity. If the positive residues take no active part in the ionisation, then as stray electrons near the cloud are driven away by the field, ionising the air as they go, they form a swarm of electrons which is separated from the cloud by a trail of positive residues. What is formed is not a tongue of negative ions reaching from the cloud, but a flying swarm, or dart, of electrons which is cut off from the cloud. On the other hand, if the field near the cloud is so intense that the positive residues acquire the ionising velocity, then they will serve as a continuing source of electrons, and a long tongue, or dart, of electrons will form. Being subjected to the field of the dart as well as to that of the cloud, the forward portion of such a dart may acquire a tremendous velocity; this will facilitate its passage, and also reduce the lateral wastage. But still there is no long tongue of negative ions extending from the cloud, there is nothing analogous to the tongue of positive ions, and apparently there cannot be. But there will be high-speed darts of free electrons. These and their highly ionised trails are essential features of the picture which

I proposed for the negative stroke. Many characteristics of lightning strokes can be satisfactorily correlated by means of such a concept.

With reference to the object struck, there are probably two main types of strokes: (1) The positive stroke, in which a positively charged tongue of ionised air extends from the cloud to the object; (2) the negative stroke by an electronic dart, of which the highly ionised trail extends from the cloud to the object. In general, the initial effects of the second will be more abrupt, more deep-seated, and more rending than those of the first.

The positive tongue theory advanced by Dr. Simpson and the electronic dart theory proposed by myself are not conflicting, but mutually complementary. The apparent conflicts, in so far as they are not a mere matter of words, arose solely from misconceptions, on one side or the other, regarding the completeness of the picture being presented.

N. ERNEST DORSEY.

2101 B Street, N.W.,
Washington, D.C.,
June 9.

IN the paper referred to by Dr. Dorsey, I discussed how a lightning flash is propagated from a positively charged cloud. In that paper, of set purpose, I did not discuss how the ionisation takes place, relying on the simple statement that ionisation does take place when and where the field exceeds a certain unspecified minimum value. I did this to avoid discussion of details which were unessential to the main purpose of the paper. But as Dr. Dorsey now raises these questions they must be considered, although the correspondence columns of NATURE are not appropriate for the full discussion which they really require. I must therefore be content with a few remarks on his main points.

There can be little doubt that free negative electrons which are always present in the atmosphere play some part in the ionisation accompanying a lightning discharge; but all the evidence, in particular the sharp boundary of the discharge channel, points to this action being confined to the immediate neighbourhood of the channel. In fact there is reason to believe that it is confined to the small region at the extreme tip of the advancing channel, where alone, in my opinion, the field is sufficiently strong to cause appreciable ionisation.

With regard to branching, Dr. Dorsey says: "Our present conceptions of the nature of the discharge of electricity through gases suggests that the branches are not outgrowths from the trunk, but ingrowths to it." I wonder to whom the word "our" in this sentence refers, for personally I cannot form any such conception. To me it is quite inconceivable that the branches grow from their tips inwards, finally uniting to form the trunk. This would mean that the electrical discharge starts in the weakest part of the field and not, as one would expect, where the field is strongest, near to the charged cloud.

The second half of Dr. Dorsey's letter is of more fundamental importance. He describes darts of negative electrons which are shot out of negatively charged clouds. It is not easy to understand Dr. Dorsey's ideas from this letter alone; but by reading his other publications I have come to the conclusion that his darts are very little different from the negative discharges which I considered and rejected in my Royal Society paper. I did not consider that such negative discharges are impossible "because the mutual repulsion of the electrons would cause a continued broadening of the tip," as stated by Dr. Dorsey. As a matter of fact, the mutual repulsion of the electrons never entered my head when writing the paper, for any such repulsion is infinitesimal in comparison with the fields which exist where ionisation takes place. The negative electrons would spread out at the tip of a negative discharge, if such could form, not because of mutual repulsion, but because the field under which the electrons move is divergent at the tip.

If it is granted that ionisation takes place where the field is a maximum, then the lines of force must diverge from that maximum. It is because the electrons move inwards for a positive discharge and outwards for a negative discharge that the former is possible and the latter impossible. It is this divergence of the field of force which would prevent the formation and existence of the darts imagined by Dr. Dorsey.

G. C. SIMPSON.

Butterfly Migration.

IN NATURE, September 5, 1925, Dr. E. P. Felt, State Entomologist of New York, in an article on the "Dispersal of Butterflies and Other Insects," said, "It is our belief that determinate flight is a comparatively small factor in promoting the spread of insects, and that in many cases this is accomplished largely by drifting with the wind, . . . There are a number of records of apparently determinate movement by butterflies, . . These cases may represent a true migration, though this is scarcely established by available data."

In a later article, "Physical Basis of Insect Drift," NATURE, May 29, 1926, Dr. Felt continued the discussion and said, "the general tendency has been to explain any widespread movement as a migration, that is, a somewhat determinate or purposive movement by hosts of insects. This attitude is due in part to our very limited knowledge as to the movements of the upper air currents, . . . Turning to the western hemisphere, there are several records of enormous swarms of this butterfly, *Vanessa cardui*, being observed in apparent migration in southern California in 1924 and 1926, the movement being from the south-east to the north-west. One of the observers suggests that the source or the origin was either the foothills of the Sierras or the Sierras proper. There is a possibility that these swarms originated at a considerably greater distance. They may have been carried into the upper air in regions bordering desert areas considerably farther south or south-east, in much the same way as suggested for this insect in the eastern hemisphere, since we have in both extensive desert areas constantly producing convectional currents, and after a certain altitude is attained, the probabilities of extensive drift are certainly excellent."

Doubtless the movements of some insect swarms cannot be explained without the help of the winds. But what is needed, at least in the case of the California 'migrations,' before a general conclusion is drawn, is a careful accumulation of facts. In the early spring of 1926, there was a migration of the 'painted lady' through Palo Alto, California, in the Santa Clara Valley. The movement lasted several days and cannot by any possibility be explained by wind drift. Neither the origin nor outcome of this migration is known; it is not even known whether the swarm started from one area or was cumulative, picking up members as it went; but at the height of the movement the facts were so plain that they could not be misinterpreted. During the two days of March 25 and 26, 1926, I was out of doors nearly all the time and my official duties took me over an area of several square miles in the town and its outskirts and to the open fields. I had opportunity to watch the flight at least six hours on each of those two days.

The flight was from south-east to north-west; that was natural enough, for nearly everything in California trends that way—the great valleys, the mountain ranges, the earthquake faults, the highways and the railways. Even the people drift that way. The numbers of the butterflies were so great that thousands of them were in sight at times in the open spaces. Prof. Doane, of the department of Entomology at Stanford University, paced some of them and found them going at a speed of fifteen miles an hour. "Many south-bound motorists had their windshields entirely obscured by the little insects crushed on the glass by their impact with the car. Radiators also became clogged by them."

The flight was straight, swift, steady and continuous, and all its features were in very striking contrast with the movements of the few white butterflies that were flitting about at leisure The whole movement left the impression of wild energy, of hurry in a definite direction. I watched carefully, but I did not once during the two days see one of the butterflies alight during the hours of flight, except in one doubtful case; and before I could reach it, it was off again

Aside from all the characteristic features of the flight itself, the records of the U.S. Weather Bureau for those two days make the wind drift hypothesis altogether untenable. What wind there was was from the north-west and the flight of the butterflies was against it The barometric pressure was low; and explaining the pressure in the western part of the country the weather report said, "This pressure distribution has been attended by fair and warm weather in California." The highest temperature for the 24-hour period of March 24 was 84° F. and the lowest 50°. The weather throughout the State was fine and steady; the winds were good-weather winds, "gentle to moderate, northerly."

Such waves of life being occasional and not periodic, long-continued and systematic observation over large areas may co-ordinate their occurrence definitely with winter and spring weather conditions favourable to mass production and survival of the butterflies. Those same conditions may stimulate to a high degree the impulse that underlies the flight. The weather certainly has a profound effect not only on the number of broods but also on the intensity of insect life in the case of the little yellow 'alfalfa' butterfly, so destructive, in its caterpillar stage, to the alfalfa hay crop. When the weather is intensely hot in the Sacramento Valley, the males of the great swarms very commonly find and mate with the females before the latter can pull themselves loose at the end of the chrysalis stage or spread and dry their wings.

FRANK CRAMER.

Palo Alto,
California

The Inheritance of Brachypterous and Macropterous Wings in *Sitona hispidula*.

IN the genus Sitona some of the species are fully winged, but in others the wings are so reduced in size that flight is impossible. In at least two species wing dimorphism occurs. One, *S. humeralis* Steph., is described by Grandi from Italy as having brachypterous wings, but all the specimens of this species which I have examined from England are macropterous; in the other, *S. hispidula* F., I find that fully winged and brachypterous individuals are common and widely distributed throughout Britain. In the brachypterous form the wings are very small and have a truncated appearance owing to the absence of the apical portion which, in the normal wing, is bent under in repose. Examples of wing dimorphism have been recorded in other beetles, usually in genera which contain both macropterous and brachypterous species, but no investigation appears to have been made to ascertain whether the two forms interbreed, and if so, how the wing condition is inherited.

With these objects in view, breeding experiments were started in 1921 with *Sitona hispidula*. Weevils were collected from two localities in the Scottish Highlands in which the two forms tended to be segregated. In one (Invershin, Sutherland) 277 specimens have now been collected, but all have proved to be macropterous; in the other (Evanton, Ross-shire) only brachypterous individuals had been met with when the experiments were started, but further collecting has since shown that 5·81 per cent. of the weevils in this locality are long-winged and about 8 per cent. of those collected and used for breeding the brachypterous race have been macropterous. The consequence of this genetical impurity in the brachypterous strain will be referred to later. From the eggs obtained from these collected weevils the parent generation was reared in autumn 1922.

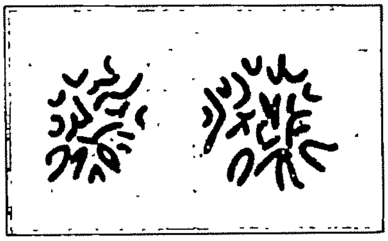


FIG. 1.—Chromosomes at spermatogonial metaphase of forms of *Sitona hispidula* Left: brachypterous form Right: macropterous form

The larvæ feed upon the roots of clover and were reared in muslin-covered pots containing clover grown from seed in sterilised soil. Under such conditions the species is not easy to rear and the numbers so far obtained have been disappointing. Over 70 P_1 individuals were reared; all those bred from Invershin weevils were macropterous and those bred from weevils in the Evanton locality were brachypterous. The sexes were segregated on emergence, and crosses were later effected between long-winged males and short-winged females and vice versa. Fertile eggs were produced but progeny was obtained from only 8 couples, and this F_1 generation, which was reared in 1924, numbered 67. Of these, 5 were macropterous and the rest brachypterous. From one couple 23 individuals were reared and all were brachypterous. The macropterous individuals were obtained from three couples (consisting of both crosses), and each of these couples yielded also brachypterous offspring. One of the macropterous F_1 females was later crossed with a 'wild' brachypterous male, and 15 individuals, all brachypterous, were reared.

These results suggest that the brachypterous condition may be dominant and that the brachypterous parent in each of the three couples in which winged individuals occurred was a heterozygote. The F_1 males did not become sexually mature the same season and the F_1 females, which were then laying eggs, were mostly mated to 'wild' macropterous and 'wild' brachypterous males. From the former cross a total of 13 macropterous and 5 brachypterous offspring were obtained, each of the three families reared containing both forms; from the latter cross 23 brachypterous and 3 macropterous resulted. The 3 macropterous individuals occurred in two out of four families, and it is again possible that in these instances the 'wild' male was a heterozygote. These numbers are inconclusive, and these experiments are being repeated with the F_1 males which have since become sexually mature. It is hoped that specimens of the F_2 generation will be obtained this season.

Through the kindness of Dr. F. A. E. Crew, an investigation of the cytology of the two forms has been made by Dr. A. W. Greenwood at the Animal Breeding Research Department of the University of Edinburgh. Dr. Greenwood informs me that no difference has been found in the number of the chromosomes of the two forms. I am much indebted to him for the trouble he has taken in the matter and for his permission to reproduce his drawings here (Fig 1).

I am anxious to obtain further particulars on the distributions of the two forms of *Sitona hispidula* and would be grateful for any information bearing on this subject.

DOROTHY J. JACKSON.

North Cliff, St. Andrews, Fife.

The Stone Age of Ceylon.

THE short account of Dr. Fritz Sarasin's recent researches into the Stone Age of Ceylon, published in NATURE (April 17, p. 567), interests me deeply. It is the first intimation I have had with regard to any sort of expedition undertaken to test my conclusions with regard to the ages of the prehistoric artefacts that have been discovered in Ceylon. I could have wished that somebody connected with that expedition had communicated with me, because it would have been a pleasure to me to render any assistance of which I am capable.

The thesis set forth in my paper ("Outlines of the Stone-Ages of Ceylon," *Spolia Zeylanica*, vol. 11, Part 41, October 1919) is that the brothers Sarasin were mistaken in ascribing the manufacture of the stone implements that have been found beneath the floors of caves to their recent occupants—the Veddas (*Spolia Zeylanica*, vol. 4, Part 16, 1907). I did not, however, dispute the statement to the effect that a neolithic facies can be recognised in Ceylon, although it must be admitted that characteristically polished neolithic work has not been found.

I further maintained that the geological settings in which the older tools were discovered, and the types of tools displayed, proved them to be palæolithic. An attempt was made to subdivide these palæoliths into groups representative of cultural facies, and thus to produce rough outlines of the pre-history of Ceylon. I said (*loc. cit.* p. 123): "The above, I submit, are outlines of the Stone Ages of Ceylon—sketchy outlines, nothing more. A great deal of work must be accomplished and much detail added before these outlines can assume the aspect of a tolerable picture. Nor do I blind myself to the fact that some alteration of the outlines may be necessary. In the main, however, I fancy they will stand. For what they may be worth I give them here now; and it is for others to investigate and criticise."

The work upon which my paper was founded was brought to an end about ten years ago, and since then I have had ample time to review afresh all the evidence I collected in Ceylon, and to reconsider it in the light of discoveries I have made of similar cultures in other countries. It is now several years since I abandoned the supposition that a Chellean facies can be recognised in Ceylon. Indeed, I never definitely maintained it; for I said (*loc. cit.* p. 98): "The Chellean phase seems to be represented by the usual hand-axe, but I have found few of these." An Acheulean facies I never contended for, but I felt myself to be on fairly safe ground when ascribing many of the older artefacts (indeed the majority of them) to a Mousterian and Aurignacean culture. The view I hold at present is this:

There is some evidence of a crude 'pebble' culture which passes into a Mousterian facies, which in its turn passes into an Aurignacean facies. The youngest stone tools of Ceylon are those of the pigmy type and others associated with them. These I put tentatively at the palæo-neolithic transition.

I have not had the advantage of seeing Dr. Fritz Sarasin's paper in *L'Anthropologie*, so I cannot claim to be acquainted with the latest evidence relevant to the Stone Age or Ages of Ceylon.

It is interesting to note that in Uganda there is evidence of cultures similar to those of Ceylon, and in both of these countries, and on the high veld of the Transvaal, to my certain knowledge, tools of the Le Moustier facies are associated with large hand axes which, if collected without the rest of the suite, would suggest a Chellean culture.

While admitting the argument, that many tools are crude for no other reason than that the materials from which they are made is poor, to be a sound one, I think there has been, on occasion, a tendency to force it. It is astonishing what good work has sometimes been performed upon the poorest of material. Moreover, in Ceylon there are areas where good flint-like chert is to be obtained in abundance.

E. J. WAYLAND.

Geological Survey Office,
Entebbe, Uganda.

Equations for Thermionic Emission.

IN 1923, S. Dushman developed a general equation for thermionic emission, in agreement with the hitherto less frequently used one of the two equations suggested by O. W. Richardson, namely,

$$i = AT^2 e^{-b/T}$$

when i = thermionic current in amp./cm.^{2}.
T = absolute temperature.
b = constant for the substance.
A = a universal constant.

A little later, in the same year, I. Langmuir, as a result of his researches on thermionic emission from thoriated tungsten filaments, proved that the thermionic emission of a body the surface of which is partially covered with a unimolecular layer of another substance, at any temperature, is proportional to

$$e^{\frac{-\{b_1\theta + b_2(1-\theta)\}}{T}}$$

when b_1 = constant for the substance covering fraction θ of the surface of the body.
b_2 = constant for the substance covering fraction $(1-\theta)$ of the surface of the body.

So far, A was accepted by all authorities as a universal constant.

In the following year, however, K. H. Kingdon, as a result of very accurate observations on electron emission from thoriated and cæsiated tungsten, evolved an empirical modification of the thermionic emission equation, namely,

$$i = A_0\{a_1^{\theta} + a_2^{1-\theta} - 1\}T^2 e^{\frac{-\{b_1\theta + b_2(1-\theta)\}}{T}}$$

when a_1 = constant for the substance covering fraction θ of the body surface.
a_2 = constant for the substance covering fraction $(1-\theta)$ of the body surface.
A_0 = a universal constant.

While the relation between b and the contact potential of a substance has been established by Richardson, no further information on the nature of the *a* and *b* constants has been submitted so far.

I find on examination of the latest experimental data of S. Dushman, I. Langmuir, K. H. Kingdon, L. R. Koller, J. J. Weigle, C. Davisson and L. H. Germer, that, with absolute acceptance of those results for which greatest experimental accuracy may be claimed, and making slight allowance in those cases when, according to the investigators' records of experiments, and, in the case of S. Dushman, in accordance with the investigator's own opinion, such allowances appear to be warranted,

(1) '*a*' can be expressed as an exponential function of molecular volume

$$a = Be^{-nv}$$

when B and n are constants.

(2) '*b*' can be expressed as a hyperbolic function of molecular volume

$$b = Cv^{-m} - K$$

when C, m and K are constants.

There certainly may be doubt as to the validity of the '*a*' equation, as, unfortunately, only six elements are available, and of these, three and two each give a common point on the semi-long curve

No such doubt is attached to the validity of the '*b*' equation, only one element, sodium, out of the fourteen elements, as divergent as tungsten and cæsium, appearing to be seriously out, and even in that case the discrepancy is capable of reduction in the light of Kingdon's equation. P. Freedman.

70 Durley Road,
Stamford Hill, London, July 3.

Seasonal Sunshine in Great Britain.

In reading the correspondence by Messrs. Harding and Phillips, in Nature of May 29, regarding the rival claims of the south-east and south-west of England as to sunshine, it seems desirable to point out that in over-stressing quite trivial differences there is some danger of losing sight of the really important climatic fact of sensible equality between the two districts. The difference, for example, quoted between the average daily amount of sunshine through the year, namely, 4·53-4·49 hours, is just about two minutes a day in favour of the south-western counties Even if such a difference deduced from a limited number of stations over no more than 35 years is real, which may be doubted, it could scarcely be of any medical or other practical importance

Mr Phillips objects to the inclusion of South Wales with the south-west counties on the ground that it lowers the sunshine values for the south-west district. The fact, however, that it does so rather tells, in my opinion, in favour of the south-east district, because the sunny conditions of the entire south coast of England stretch much farther north up the east coast than they do up the west coast, leaving the south-east district more centrally situated in the bright belt than the south-west. This may be verified from the sunshine maps in "Book of Normals," Sect. III., and may have some significance.

Sunshine is one of several elements that indicate a sharper seasonal variation when the daylight quarters are employed in preference to the thermal quarters which lag a month behind, namely, November-January, rather than December-February, etc. Still better is the seasonal variation exhibited by taking the four-month summer and winter (May-August) and (Nov.-Feb.) respectively, with the two pairs of equinoctial months for spring and autumn—a scheme coming increasingly into vogue. The English climate is such that the average meteorological sunniness or percentage of possible amount varies in the same sense as the astronomical sunniness or length of day. The result is that the actual amount of sunshine exhibits a very close relationship to the solstices in a land where the days are only 7½ hours at the low solstice and as much as 16½ hours at the high solstice. There are some climates, on the contrary, where, with cloudy summers and clear winters, the summer excess of sunshine is but slight. L. C. W. Bonacina.

27 Tanza Road, Hampstead, N.W.3.

Spatial Relations in a Dream.

In a letter in Nature of March 17, 1923, Mr. Gheury de Bray described some observations on time relations in a dream He mentioned that hypnopompic (or hypnostrophic) images "are generally landscapes passing slowly before one's closed eyes, when in an almost awake condition . . . and having one's full reasoning powers while the illusion proceeds." It seemed "that the speed of succession of the images is an inverse function of the degree of wakefulness." A recent experience would tend to confirm these observations. A succession of faintly coloured landscape images was followed by a less ephemeral and apparently more vivid landscape, while there intruded, at first faintly, then more distinctly, sounds which became identified as knocking on the door. In the dream, the image (a well-known landscape) appeared as if the observer were in a vertical position. But after (? during) the disturbing sounds, an awareness of the actual (*i.e.* horizontal) position of the observer resulted in a conformable orientation of the image As the observer was lying on his right side, the image seemed to have rotated 90° to the right, and thus the same relative position of observer and image, and also the continuity of the dream, were apparently preserved until completion of the wakening process J. H. Kenneth.

The Homestead, Clynder,
Dumbartonshire, June 6.

Television or Teleoptics?

Is it too late to enter emphatic protest against admitting into English vocabulary such an excruciating hybrid as 'television'? I am afraid it is, otherwise this term would not have appeared in this journal (July 3, p 18) as the title of A R.'s interesting paper, thereby receiving the *cachet* of Nature. Hitherto the terminology of science has been framed in scrupulous conformity with the unwritten law or rule against the fusion of different languages in a compound vocable. In this case there is all the less occasion for relaxing the rule because there is ready to hand the term τὰ ὀπτικά, employed by Aristotle to denote all that relates to vision—optics. Surely 'teleoptics' would be as convenient a name as the cacophonous 'television,' and would not upset the equanimity of pedants like myself. Herbert Maxwell.

Monreith

Rotation and Relativity.

The case of a vortex ring appears to have a special bearing on the question of rotation in relation to the relativity theory An observer regarding such a ring can establish definitely that the ring is rotating with respect to himself, but not he with respect to the ring, as in the latter case he would see the ring pass round him, himself passing through the ring (together with the rest of the universe) at each revolution. These two cases are not equivalent, and it is suggested that this affords proof that rotation is not relative, but absolute. A. Jaques.
J S. Morgan.

Liverpool, July 19.

Meteors and the Constitution of the Upper Air.

By Prof. F. A. Lindemann, F.R.S.

FROM the earliest times meteors and meteorites have probably been objects of wonder and interest. Astronomers have examined their radiants and established their connexion with certain comets, and physicists have been led by the study of their characteristics to quite unexpected conclusions about the conditions of the atmosphere at great heights. It is these latter developments that it is proposed to describe as briefly as possible.

Practically all meteorites which have been analysed are mixtures of metallic iron-nickel and of an olivine-like glass consisting of a double silicate of magnesium and aluminium, the proportions ranging from pure metal to pure glass. Since there is no real line to be drawn between meteorites and meteors, it seems legitimate to infer that meteors are composed of the same materials. Meteors appear at heights between 150 and 80 kilometres, and disappear at any height above ground-level, the meteorites of course actually reaching the ground. Their brightness varies within wide limits from the faint telescopic meteors invisible to the naked eye to the fire-balls said to rival the sun in brilliance, and their visible life may be anything between a fraction of a second and some fifteen seconds. Their recorded velocities range from some 10 km./sec. to about 100 km./sec., but it is clear from the nature of the case that these figures, especially in the higher ranges, cannot pretend to any great accuracy any more than can the estimates of luminosity. Deceleration along the path has never been certainly observed.

Presumably everybody would agree that meteors are extra-terrestrial particles moving with planetary velocities brought to incandescence by friction against the air. If further information, however, is desired, it is necessary to formulate somewhat more precisely what occurs when the meteor enters the atmosphere. To fix one's ideas it is as well to have in mind a typical meteor, for example, a meteor which appears at a height of 100 kilometres and disappears at a height of 80 kilometres after traversing a path of 60 kilometres in 1·5 seconds. It may be assumed that this meteor appears as bright at a distance of 150 kilometres as a first magnitude star, *i.e.* that it radiates in the 1·5 seconds of its visible life $3 \cdot 3 \times 10^{10}$ ergs.

The first question to be examined is the original size of the meteor. It is easy to show that practically all its initial energy will be converted into radiation; for its speed relative to the air is so great, and collisions between particles moving at this speed and air molecules consequently so violent, that they disturb the electrons; sooner or later these must return to their normal orbits, entailing, of course, the emission of radiation. If all the energy appears as radiation it is simple to calculate the mass of the particle. The total energy is $3 \cdot 3 \times 10^{10}$ ergs, the velocities 40 km./sec., so that its initial mass must have been 6·25 milligrams. If composed of iron, therefore, such a typical meteor would consist of a particle of diameter 1·15 millimetres, *i.e.* about as large as a small shot.

It is now possible to examine what occurs when such a particle approaches the earth's atmosphere. At first the atmospheric molecules are so rare that the effect of one collision with a molecule will have been dissipated before the next occurs. The result of such collisions will be inappreciable. Most of the energy will be used up in ionising and breaking up the molecules, a part will be radiated, a smaller part will perhaps cause local heating and evaporation, but enough light to render the meteor visible cannot be produced. As the meteor approaches the earth, the density of the air increases and the frequency of these impacts becomes greater, until at a certain height the original colliding molecules and the evaporated meteoric molecules have not time to escape laterally from in front of the advancing meteor before they again collide with air molecules. It is in this region that a cap of gas begins to form in front of the particle which protects it from direct impacts and from loss of heat. Heat now begins to flow from this compressed and heated cap of gas into the particle, ultimately causing it to volatilise.

It is only when evaporation is appreciable that a meteor becomes visible. However hot it might be, a particle the size of which is measured in millimetres could not be seen at a distance of a hundred kilometres; when it evaporates its vapour spreads out and is brought to rest by collision with the molecules of the air in a comparatively large cross-section. The radiation emitted in this process from an effective surface measured in square centimetres is what is observed.

It may readily be seen how this qualitative description may be put upon a quantitative basis, and used to obtain information about conditions in the upper air. Meteors cannot appear until the cap of gas begins to form, *i.e.* until the chance of a molecule escaping laterally without further collision with an air molecule is small. We know the speed at which the meteor is travelling; we can make a fairly close estimate of the average lateral component of velocity of the escaping molecules; and, as shown above, we can calculate the size of any particular meteor the distance, brightness, duration and speed of which are known. Therefore we can calculate what the density of the air must have been if a cap was to be formed. This should represent a minimum value for the density at the height of appearance of the meteor. Fig. 1 shows the calculated densities plotted on a logarithmic scale against the height of appearance of sixty-five meteors the speed, brightness, etc., of which had been observed.

A second check may be attained by considering what happens after the cap has formed. A simple application of the kinetic theory of gases enables one to calculate what fraction of the total heat produced by the impact of the moving meteor upon the air will actually flow through the cap into the meteor and become available for heating and finally volatilising it. The total heat is of course equal to the amount of air accelerated in unit time, *i.e.* the product of the atmospheric density with the cross-section and velocity of the meteor, multiplied by one-half the square of its velocity. Hence the flow of energy available for heating or volatilising in terms of the atmospheric density can be determined. Since we are fairly certain of the size and constitution and consequently heat capacity and latent heat of each meteor, we can calculate the amount of heat necessary to raise it to a temperature at which evaporation takes place (the point at which the meteor should appear), and also the amount of heat necessary to complete the meteor's evaporation (the point at which the meteor should disappear). Therefore the heights of appearance and disappearance can be calculated in terms of the observed meteoric characteristics and the atmospheric density, or inversely the atmospheric density can be calculated from the meteoric characteristics. Fig. 2 shows densities calculated on this basis for some hundred meteors plotted as crosses and dots against their heights of appearance and disappearance.

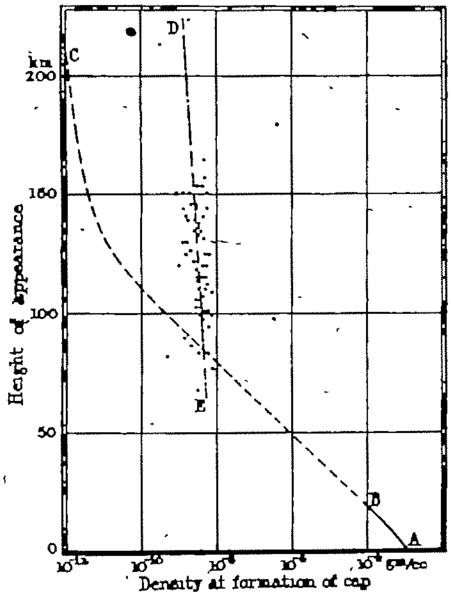


FIG. 1.

Though one could wish these points lay more closely upon a curve, their agreement may be regarded as satisfactory considering the uncertainty in the observational data, introduced more especially by the determination of the meteor's velocities. The two methods agree quite well among themselves, as is shown by the line DE repeated in Fig. 2 from Fig. 1.

In both figures the line AB represents the density of the air derived from *ballon sondes* observation and the dotted line BC the density calculated, assuming the observed temperature of 220° Abs. at a height of 11 kilometres to remain constant up to the confines of the atmosphere. It is clear that at great heights both methods give very much higher densities than correspond to this assumption. The only reasonable interpretation of the discrepancy seems to be that one is not justified in assuming that the temperature is constant from 25 km. to 150 km. simply because it has been shown to be constant between 11 km. and 25 km. In the accompanying figures the immediate observation of the temperature extends from A to B. In view of the evidence obtained from meteors, it seems quite unjustifiable to extrapolate from B to C. The meteor results would be satisfied if one assumed that the atmospheric temperature increased at heights above about 50 kilometres to something of the same order as the earth's surface temperature or perhaps somewhat higher.

This assumption may be supported by two lines of argument: the first is that further experimental facts seem to accord with it; the second is that it is to be expected *a priori* on the ground of known physical laws.

We may first consider four empirical facts which seem to agree with the view that the temperature at great heights is considerably higher than 220° Abs., the first two based on observations of meteors, the last two upon quite independent phenomena.

As has been pointed out, meteorites consist almost without exception of two components, nickel-iron and a glassy olivine-like substance mixed in varying proportions. It has been shown that a meteor can only become visible if it evaporates; therefore the temperature in the cap of compressed gas in front of the meteor must attain a temperature at which iron or olivine evaporate if the meteor is to appear. Now the maximum temperature which gas can attain under adiabatic compression is readily calculated if one knows the initial temperature and the compression ratio. In the case we are considering it may be shown that the compression ratio is $3v^2/2V_0^2$, v being the meteor's velocity and V_0 the molecular velocity. Hence the maximum temperature at the meteor's surface can be determined in terms of the velocity of the meteor and of the initial temperature of the air. Iron and olivine will only evaporate sufficiently rapidly to give rise to a visible meteor if the temperature is above 2000°. Meteors have been observed moving at a velocity of 12 km. per sec. Our formula tells us that air compressed by a particle moving at 12 km. per sec. can only reach 2000° if its initial temperature was 300°. This provides a very satisfactory and quite independent confirmation of the previous result.

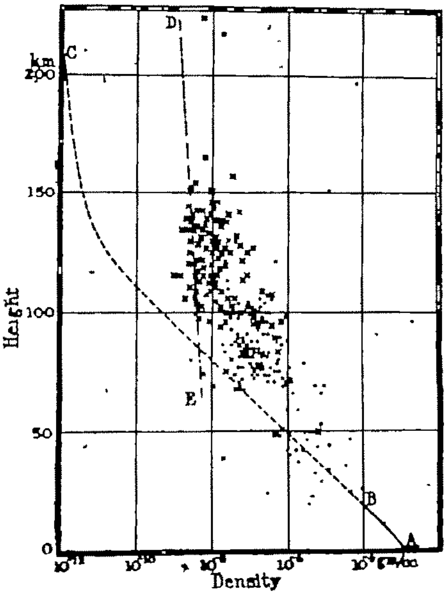


FIG. 2

A second somewhat more doubtful check may be found if the number of meteors which disappear at various heights is examined. It is found that whilst many meteors disappear between 100 km. and 60 km.

and many below 50 km., scarcely any disappear between 50 km. and 60 km. So far only one reason has been put forward to account for this quite unexpected fact. As we have seen, the hotter the air is, the greater the flow of heat into the meteor. For a meteor approaching the earth there should be, on our theory, a region in which the air's initial temperature falls from 300° to 220°, giving rise to a corresponding fall in the flow of heat. In this region one would expect a slower rate of evaporation and therefore diminished luminosity; this effect would, however, soon be outweighed by the increased friction and heat production due to increased air density. It is clear that such a region is the most unlikely one for a meteor to disappear; if it reaches it at all it will probably penetrate into the cooler but denser atmosphere below. The only explanation for the fact that no meteors have been observed to disappear at 55 km. seems to be that somewhere between say 52 km. and 57 km. the temperature of the air rises from the 220° of the stratosphere to the higher temperatures in the neighbourhood of 300° of the outer regions.

This view is confirmed in two very striking ways. As is well known, sources of sound are surrounded by alternate zones of audibility and silence. The distribution of these zones has been explained by the assumption that the velocity of sound increases at great heights. Recent investigations have shown that the height at which this increase should occur in order to account for the observed facts is of the order of 50 km. Clearly the well-known increase in velocity of sound with temperature would explain this otherwise inexplicable acoustical phenomenon if the view put forward above is correct, namely, that the temperature increases rapidly with height in this region.

A fourth argument in favour of this, though as yet not really a convincing one, is found in the well-known anomalies in the propagation of wireless waves. Notoriously the observed facts seem explicable only on the assumption that there is a conducting layer, the Heaviside layer, at a height varying from 50 km. at sunset to some 80 km. at sunrise. One can, with some plausibility, attribute this conducting layer to solar ionisation by day, but it seems difficult to account for its persistence at night otherwise than by assuming that the solar radiation forms some unstable compound which gradually reacts or breaks up forming ions during the hours of darkness. Such a substance is ozone, and it is clear, owing to the enormous increase in the rate of reaction with temperature, that the layer of maximum ionisation after sunset will be the lowest layer at which a high temperature exists, and that this will move up as the ozone is used up during the night to regions of lower density in which the rate of reaction is smaller. This hypothesis, of course, awaits many further checks, *e.g.* by observations at high latitudes during the polar night; but whatever the outcome, the observed fact that the height of the Heaviside layer after sunset lies between 50 km. and 60 km. seems very significant.

Finally, it might be worth while to discuss briefly the theoretical aspect of the high temperatures which observation seems to imply. Roughly speaking, above the troposphere, the region of convective equilibrium, the temperature is determined by radiation alone. Clearly a black or grey body would reach the mean temperature of the earth's surface, for this is the temperature at which emission balances absorption. The gases of the atmosphere are scarcely to be compared to black or grey bodies, however. The main constituents are, from the radiative point of view, somewhat dull and inert. Apart from the rather weak bands of oxygen in the red, neither oxygen, nitrogen nor argon has any well-marked absorption, and therefore emission bands at wave-lengths greater than 2000 Å.U., *i.e.* those to which practically all the sun's emission is confined. Infra-red absorption seems to be the function of the water-vapour, carbonic acid and the ozone. Now if one has a gas with strong absorption bands, even if mixed only in a small proportion with a neutral gas such as nitrogen, it will impose upon the whole mixture its own radiative equilibrium temperature. For the active gas will absorb radiation, and either pass it on to the neutral gas by a 'collision of the second sort' (Stoss zweiter Art) or re-emit it. Equilibrium between energy loss by impacts and gain from collisions will be established when the temperatures are equal. Hence we need only consider the 'active' gases water-vapour, carbon dioxide, ozone and oxygen.

Immediately above the troposphere, say from 10 km. to 50 km., the effect of the oxygen will be unimportant. Its absorption in the visible region is small; the rays it can absorb in the far ultra-violet will have been filtered out by the oxygen above. The influence of ozone might be more important, but it will be far outweighed by the effect of the water-vapour and the carbonic acid, the concentration of which in this region is considerable. The concentration of water-vapour at 11 km. will probably be about $2{\cdot}5 \times 10^{-8}$ gm./cm.^{3}, falling to about 4×10^{-10} gm./cm.^{3} at 55 km. The concentration of carbonic acid will be about $1{\cdot}2 \times 10^{-7}$ gm./cm.^{3} at 11 km., falling to about $7{\cdot}5 \times 10^{-12}$ gm./cm. at 55 km. The total amount of ozone above 11 km. amounts to about $1{\cdot}4 \times 10^{-5}$ of the whole amount of oxygen above this level, but its exact distribution is at present unknown. Presumably it is formed by the sun's ultra-violet radiation, which is absorbed by oxygen at wave-lengths below 2000 Å.U. In this case the amount formed per cm.^{3} must reach a maximum somewhere in the neighbourhood of 60 km. At greater heights the decrease in the partial pressure of oxygen outweighs the increase in intensity of the solar radiation. At lesser heights so much of the initial radiation of the effective wave-length has been absorbed that its loss is not counterbalanced by the increased concentration of oxygen. Hence it is above 50 km. that the concentration of ozone compared to the concentration of water-vapour and carbonic acid becomes important.

Now the equilibrium temperature of the air will be some sort of mean between the equilibrium temperatures in these three gases. The equilibrium temperature of carbon dioxide is easy to calculate. It has only one strong absorption band at $14{\cdot}6\mu$, and its temperature will be found by equating the emission from this band to the absorption. Since there is very little energy in this part of the solar spectrum, the carbon dioxide only absorbs energy from the layers below, more especially the earth, whilst it radiates both upwards and downwards. Its equilibrium temperature is therefore low, about 236°. The value for water-vapour is not so easy to determine, on account of its complicated absorption spectrum. It also absorbs in the infra-red only, and therefore has a low equilibrium temperature, probably between 200° and 220°. The case of ozone is even more complicated, since it absorbs not only at 9·5μ but also to a certain extent in the visible and very strongly in the ultra-violet below 3000 Å.U. Since a not inconsiderable fraction of the sun's radiation (probably more than 1 per cent.) lies in this region, this amount of heat as well as that abstracted from the visible part of the spectrum has to be accounted for in some form or other. It can only be re-emitted by pure ozone at a wave-length of 9·5μ, and its equilibrium temperature when exposed to sunlight and the earth's radiation would therefore be correspondingly high, probably well above 300°.

The general picture may therefore be drawn in outline as follows. At low heights in the troposphere we have convection and therefore an adiabatic temperature gradient. Above 11 km., at which height the temperature has fallen to the equilibrium radiative temperature, *i.e.* 220°, convection will be damped out. From here on one should have a compromise between the radiative equilibrium temperatures of the various active gases. At 11 km. the effect of water and carbon dioxide will preponderate and a low temperature will obtain, but as one ascends, the carbon dioxide disappears and the water diminishes, whilst the ozone with its high equilibrium temperature will become more and more dominant. Above 60 km. the effect of ozone should outweigh that of the other gases and the air should approach the equilibrium temperature of this gas, *i.e.* about 300°, as is indicated by the various more empirical arguments we have outlined.

Whether the agreement of all these forms of indirect reasoning is regarded as convincing is of course a matter of personal opinion. Final certainty can only be attained by direct measurement. It is much to be desired that such immediate observations be made at the earliest possible moment, but the expense and difficulty at present seem to be prohibitive.

Methods and Results of the American Museum Expeditions in the Gobi Desert, 1922-25.[1]

By Prof. HENRY FAIRFIELD OSBORN, For. Mem. R.S.

A NEW volume in the life-history of the earth, composed up to the present of twenty-four chapters (see table below), has been revealed by the discoveries of the Mongolian Expeditions of the American Museum of Natural History, under the leadership of Roy Chapman Andrews. Central Asia, and especially the region east and south-east of Chinese Turkestan, long remained the *terra incognita* of geology, palæontology, and, in a minor sense, of geography. In 1900 the lecturer predicted that the unknown high-plateau region of Central Asia, rather than the well-known Asiatic provinces on the south, such as the Siwalik Hills of India, explored by Hugh Falconer (1830–50), would prove to be the chief centre of the origin and distribution of the mammalia from which waves of north mammalian life radiated to the continents of Europe and of North America.

Andrews's expeditions in the three seasons of 1922, 1923, and 1925, have not only completely verified this prediction, but have also revealed the high Central Asiatic plateau region as the chief home of the terrestrial deinosaurian reptiles of Upper Jurassic and of Cretaceous time. In brief, these discoveries establish Mongolia as a chief centre of northern terrestrial life-history, from the close of Jurassic time onwards to the very close of Pleistocene time.

From the point of view of palæogeography, the outstanding geological discoveries of the expedition are: First, this Central Asiatic continent of Gobia, as it has been named by Grabau, was for several millions of years extremely favourable to the evolution of reptiles, mammals, insects, and plants, and probably birds as well, hitherto known along the low-lying Cretaceous forelands of western Europe (such as the Wealden of England and Belgium), and in less degree of southern Asia. Secondly, this now terribly desert region of Gobia, traversed only by the gazelle and the wild ass, and thoroughly uninhabitable in the summer season, was abounding in life throughout Upper Jurassic, and throughout all Cretaceous and Tertiary time, sparsely forested, traversed by streams and rivers, with a limited seasonal rain-supply like the high-plateau region of Central Africa to-day. Thirdly, these dry and stimulating upland conditions of Tertiary time, as compared with the densely forested conditions of the Asiatic lowlands, have led to the recent prediction by the lecturer on returning from Iren Dabasu in 1923, that this region is the most likely one in which to search for the Tertiary ancestors of man, namely, those of Eolithic or Dawn-stone Age, though no traces of man have, as yet, been discovered by the expedition older than those of Lower Palæolithic age. The discovery of human and pre-human remains in Tertiary time has thus become one of the chief remaining objects of the expedition.

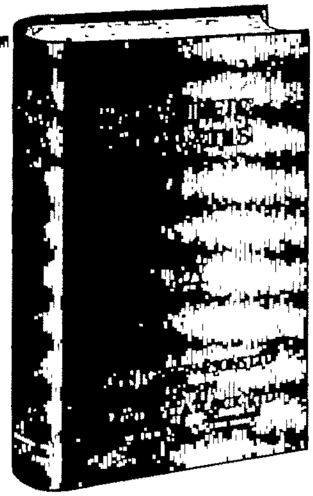
During the season of 1925 a great culture-camp, probably of Azilian-Campignian time, was discovered on the eastern slopes of the Altai Range, not far from Shabarakh, and not far from Djadokhta, where the now famous deinosaur eggs were discovered, far north of the Ordos locality explored by Licent and Teilhard de Chardin. In fact, these Upper Palæolithic artisans collected the broken shells of the deinosaur eggs with which to manufacture necklace ornaments, these perforated fossil shells serving as well as the recent eggshells of the giant Struthiolithus, the great ostrich of the Stone Age of Mongolia.

No human fossils have so far been found: the industrial levels are not as yet precisely determinable, but the chief anthropological fact is established that the Stone Age tribes spread over the borders of the Gobi Desert region during the Ice Age, establishing their quarries near the large lakes bordering the Altai Mountains on the east and fed by glacial streams. The geologists of the party have discovered traces of this glacial age along the summits of the Altai Range.

As for methods, by combining a very large caravan for the camel transport, which leaves Kalgan on December 1, and reaches the eastern base of the Altai Range on May 1, with an automobile train of five to

---

[1] Abstract of a lecture delivered by the author to the Geological Society of London on June 23.



GRIFFIN & BAIRD & TATLOCK

beg to announce the publication of

A NEW CATALOGUE

OF PHYSICAL INSTRUMENTS AND APPARATUS

GRIFFIN AND BAIRD & TATLOCK

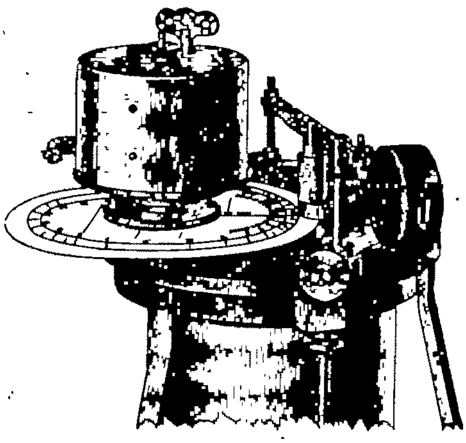
LIST NO 50.—SCIENTIFIC APPARATUS

This catalogue, prepared by the two firms, in association, is of unusual interest, as it is not only a comprehensive and discriminating record of Apparatus for the Physical Sciences but contains many instruments of new and improved design.

A UNIQUE SERVICE is provided by the combination of the experience of the two firms, who have specialised for many years in the production of high-class Physical Apparatus.

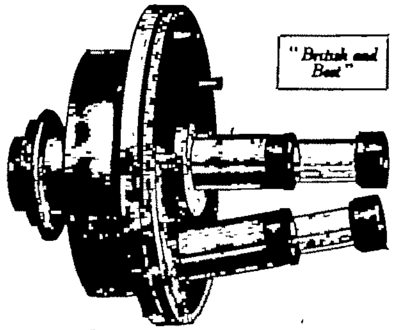
JOHN J. GRIFFIN & SONS LTD
LONDON W.C.2
BAIRD & TATLOCK LTD.
GLASGOW MANCHESTER
EDINBURGH LIVERPOOL.

SMOKE POLLUTION



Dr. Owens's Instruments for Measuring Atmospheric Pollution are made by
C. F. CASELLA & CO. LTD.
Parliament St., London, S.W.1

B-S
Spectrophotometer
for
Accurate Absorption Measurements in the Visible or Ultra-violet Spectrum.



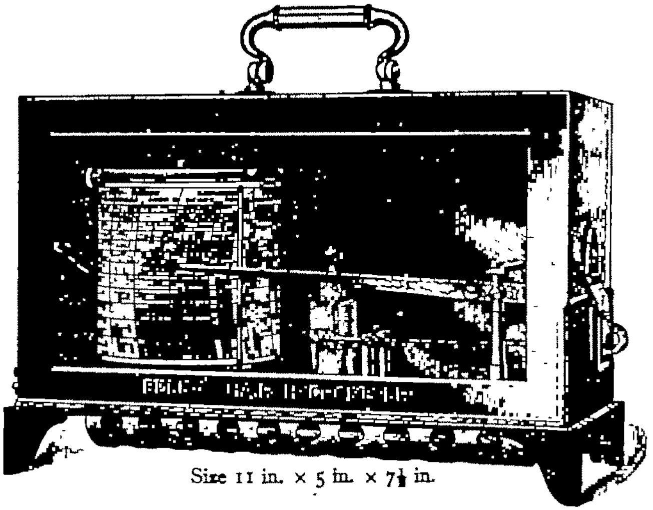
This instrument is attached directly to the slit of the spectrometer or spectrograph, and thus only one adjustment (that of the light source) is necessary.

Full particulars and absorption spectrum photograph from the Makers:

BELLINGHAM & STANLEY LTD.
71 Hornsey Rise, London, N.19
Phone: Mountview 2270

"Edney" Hair Hygrographs

of guaranteed accuracy

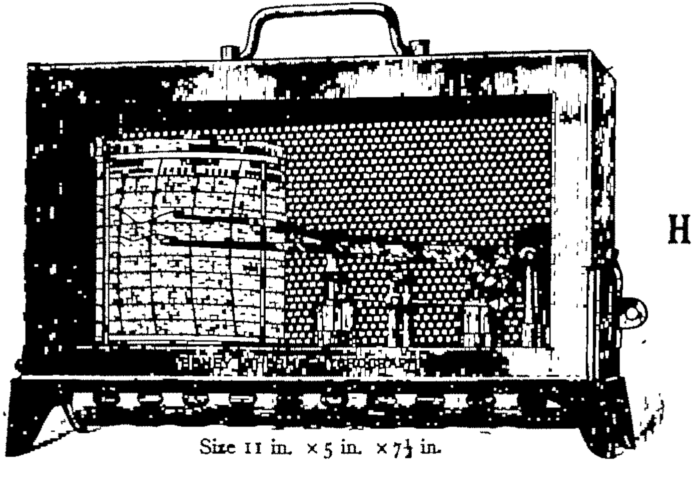


Size 11 in. × 5 in. × 7½ in.

THE "EDNEY" HAIR HYGROGRAPH records directly the **percentage of humidity** in the atmosphere of the room or place being tested. Actuated by a string of human hair, the movement is transmitted through levers to the pen, which records on the chart the exact percentage of humidity. The Instrument is strongly mounted on cast-iron base with hinged copper cover.

Price complete, with charts for one year and bottle of ink . . . **£8 0 0**

THERMO-HYGROGRAPH



Size 11 in. × 5 in. × 7½ in.

THE "EDNEY" THERMO-HYGROGRAPH records on the same chart by different coloured inks the **temperature and humidity** of the atmosphere. The Instrument is strongly mounted on cast-iron base with hinged copper cover.

Price complete, with charts for one year and red and blue inks . . **£12 12 0**

Illustrated Descriptive List of above and other patterns of Hygrographs and Thermographs, also Hygrometers, post free from the Sole Manufacturers:

PASTORELLI & RAPKIN LTD.

Established 1750. Contractors to various Departments of H.M. Government.

Actual Makers also of Thermometers, Barometers, Barographs, Hydrometers, and Standard Meteorological Instruments.

46 HATTON GARDEN, LONDON, E.C.1.

Telephone: Holborn 1981] ***Any instrument sent on approval if desired*** [*Telegrams:* Rapkin, London

Carriage paid and safe delivery guaranteed of all instruments within the British Isles.

Bell's Books

A TEXT-BOOK OF ORGANIC CHEMISTRY

By J. READ, M.A., B.Sc., Ph.D.

Professor of Chemistry in the University of St. Andrews.

87 Figs 692 pp. **12s. 6d.** net.

A remarkably lucid and interesting exposition of the subject. Special attention is devoted to main principles, the amount of detail being kept as low as is consistent with thoroughness. A novel feature is the emphasis laid upon the economic aspect of organic chemistry.

INTERNATIONAL TEXT-BOOKS OF EXACT SCIENCE.

EDITOR: Professor E. N. DA C. ANDRADE, D.Sc., Ph.D.

VACUUM PRACTICE

By L. DUNOYER

236 pp. Illustrated. **12s. 6d.** net.

The next volume to appear in this new series will be a translation of Born's "Atommechanik."

AN INTRODUCTION TO INDUSTRIAL CHEMISTRY

By S. I. LEVY, M.A., Ph.D., F.I.C.

With an Introduction by Sir WILLIAM J. POPE, D.Sc., F.R.S.

302 pp. 16 Plates, many other Illustrations. **15s.** net.

THE JOURNAL OF EDUCATION: "The author has broken entirely new ground, and we fancy that this 'Industrial Chemistry' will soon become indispensable in all university courses in Chemistry."

X-RAYS AND CRYSTAL STRUCTURE

By SIR WILLIAM BRAGG, K.B.E., F.R.S., D.Sc., and W. L. BRAGG, M.A., F.R.S.

New [5th] Edition, Revised. 336 pp. Illustrated. **21s.** net.

BRITISH MEDICAL JOURNAL: "The book is a record of some of the most important scientific research ever undertaken."

SCIENCE PROGRESS: "Any recommendation of this book is superfluous."

RADIUM, X-RAYS, AND THE LIVING CELL

By HECTOR A. COLWELL, M.B., D.P.H. and SIDNEY RUSS, D.Sc.

Large 8vo. 378 pp. Illustrated. **21s.** net.

Revised and Enlarged [2nd] Edition.

LANCET: ". . . the standard treatise on the subject. To the radiologist the volume is indispensable."

THE STRUCTURE OF THE ATOM

By E. N. DA C. ANDRADE, D.Sc.(Lond.), Ph D.

Professor of Physics in the Artillery College, Woolwich

Demy 8vo. Illustrated. About **21s.** net.

New [3rd] Edition, Revised and Enlarged. (In preparation.)

One of the most brilliantly reviewed and fascinating science books of recent years. The new edition, for which many students are waiting, will be issued in the autumn.

G. BELL & SONS, Ltd., Portugal Street, LONDON, W.C.2

Works by Professor

Henry Fairfield Osborn

LL.D., President of the American Museum of Natural History.

Published by CHARLES SCRIBNER'S SONS
7 Beak Street, London, W.1.

IMPRESSIONS OF GREAT NATURALISTS.

By HENRY FAIRFIELD OSBORN, LL.D., President of the American Museum of Natural History. With Portraits. Cr. 8vo. 12s. 6d. net.

WALLACE — DARWIN — HUXLEY — PASTEUR, etc.

". . . a truly delightful book of impressions marked by insight, balanced judgment, and humour."—*Nature.*

". . . penetrating sketches, illustrated with excellent photographs and enlivened by personal reminiscence. . . ."—*The Times Literary Supplement.*

FROM THE GREEKS TO DARWIN. (New Edition.) An outline of the development of the Evolution idea. 12s. 6d. net.

EVOLUTION OF MAMMALIAN MOLAR TEETH. To and from the triangular type. Profusely illustrated. 14s. net.

THE AGE OF MAMMALS. In Europe, Asia, and North America. Profusely illustrated. 40s. net.

(At present out of print; New Edition in preparation.)

THE EARTH SPEAKS TO BRYAN. Written for popular consumption, this timely and eloquent book is the most concise, as well as the most powerful statement of the case for the evolutionists that has been made. 4s. 6d. net

---

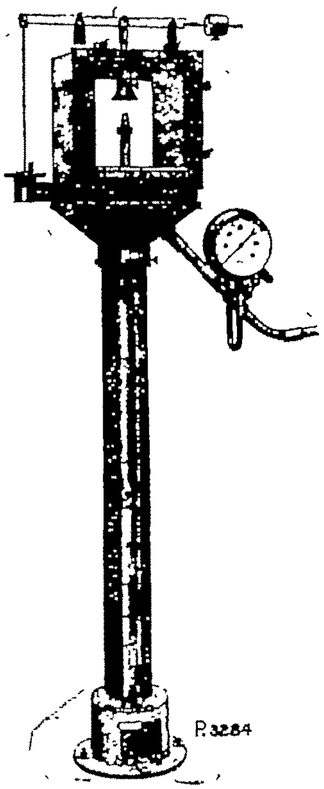
The following works by Dr. Osborn are published by G. BELL & SONS, LTD., York House, Portugal Street, London, W.C.2.

MEN OF THE OLD STONE AGE. Their Environment, Life, and Art. 269 Illustrations, and Maps. 588 pp. 30s. net.

"Prof. Osborn's wonderful treatise tells us in detail how everything was bound up for the ancestors of the modern *homo sapiens* in the hunting of the great beasts that roamed through Western Europe in prehistoric days This work by one of the most famous of American scientists . . .covers a wide field of varied interests."—*Morning Post.*

THE ORIGIN AND EVOLUTION OF LIFE. On the Theory of Action, Reaction, and Interaction of Energy. 135 Illustrations. 354 pp 25s. net.

". . One of the most interesting biological books that has appeared for some years."—*Science Progress.* "We have found the book so interesting that we have left ourselves no room to praise it. So far as its matter goes, that perhaps is the highest praise."—*The Times.*



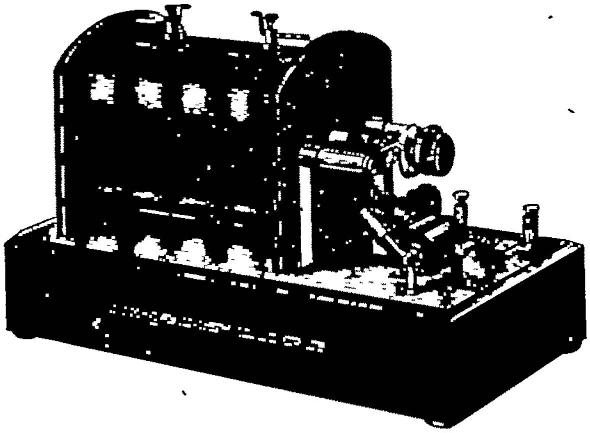
ACTUAL MAKERS since 1876
OF APPARATUS AND EQUIPMENT FOR
ALL BRANCHES OF MECHANICAL SCIENCE

Geometrical and Mathematical Models.

ENGINEERING LABORATORIES FULLY INSTALLED.

G. CUSSONS, LTD.
THE TECHNICAL WORKS, LOWER BROUGHTON, MANCHESTER.
London Office: 231 STRAND, W.C.2. Opposite the Law Courts.

X-RAY APPARATUS
For Crystallography and Physical and Industrial Research
INDUCTION COILS AND TRANSFORMERS



Induction Coils from 1″ to 20″ spark.

Oil-immersed Transformers up to 10″ spark.

Coils up to 6″ spark length are complete with platinum or tungsten contacts.

Coils from 8″ upwards are arranged for use with motor mercury interrupters.

We specialise in X-Ray Apparatus (new and guaranteed second-hand) for Laboratories.

Please write for
1. Special List of New apparatus, including Coils, Transformers, Interrupters, X-Ray Tubes, etc.
2. Special List of guaranteed Second-hand apparatus.
Post free on request.

THE COX-CAVENDISH ELECTRICAL CO. (1924) LTD.
105 Great Portland Street, London, W.1
Telephone] [Langham 1145

JOHN MURRAY

By VISCOUNT HALDANE

Human Experience: A Study of its Structure.
"Full of that quiet scholarship, sound reasoning, and swift mastery of a problem characteristic of the author."—*Daily Telegraph*. **6s.** net.

The Reign of Relativity.
As a result of conversations with Professor Einstein, Lord Haldane has added fresh paragraphs to this new edition. Fourth Edition. **21s.** net.

The Philosophy of Humanism and of other Subjects.
An admirable sequel to "The Reign of Relativity."—*Manchester Guardian*. **12s.** net.

By Prof. FREDERICK SODDY, M.A., F.R.S.

The Interpretation of Radium and the Structure of the Atom.
"Admirably conceived"—*Spectator*. Fourth Edition. Revised and Enlarged. With Illustrations. **15s.** net.

Science and Life. Aberdeen Addresses.
"We are the Professor's debtor for a most suggestive book."—*Morning Post*. Third Impression. **10s. 6d.** net.

Cloud Studies.
By Arthur W. Clayden. Second Edition. Re-arranged and Enlarged. 64 Illustrations. **15s.** net.

Heredity.
By J. A. Thomson, M.A., LL.D. New and Fifth Edition. Thoroughly Revised. **21s.** net.

Variation, Heredity and Evolution, Recent Progress in the Study of.
By R. H. Lock, M.A., Sc.D. Fifth Edition. Revised by Leonard Doncaster, Sc.D., F.R.S. With Portraits and Diagrams. **9s.** net.

Mechanism, Life and Personality. An Examination of the Mechanistic Theory of Life and Mind.
By J. S. Haldane, M.D., LL.D., F.R.S., University of Oxford. Second Edition. **6s.** net.

Practical Zoology, A Junior Course of.
By the late Prof. A. Milnes Marshall, M.D., D.Sc., F.R.S., and the late Herbert Hurst, M.D. Ninth Edition. Revised by Prof. F. W. Gamble, D.Sc., F.R.S., University of Birmingham. **12s.** net.

The Realm of Nature. An Outline of Physiography.
By H. R. Mill, D.Sc., LL.D. Third Edition (Tenth Impression). Revised and entirely Reset. **7s. 6d.** net.

Microscopy. The Construction, Theory and Use of the Microscope.
By Edmund J. Spitta, F.R.A.S., F.R.M.S. Diagrams and Illustrations. Third Enlarged Edition. **25s.** net.

Physical Science, The Recent Development of.
By William C. Dampier Whetham, M.A., F.R.S. Fifth Edition. Entirely Revised and greatly Enlarged. **9s.** net.

Splendours of the Sky.
By Isabel M. Lewis. "Her object has certainly been pleasantly fulfilled, without the slightest loss of accuracy."—*Morning Post*. Illustrated. **9s.** net.

John Murray, Albemarle St., London, W.1.

FROM CONSTABLE'S LIST

THE SMOKE PROBLEM OF GREAT CITIES. Sir Napier Shaw, LL.D., Sc.D., F.R.S., sometime Director of the Meteorological Office, London, and John Switzer Owens, M.D., A.M.I.C.E. Demy 8vo. 312 pages. Illustrated. **21s. 6d.** net.

FORECASTING WEATHER. Sir W. N. Shaw, F.R.S., Sc.D., etc., sometime Director of the Meteorological Office, London. 2nd Edition. **36s.** net.

CLOUDS. A Descriptive Illustrated Guidebook to the Observation and Classification of Clouds. George Aubourne Clarke, F.R.P.S., F.R.Met.Soc. With a Preface by Sir Napier Shaw, LL.D., Sc.D., F.R.S., Director of the Meteorological Office. Demy 8vo 148 pages. Illustrated **21s.** net.

THE STATES OF AGGREGATION: THE CHANGES IN THE STATE OF MATTER IN THEIR DEPENDENCE UPON PRESSURE AND TEMPERATURE. Gustav Tammann, Director of the Institute of Physical Chemistry at the University of Gottingen. Authorised translation from the 2nd German Edition by R. F. Mehl, Ph.D. Demy 8vo. 308 pages. Illustrated. **24s.** net.

INTRODUCTION TO THEORETICAL PHYSICS. Arthur Haas, Ph.D. Translated by T. Verschoyle. 2 volumes. Demy 8vo. Illustrated. Vol. I., **21s.** net. Vol. II., **21s.** net.

THE PRINCIPLES OF SOUND SIGNALLING. Morris D. Hart, M.Sc., D.I.C., A.M.I.E.E., and W. Whately Smith, M.A., M.Sc. A Book on Efficiency in Acoustics and the Reception, Transmission and Production of Sound. Demy 8vo. 156 pages. Illustrated. **12s. 6d.** net.

PHOTOMETRY. John W. T. Walsh, M.A., M.Sc., A.M.I.E.E., F.Inst.P. Royal 8vo. Illustrated. **40s.** net.

THE SCIENCE OF SOILS AND MANURES. J. Alan Murray, B.Sc., Lecturer in Agricultural Chemistry at University College, Reading. 3rd Edition. Demy 8vo. Illustrated. **12s. 6d.** net.

FRUIT GROWING. William Henry Chandler. Demy 8vo. 776 pages. Illustrated. **21s.** net.

NOMOGENESIS or EVOLUTION DETERMINED BY LAW. L. S. Berg, D.Sc. Demy 8vo. Illustrated. **28s.** net.

OUTLINES OF EVOLUTIONARY BIOLOGY. Arthur Dendy, D.Sc., F.R.S. 4th Edition. Illustrated. Demy 8vo. **16s.** net.

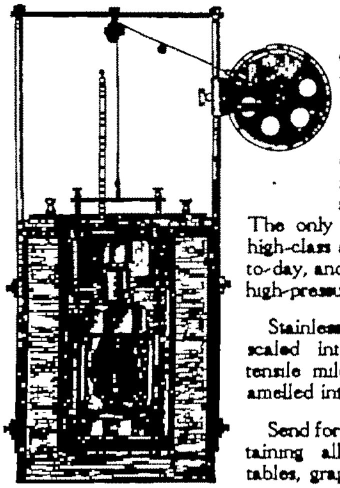
SOCIAL LIFE AMONG THE INSECTS. William Morton Wheeler, Ph.D., Sc.D. Medium 8vo. 116 Illustrations. **16s.** net.

Complete Lists of Scientific Books sent Post Free on Request.

10 & 12 ORANGE ST., LONDON, W.C.2

THE

MAHLER-COOK BOMB CALORIMETER



For determining the calorific value of Fuels (Coal, Coke, Oils, etc.)

The original Bomb Calorimeter, used all over the World and first introduced by the present makers in 1900. The only reliable, accurate, and high-class apparatus on the market to-day, and made by Engineers and high-pressure experts.

Stainless steel Bombs with descaled internal finish, or high tensile mild steel Bombs with enamelled interior.

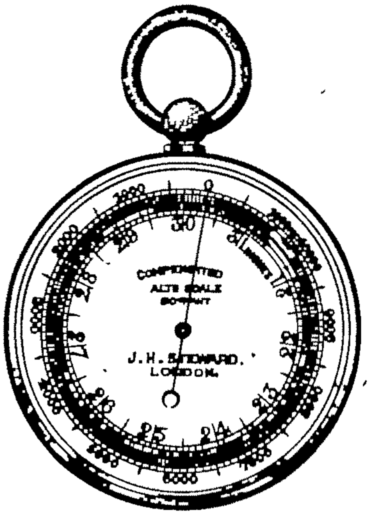
Send for Illustrated Booklet containing all working instructions, tables, graphs, etc.

High Pressure Apparatus, Centrifuges, Microtomes, Electroscopes, Steam Meters, Electric Furnaces, etc.

CHAS. W. COOK & SONS,
ROYAL HOTEL WORKS,
ASHBY-DE-LA-ZOUCH, LEICS.

ANEROID BAROMETERS

FOR MEASURING THE ALTITUDE OF MOUNTAINS OR AIRCRAFT.



Best Quality Movements compensated for Temperature.

With Altitude Scale reading up to 10,000 feet and divided to every 50 feet.

£5 0 0

With Altitude Scale to 15,000 feet and divided to 100 feet.

£5 10 0

With Altitude Scale to 20,000 feet and divided to 100 feet.

£6 15 0

J. H. STEWARD, Ltd.

Opticians and Scientific Instrument Makers to the British and Foreign Governments,

406 and 457 Strand, London, W.C.2.

Established 1852.

"POSTLIP"
(No. 633 Mill)
ENGLISH FILTER PAPERS

Manufactured in
ANNUALLY INCREASING QUANTITIES
for upwards of 50 years.

White and Grey Plain, Antique, Crinkled, and Embossed.

PURE FILTERING POSTLIP MILLS

All sizes in Squares, Circles, and Folded Filters. Rolls made to order.

Pure Filterings for Laboratory Work and in quantities for all industrial purposes.

See Report of TESTS made by The National Physical Laboratory, a copy of which will be sent on application, together with free samples if required.

EVANS, ADLARD & CO., LTD.
POSTLIP MILLS,
WINCHCOMBE, CHELTENHAM, ENGLAND.

W. OTTWAY & Co. Ltd.
(Established 1640)
Actual Makers of Astronomical and Terrestrial Telescopes

STAINLESS STEEL MIRRORS AND FLATS

for Reflector Telescopes; no silvering required. A permanent highly polished surface guaranteed.

Surplus stock of $1\frac{1}{4}''$ and $2''$, 90 degree **REFLECTING PRISMS** made from the best Optical glass flat surfaces; guaranteed highest quality. $1\frac{1}{4}''$, **£1 5 0.** $2''$, **£1 15 0.**

All types of **Astronomical Telescopes, Eyepieces, Equatorial Mountings, etc.** Pamphlets post free on application.

Orion Works, Ealing, London, W.5.

OXYGEN

And other Gases.

The British Oxygen Co. have works for the production of Oxygen, Nitrogen, Carbonic Acid, Nitrous Oxide, Hydrogen, and Argon in all chief industrial centres. The Company's Plants are capable of an aggregate output of **about four million cubic feet per day.**

Special Terms quoted to the Trade.

Catalogue and full particulars on application to the Head Offices of the Company—

THE BRITISH OXYGEN CO., Ltd.,
ANGEL ROAD, UPPER EDMONTON,
LONDON, N.18.

JOURNALS FOR SALE

Physikalisch-chemisches Centralblatt. Herausgegeben von Dr. MAX RUDOLPHI-DARMSTADT. Vols. I.–VI. (1904–1909). 6 vols., half-leather. **£9 : 9s.**

Chemisches Centralblatt. 1900–1907 (being Vols. IV.–XII. of 5th Series), with General Register 1897–1901, 1902–1906. In all 20 vols., half-leather. **£10 : 10s.**

Berichte der deutschen chemischen Gesellschaft. 1898–1915. 49 vols., cloth, rest in parts (1 part imperfect). **£50**

Journal of the Society of Chemical Industry. Complete from the commencement to 1922. Being Vols. I.–XLII. (1882–1923). 28 vols., half-calf, rest in parts. **£60**

Botanical Monographs. Mostly presentation copies with authors' inscription. Classified as Botany, 51 vols.; Fermentation, 4 vols.; Physiology, 5 vols.; and MS. Index, 2 vols. In all 62 vols., half-morocco. **£25**

An important and valuable collection formed by an eminent Professor of Botany, now retired.

Botanisches Centralblatt. Herausgegeben von UHLWORM U. BEHRENS. Vols. XXV. (1886) to CXXX. (1916) and parts of CXXXI.–CXXXVII., in buckram and half-calf. **£65**

Journal of Morphology. Ed. WHITMAN. Vols. X.–XVII. (1895–1901). Half-calf. Boston, U.S.A. **£8 : 8s.**

History of the Cavendish Laboratory, Cambridge, 1871-1910. By FITZPATRICK, SCHUSTER, GLAZEBROOK, J. J. THOMSON, NEWALL, RUTHERFORD, WILSON, CAMPBELL, and WILBERFORCE. Portraits of Maxwell, Rayleigh, and Thomson, and Plates 8vo, cloth. 1910. *Offered for* **5s.** *post free*

Life and Letters of Adam Sedgwick (1785-1873). By J. W. CLARK and T. MCKENNY HUGHES. 12 full-page Illustrations, Portraits, etc. 2 vols., 8vo, cloth. 1890. *Offered for* **8s. 6d.** *post free*

Quarterly Journal of Pure and Applied Mathematics. Edited by SYLVESTER, STOKES, CAYLEY, FERRERS, HERMITE, and GLAISHER *A complete set* from the commencement, being Vols. I.–L. (1926), bound uniformly in cloth. **£76**

We are in direct touch with the principal Foreign Publishing Houses, and can supply books promptly and at moderate prices. The most important FRENCH and GERMAN Scientific books are received week by week as published.

Special attention is given to the requirements of RESEARCH WORKERS, and customers interested in any Special Subjects can have new books in those subjects reported to them as they appear.

Being also dealers in Scientific Works and Journals, we are at all times glad to receive inquiries from librarians and others who wish to buy or sell such works.

Classified lists of English and Foreign books, New and Second-hand, are sent gratis on application.

BOWES & BOWES

1 TRINITY STREET, CAMBRIDGE, ENGLAND

University Tutorial Press

SELECTED SCIENCE TEXT-BOOKS

AGRICULTURE.

The Chemistry of Crop Production. By T. B. WOOD, C.B.E., M.A., F.R.S., F.I.C., Professor of Agriculture in the University of Cambridge. *Second Edition.* **4s. 6d.**

Animal Nutrition. By Professor T. B. WOOD. **4s. 6d.**

Farm Calculations and Accounts. By A. G. RUSTON, D.Sc., Lecturer on Farm Economics in the University of Leeds, and C. V. DAWE, B.Com. **3s. 6d.**

Farm Measurements. By A. G. RUSTON, D.Sc., and C. V. DAWE, B.Com. **2s. 6d.**

CHEMISTRY.

The Tutorial Chemistry. By G. H. BAILEY, D.Sc., Ph.D. Edited by WM. BRIGGS, LL.D., M.A., B.Sc., F.C.S.

PART I. Non-Metals. *Fourth Edition.* **5s.**

PART II. Metals and Physical Chemistry. *Fifth Edition.* **7s. 6d.**

ECONOMICS.

The Economics of Social Problems. By H. A. SILVERMAN, B.A., Lecturer in Economics in the University of Birmingham. **5s. 6d.**

Social Psychology: A Text-book for Students of Economics. By R. H. THOULESS, Ph.D., M.A., Senior Lecturer in Psychology in the University of Manchester. **5s. 6d.**

PHYSICS AND ENGINEERING.

Properties of Matter. By C. J. L. WAGSTAFF, M.A. *Third Edition.* **5s.**

Heat, Higher Text-book of. By R. W. STEWART, D.Sc. *Second Edition.* **7s. 6d.**

Light, Text-book of. By R. W. STEWART, D.Sc., and JOHN SATTERLY, D.Sc., M.A. *Fifth Edition.* **6s. 6d.**

Sound, Text-book of. By EDMUND CATCHPOOL, B.Sc. *Fifth Edition.* **6s. 6d.**

Magnetism and Electricity, Advanced Text-book of. By R. W. HUTCHINSON, M.Sc., A.M.I.E.E. In two volumes. *Second Edition.* **12s. 6d.**

Electricity, Technical. By H. T. DAVIDGE, B.Sc., M.I.E.E., and R. W. HUTCHINSON, M.Sc., A.M.I.E.E. *Fourth Edition.* **12s. 6d.**

Electrical Engineering, Continuous Current. By W. T. MACCALL, M.Sc., M.I.E.E. *Second Edition.* **15s.**

Electrical Engineering, Alternating Current. By W. T. MACCALL, M.Sc., M.I.E.E. **15s.**

Wireless Telegraphy and Telephony, A Text-book of. By W. GREENWOOD, B.Sc. (Eng.), A.M.I.E.E., A.C.G.I. **5s. 6d.**

Complete Catalogue and Sectional Catalogues in Mathematics and Science post free on application.

University Tutorial Press Ld.,

25 High Street, New Oxford Street, London, W.C.2.

His Majesty's Stationery Office

From time to time H.M. Stationery Office publishes monographs and standard text-books in various branches of pure and applied science, and readers of this announcement who are interested in any of the recent reports listed below, or other aspects of scientific research, should get into touch with the Department's Sale Offices so as to be kept informed of new reports.

FUEL PROBLEMS. Carbonisation of Coal in Continuous Vertical Retorts. Holmside (Durham) Coal, with Experiments on the Production of Coal Gas of High Calorific Value. 1s. 3d. (1s. 4d.) Power Alcohol from Sugar Beet. Report of the Departmental Committee. 6d. (6½d.) Physical and Chemical Survey of the National Coal Resources. No. 6. The Lancashire Coalfield: the King Seam. 1s. 6d. (1s. 7d.)

A SHORT COURSE in Elementary Meteorology. By W. H. PICK, B.Sc. 2nd edition revised. 1s. 6d. (1s. 8d.) Illustrated with figs. and diagrams.

AN OUTLINE of the Practice of Preventive Medicine. By SIR GEORGE NEWMAN, K.C.B., M.D., F.R.C.P., Chief Medical Officer of the Ministry of Health. 1s. (1s. 2½d.) Public Education in Health. 6d. (6½d.)

EMPIRE FRUIT. Report of the Imperial Economic Committee on Marketing and preparing for Market Fruit produced in the Overseas Parts of the Empire. 4s. 6d. (4s. 10d.)

INDUSTRIAL WELFARE. Ventilation. A Physiological Study of the Ventilation and Heating in certain Factories. (Illus.) 3s. (3s. 1½d.) Fan Ventilation in a Humid Weaving Shed. 1s. 9d. (1s. 10d.) A Study in Vocational Guidance. Report No. 33. By the Industrial Fatigue Research Board. 4s. (4s. 2d.) The Design of Machinery in relation to the Operator. 1s. 3d. (1s. 4d.)

TEXT-BOOK of Topographical Surveying. 3rd edition of this well-known standard work. 15s. (15s. 9d.)

MILK ANALYSIS. Variations in the Composition of Milk. 21s. (21s. 9d.)

GEOLOGY OF ENGLAND. Oxford. The Geology of the Country around Oxford. 2nd edition. Illustrated with diagrams and photographs. Roy. 8vo. Pp. viii + 191. 4s. (4s. 3½d.) The Geology of Berwick-on-Tweed, Norham and Scremerston. 1s. 6d. (1s. 7½d.) The Concealed Coalfields of Yorkshire and Nottingham. 2nd edition. 8s. (8s. 6d.) The Economic Geology of the Central Coalfield of Scotland. Area V.: Glasgow East, Coatbridge and Airdrie. 5s. (5s. 5½d.)

ADHESIVES RESEARCH. Second Report of the Adhesives Research Committee. 3s. (3s. 2d.)

RADIO RESEARCH. Variations of Apparent Bearings of Radio Transmitting Stations. Observations on Ship and Shore Transmitting Stations, Nov. 1922–March 1924. 2s. 6d. (2s. 7½d.)

SEA TROUT of the River Ewe and Loch Maree. By the Fishery Board for Scotland. 4s. 6d. (4s. 7½d.)

BUILDING RESEARCH. The Stress Analysis of Bow Girders. 1s. 3d. (1s. 4d.) Primary Stresses in Timber Roofs. 1s. 3d. (1s. 4d.) The Permeability of Portland Cement Concrete. Paper No. 3. 1s. 6d. (1s. 7d.) Forest Products Research. The Movement of Moisture with reference to Timber Seasoning. 1s. 6d. (1s. 7d.)

THE STORAGE OF EGGS. Special Report No. 26 of the Food Investigation Board. 1s. 3d. (1s. 4½d.)

NATIONAL Physical Laboratory. Report for the year 1925. 8s. 6d. (9s.)

All prices are net. Those in brackets include postage.

May be obtained from the Sale Offices of the Department at

LONDON: Adastral House, Kingsway, W.C.2 *MANCHESTER:* York Street
EDINBURGH: 120 George Street. *CARDIFF:* 1 St. Andrew's Crescent.
Or through any Bookseller.

Supplement to NATURE

No. 2962 AUGUST 7, 1926

Scientific Research and Service.[1]

By H.R.H. The Prince of Wales, K.G., D.C.L., F.R.S.

MY first duty, as president of our great Association, must be to read to you the following message from His Majesty The King:

> I am sensible of the distinction conferred upon my dear son, The Prince of Wales, in presiding at this year's meeting of the British Association for the Advancement of Science; for I realise that no member of my family has occupied this position since my grandfather was president in 1859. I cannot do better than repeat the assurances then made by the Prince Consort on behalf of Queen Victoria, and express my deep appreciation of the all-important and ceaseless labours in the cause of science of those eminent men who enjoy the membership of your world-renowned society.

I propose on behalf of the Association to forward the following reply to this message:

> The members of the British Association for the Advancement of Science assembled at Oxford humbly beg to express to Your Majesty their loyal appreciation of the patronage extended to the Association by your Father and Yourself, and of Your Majesties' repeated expressions of personal interest in its work.
>
> The advancement of science is the constant object of the British Association; to give a stronger impulse and more systematic direction to scientific inquiry, to promote the intercourse of those who cultivate science in different parts of the British Empire with one another and with foreign philosophers, to obtain a greater degree of national attention to the objects of science, by removing those disadvantages which impede its progress, for the well-being of Your Majesty's realm and the general good of mankind.

My second duty is to try to tell you—if this be possible—something which you do not know already. I must admit frankly that, for a long time, the prospect of attempting this has weighed on me heavily. For a man who, along with the great majority of his fellow-creatures, can lay claim to no intensive scientific training, it is no light responsibility to be called on to address the annual gathering of the British Association. But, believe me, I do not intend to shirk that responsibility; for it seems to me that only by discharging it as well as I possibly can, shall I be able to show you how highly I value the great honour you paid me when you added my name to those of the distinguished men who have been your presidents in past years.

At first sight it might appear a hopeless task for any one who knows nothing of science to talk to you, who know everything about science. But those who work in the scientific field will be the first to admit that no task is really hopeless, and, when I approached this one, I began to think I might perhaps find a few topics in which I could interest you. For, after all, science is only another name for knowledge, and any man who goes about the world with his eyes open cannot fail to acquire knowledge of some sort, which, if he can express it, must appeal to any audience.

To adapt one of our most familiar sayings, the onlooker can see a great deal of the game. I, for example, though I claim no insight into pure science, can fairly claim an onlooker's experience of very many practical examples of science as applied to the needs of our civilisation to-day. For some years past, in war and in peace, I have been privileged to have countless opportunities of examining, at close quarters, the concrete results of such applied science. In things military and naval, in factories, workshops, mines, railroads, in contact with the everyday problems of education, health, land-settlement, agriculture, transport or housing—in all such varied departments of human life—it has been borne in on me more and more that if civilisation is to go on, it can only progress along a road the foundations of which have been laid by scientific thought and research. More than that, I have come to realise that the future solution of practically all of the domestic and social difficulties with which we have to grapple nowadays will only be found by scientific methods.

It is from this experience, and with the convictions it has brought, that I should like to tell you something of my general impressions of the bearing of scientific research on the daily life of the community; and to show how that relationship can be developed by the mutual co-operation of scientific workers and the State. I cannot better embark on this attempt than by quoting to you the words of my distinguished predecessor, though without the hope that what follows will maintain the high standard which he set in his presidential address at the last meeting.

---

[1] Presidential address delivered to the British Association at Oxford on August 4.

Prof. Lamb, on that occasion, expressed confidence that the efforts of scientific workers "have their place, not a mean one, in human activities, and that they tend, if often in unimagined ways, to increase the intellectual and the material and even the æsthetic possessions of the world. And in that assurance," he continued, "we may rejoice that science has never been so widely and so enthusiastically cultivated as at the present time, with so complete sincerity, or (we may claim) with more brilliant success."

This claim, by no means exaggerated, invites reflection upon the intimate association of the results of scientific research with the daily lives and affairs of every one of us. It is a good thing to reflect upon this, even for those who have no sort of direct contact with scientific research, if only because the doing so may dispel an attitude towards science, which personifies it somewhat as the ancients personified the powers of darkness, and invests it with some of their sinister attributes. Such an attitude of mind is fortunately less common than it used to be. Prof. Lamb, in the address already quoted, referred to a certain feeling of dumb hostility toward science and its works, which still survives. No doubt it does; but at least it has ceased to be vocal, as it was in the earlier days of the Association. It became loud, for example, at two of the meetings in this very place. The later of these two occasions was the Oxford meeting in 1860, and the field of battle was the Section of Botany and Zoology, in which the theories put forward in Darwin's "Origin of Species" were debated, in a manner which has passed into history, between Wilberforce, Bishop of Oxford, on one hand, and Huxley and Hooker on the other.

The earlier occasion, however, more appropriately illustrates, by contrast, the modern realisation of our debt to science. The second meeting of the Association, in 1832, took place in Oxford. The University was not, at that time, without distinguished cultivators of science. The invitation to Oxford came from Charles Daubeny, who combined the professorships of chemistry, botany, and rural economy, and the president was William Buckland, then Canon of Christ Church and professor of mineralogy and geology. A strong body of opinion resented the recognition of science by the University when carried to the extent of conferring honorary degrees upon four of the distinguished visitors. The famous Keble, moved for once to anger, referred to those who were thus honoured as a "hodge-podge of philosophers." Their names were David Brewster, Robert Brown, John Dalton, and Michael Faraday. Each of these men has left in the history of his own special branches of science an outstanding memorial. Brewster's researches into optics were his greatest scientific achievement; to our own gratitude he has an especial claim as the leader among the founders of our Association. Brown's services to botany were unsurpassed; perhaps that of widest appeal is his very thorough investigation of the flora of the coastlands of Australia, made during the voyage on which he accompanied Flinders in 1810–14—an early example of what may be termed imperial research. Dalton's name is identified for ever with the atomic theory, and he placed meteorology on a scientific footing. Faraday's labours provide one of the most wonderful examples of scientific research leading to enormous industrial development. Upon his discovery of benzene and its structure the great chemical industries of to-day are largely based, including, in particular, the dyeing industries. Still wider applications have followed upon his discovery of the laws of electrolysis and of the mechanical generation of electricity. It has been said, and with reason, that the two million workers in Great Britain alone who are dependent upon electrical industries are living on the brain of Faraday; but to his discoveries in the first instance many millions more owe the uses of electricity in lighting, traction, communication, and industrial power.

Oxford, then, was not dishonoured in the hodge-podge of philosophers whom she recognised in 1832. Nor will she recall with any disfavour the singularly doubtful compliment paid her on that occasion by another distinguished visitor, in whose mind the opposition must have rankled; the University, he said, had prolonged her existence for a hundred years by the kind reception he and his fellows had received. The Association will scarcely make that claim to-day; but its visiting members will have ample opportunity to learn how, through her museums and laboratories, Oxford, within the hundred years thus tolerantly allotted to her, has kept pace with the scientific development of the period. It need surely be no matter for regret if science has worked for and is taking a place, not only in the university but also in the schools, complementary with that occupied by the humanities. For complementary these two branches of learning must ultimately be. All the greatest exponents of scientific learning have been men of attainment also in letters.

The services rendered to mankind by the labours of outstanding figures in science, such as Faraday, or Kelvin, or Pasteur, or Lister, are matters of too common knowledge to need insisting upon in this place. What is perhaps less generally appreciated is the extent to which, through the efforts of very numerous workers, the results of scientific research have been brought to bear upon many of the most pressing domestic and industrial problems of the day, and that the co-operation between the laboratory and the State (which means the community) has been greatly strengthened of recent years. The British Association has always supported such co-operation. One of its principal aims, as stated by its founders and maintained ever since, is "to obtain more general attention for the objects of Science and the removal of any disadvantages of a public kind which impede its progress." In an article contributed by Brewster to the *Quarterly Review* in 1830, he asserted frankly that "the sciences of England" were "in a wretched state of depression, and their decline is mainly owing to the ignorance and supineness of the Government" as well as to various other causes which he detailed. The same theme (if less forcibly stated) recurs in some of the earlier addresses from the chair of the Association: the Prince Consort, for example, as president in 1859, thus indicates his view of the situation at that time: "We may be justified in hoping," he said, "that by the gradual diffusion of science, and its increasing recognition as a principal part of our national education, the public in general, no less than the legislature and the State, will more and more recognise the claims of science to their attention; so that it may no longer require the begging-box, but speak to the State, like a favoured child to its parent, sure of his parental solicitude for its welfare; that the State will recognise in science one of its elements of strength and prosperity, to foster which the clearest dictates of self-interest demand."

It may be fairly said that the position foreshadowed in those words is now, in a large measure, attained. The progress towards it was visible, if slow, down to the end of the last century; but the beginning of a new era was then marked by the establishment of the National Physical Laboratory. This was at first set up in Kew Observatory, a building which, as a laboratory for magnetic and meteorological observations, and for the standardising of instruments, owed its maintenance to the British Association for thirty years from 1841, when, as a Royal Observatory, the Government decided to dismantle it. The building proved incapable of extension to accommodate the whole of the work, and in 1900 Bushy House, Teddington, was placed at the disposal of the laboratory by the Crown. The Laboratory, at its inception, was divided into departments dealing with physics, engineering and chemistry, and it possesses also the famous William Froude experimental ship tank. The investigations with which it has been so largely concerned—the testing and standardisation of machines, materials, and scientific instruments, researches into methods of measurement with the utmost accuracy, work on scale-models of ships, and the like—while of the first importance to Government Departments concerned with such applications of science, have also achieved many valuable results for industry in improving standard qualities, in indicating scientific methods applicable throughout a variety of manufactures, and thus in bringing about an improvement in the quality of their output for the benefit of consumers—which is to say, ourselves.

In historical sequence among the events which have strengthened interaction between science and the State, there follows the establishment of the Development Commission in 1908. Until that date the only agency for agricultural research in Great Britain was the classical experimental station at Rothamsted, a private benefaction; and the expenditure of the State on this prime factor in national economy was trifling. Since 1908 the Rothamsted station has been expanded to cover the whole field of nutrition and disease in the plant, while other institutes have been founded to deal with other aspects of agriculture such as plant breeding, the nutrition and diseases of animals, agricultural machinery and the economics of the industry. Not only are these institutes providing knowledge for our own farmers, but they also form the training-ground for agricultural experts required by the Dominions, India, and the Crown Colonies, which need no longer look abroad for their advisers. At the plant-breeding institute at Cambridge, Sir Rowland Biffen has provided several new wheats, of which two are generally grown throughout England; the extra yield and value of these wheats must already have more than repaid the whole expenditure on agricultural research since the institute was founded.

Among other examples of the value of research there may be mentioned the discovery of a variety of potato immune from the ineradicable wart disease, which a few years ago threatened the principal growing districts. The clearing up of the confusion into which commercial stocks of fruit trees had fallen has ensured that growers may plant orchards upon uniform stocks suitable to the soil and climate. Among the most important inquiries are those into the production and cleansing of milk, which have resulted in an entire reform of rationing, increasing the yield of each cow by one to two hundred gallons a year, and in freeing milk from the risk of contamination with disease.

Research into fisheries, which are administratively associated with agriculture, has become a matter of necessity in the light of evidence that even the vast resources of the sea have their limit, and can be injured if they are not exploited with due care and knowledge. Great Britain, acting in co-operation with the other nations who share with us the northern seas, has accomplished much in ascertaining the causes of the fluctuating herring supply, and has contributed notably to the study of the methods by which the stocks of plaice can be maintained. Research again is active in finding methods by which we can mitigate one of the consequences of our dense population—the pollution of our rivers and estuaries—and a method has been found whereby great supplies of shell-fish that had been condemned are once more available as food. Many know, too, of the remarkable results obtained from the scientific study of the habits of the salmon. Though fishing has been described as "a fool at one end of a string and a worm at the other," the subject is not without its personal interest, I believe, to many learned men.

Reverting to the historical sequence, it is appropriate to recall, with gratitude for its labours, the constitution of the Medical Research Committee in 1913, under the Insurance Act of 1911: this has since (in 1919) been transferred to a committee of the Privy Council under the name of the Medical Research Council, and its funds are directly voted by Parliament instead of being drawn from the contributions made by or on behalf of insured persons.

Research alone could provide the knowledge on which must be based all wise and effective legislation or administrative action in the interests of the nation's health. Yet until 1913 the State had played at best a subsidiary part in the organisation of such research and the provision of its material support. Under the new conditions, the State is actively concerned with the promotion and co-ordination of medical research towards conquest of those infirmities with which ignorance has afflicted humanity. A few only may be mentioned, which have rightly appealed to wide public interest. Insulin, a gift to science and to humanity from young enterprise and enthusiasm in the Dominion of Canada, is not only saving lives that were threatened, and restoring almost to normal health and enjoyment many that were crippled by weakness and restriction, but also, as a tool of investigation, is shaping new knowledge that will influence all our ideas of the functions of the body, in health or disease. The discovery of the vitamins, those still mysterious and minute constituents of a natural diet, has brought understanding of various defects of health and of development, created for us largely by the blindness of civilisation to dangers accompanying its progress, dangers which science can avert.

Closely linked with the discovery has been the more recent development of knowledge concerning the need of sunlight for health, in man and his fellow animals as in plants. We know now that crippling deformity appears in the growing child unless he receives his proper share of the vitalising rays of the sun, either directly or through the presence in natural foods of vitamins which these rays have produced. Sunlight, or its artificial equivalents, have some importance already in the treatment of disease; but a realisation of its significance for health has a much greater importance in preventive hygiene. There can surely be no plainer duty, for a State charged with the health of an industrial civilisation, than to promote with all its resources the search for such knowledge as this, as well as to provide for its application when obtained.

Among diseases which painfully affect the popular imagination, cancer has an evil pre-eminence, largely on account of its mysterious, and therefore seemingly inevitable nature. For many years past a volume of investigation, supported by private benefactions and organised charity, has patiently accumulated knowledge of the beginnings of cancer and the conditions of its growth. Now, at length, there are signs of more rapid progress towards a penetration of its secret. Patience and caution are as necessary as ever; a new and exacting technique is still in development; but there is a new spirit of hope and enthusiasm. It is reassuring to know that in this, as in other directions, the State is giving its direct support to investigation, and co-operating with the foundations due to private generosity.

Looking backward a dozen years or so, one may say that science was definitely, by that time, a working part of the machinery of the State, though, as we see now, not a part working at full power. The War caused a broadening, so to speak, of the scientific horizon, for men of science themselves in some measure, but for the layman in a measure far greater. We all were brought to recognise the applications of science as adding, it may be, in certain respects to the distresses of warfare; but also as immensely alleviating the sufferings caused by it, and as indicating many methods of strengthening the arts of defence—some of which methods are no less valuable in strengthening the arts of peace. The creation of the Government Department of Scientific and Industrial Research was an act which falls, historically, within the period of the War; but as an outstanding incident in the scientific advancement of national affairs, it certainly is not to be regarded as merely a war measure; it was once described as a near relative of "Dora," but that was a mistake. Nevertheless, by an odd freak of history, it needed the whole period of a century between one great war-time and the next—between the Napoleonic and the World Wars—to mature the conception of a State department of scientific research. Some idea of this kind was clearly present in the mind of Brewster, and certain of his contemporaries, concurrently with his idea of the foundation of our own Association in 1831; and later, in 1850, when he addressed the Association from the chair, he claimed a strong advance in scientific and public opinion toward his views. Five years later a concrete proposal for the creation of a Board of Science, possessing "at once authority and knowledge," was put forward by the Parliamentary Committee of this Association (a committee no longer existing); but our Council at the time considered that the proposal had "yet to receive sanction from public opinion, and more especially from the opinion of men of science themselves."

It was not, in fact, entirely owing to lack of prevision on the side of successive Governments that the developments which have been outlined were so long delayed. There was an element of mutual distrust between science and the State—now, it may happily be believed, almost if not quite wholly removed. A strong body of scientific opinion was avowedly afraid, as Sir George Airy phrased it, of "organisations of any kind dependent on the State." It is to be hoped that modern developments have removed that fear. The progress of science cannot be kept wholly within training-walls, and no one wants to try to keep it so. The waters of a river may be guided artificially to do the work of irrigation; but not at their sources, nor yet where, at the last, they percolate the soil. The guidance of scientific research, in its inception, lies with the genius of the individual; its results for the future may lie far beyond the realisation even of the scientific workers themselves. The Oxford meeting of the Association in 1894 supplies a simple example of this. There was a discussion on flight, in the Section of Mathematics and Physics, opened by Hiram Maxim; and no less a leader in science than Kelvin afterwards described Maxim's own flying machine as a child's perambulator with a sunshade magnified eight times. Yet it was not many years before research in aeronautics had become the care of the State as well as of the individual; and the work carried out before 1914 under what is now the Aeronautical Research Committee led on to our wonderful development of aircraft during the War.

A recent report of the Committee of the Privy Council for Scientific and Industrial Research shows that under the Department there are eleven research boards, some of which direct the work of committees to the number of three dozen in all. These boards co-ordinate and govern researches in chemistry, fabrics, engineering, and physics, radio, building, food-investigation, forest-products, and fuel; and to these are to be added the board of the Geological Survey and the executive committee of the National Physical Laboratory. Under the general supervision of the advisory council there are upwards of twenty industrial research associations, formed in alliance with the same number of the principal industries of Great Britain, for the purposes of scientific investigations connected with those industries.

No attempt can be made here to review the whole field of work of these various bodies; but a few examples may be chosen for the purpose of pointing out what may be called their homely application. First, then, as to the building of the home. The Building Research Board was created in 1920, and in 1925, at the request of the Ministry of Health, considerably extended its activities. Researches are concerned with the study of materials from the chemical and geological aspects, their strength, weathering, moisture condensation on wall coverings, acoustics, and various other problems; these inquiries, together with the collection and supply of information both by publication and through an intelligence bureau, represent, as the report states, "an attempt to create a real science of building, to explain and supplement the traditional knowledge possessed to-day in the industry." It can scarcely be questioned that industrial Britain inherits a legacy of discomfort in the housing of its workers, with all which that implies, dating from a period when the building of the home lacked scientific as well as æsthetic guidance. We need that guidance no less to-day, when the saving of labour is one of the main objectives of the 'ideal home' and its fitments.

Next, a further word as to our food supplies. The Food Investigation Board directs committees concerned with meat and fish preservation, fruit and vegetables, oils and fats, and canned foods. There is also a committee for engineering problems associated with the investigations; conditions of storage have been investigated on ships between Great Britain and Australia, and problems of heat conductivity at the National Physical Laboratory, while chemical substances suitable for refrigerants have been studied at the Engineering School in Oxford. At Cambridge a low-temperature research station has been established on ground given by the University, and is working in co-operation with the University biochemical, botanical, agricultural, and other laboratories. As for the investigations upon fruit and vegetables, the report may again be quoted, for it illustrates in a sentence something approaching the ideal of scientific co-operation brought to bear upon one particular home necessity, and, what is more, upon a particular and important branch of Imperial commerce. "There is," it says, "a closely knit scheme of work, which rests, on the one hand, in university schools of botany, and, on the other, in commercial stores scattered all over the country, where accurate records of results and conditions have been kept, and extends to the conditions of transport by ship, and overseas so far even as the Australasian orchards."

Other directions of research which touch upon commonplaces of our daily life are those concerned with fuel, with illumination, with the deterioration of fabrics and the fading of coloured stuffs, and—perhaps most homely example of all—with the application of scientific methods in the laundry industry. This will be good news to those of us who may have suffered, or may even be suffering now, from the torture of a collar which comes back from the wash with an edge like a surgical saw.

It must be clearly understood that the few examples mentioned represent only a small fraction of the present activities of science in co-operation with the State, and, expressed as they are here expressed, they may appear to wear an aspect even of triviality, because they deal with common things. But it is precisely because they do deal with common things that they are not trivial. There may be matter for amusement in the fact that science is concerning itself with the contents of the clothes-basket; but there is also matter for congratulation, and there may, in the future, be matter for sincere gratitude. Scientific research, properly applied and carried out, is never wasted. It may prove that a thing can be done, or that it can not be done; but even the proof of a negative may save the waste of further effort.

This attitude of the State toward science makes for an easing of the paths for the advancement of science in many directions; it marks a definite step in human progress, taken after long hesitation, but in itself new; and because it is new, we may believe with some reason that we live, not merely in an age of science, but at the beginning of it. The movement for co-operation which we have been discussing is not confined to Great Britain. It has borne fine-fruit already in other lands; and in particular it is active in our own Dominions. The Indian Empire stands in a somewhat different category from these: there is here a tradition, so to say, for the application of science in its government, and the scientific results of its census investigations, its surveys, its agricultural, forestry, and other administrative departments have long been famous. This is not to imply that brilliant scientific work has been wanting in the Dominions—far from it—but the co-operative movements with their governments have followed that in Britain and with a laudable promptitude.

The trend of developments following upon all these movements has been similar, broadly speaking; it is sought to take a comprehensive survey of the natural resources and industrial opportunities of each Dominion, to explore the means by which science may be best applied to their exploitation, to provide, whether in State institutions or in university and other laboratories, for the pursuit of the necessary researches, to co-ordinate the work, and to ensure the dissemination of knowledge acquired. The nature of the researches themselves is conditioned to a large extent (though by no means wholly) by geographical circumstances in the respective territories: agricultural, pastoral, and forestry problems, for example, are not identical in all of them, and that very fact adds to the interest and value of co-ordinating the results of research work throughout the Empire. While problems may differ, solutions may point to a common end. Nothing but good can follow from personal contact between scientific workers in different parts of the Empire. Nothing but good can follow from their researches if they add, as gradually they must add, to the wider knowledge of the Empire not only among the workers themselves, but ultimately among the whole body of informed Imperial citizenship; not only in the overseas territories, but also at home. For us at home the Empire is worth knowing. Our knowledge of it begins with the school lessons in geography and history—or should do so; no doubt the ideal here is yet to be attained. Such knowledge may become later of vital importance to those who wish to join the stream of overseas migration.

The British Association, in pursuit of its policy of obtaining from time to time "reports on the state of science" in one department or another, has recently, through a committee of the Section of Educational Science, been collecting evidence as to the facilities existing in our schools for training boys and girls for life overseas. In the crowded curriculum of most schools these facilities, at any rate in their particular Imperial application, are not conspicuous. Yet any labour which time allows us to spend, whether in school days or after them, upon the advancement of scientific knowledge of the Empire, of the means and manner and environment of life in its component territories, must be well spent. The British Association has played its part in this advancement since, in 1884, it admitted the principle and established the practice of holding occasional meetings overseas. Those of our members who travelled from Great Britain to take part in these meetings have had peculiar opportunities to meet and discuss each his own scientific problems with fellow-workers in the Dominions—and it should be added with particular reference to those meetings which have been held in Canada that they have provided almost unique opportunities for personal contact between British workers in science and their American colleagues.

Our travelling members have been able to see how science is cultivated in the universities of the Dominions and in many other institutions; they have gained first-hand acquaintance with the special problems of one territory and another; and when they have returned home they have talked—as any one who travels the Empire is impelled to talk. I have myself been guilty of giving way to this impulse on more than one occasion. Opportunities for travel are none too common for most of us, but most of us can at least cast our minds back to the exhibition at Wembley. Science herself, as an exhibitor, took a place there befitting her natural modesty. The scientific exhibit arranged by the Royal Society, admirable as it was, was confined to two rooms of the Government Pavilion. But was not a very large proportion of the entire exhibition, in point of fact, an exhibition of applied science?

It is impossible in the Imperial connexion to overstate the case for science. Sir William Huggins, in his presidential address to the Royal Society in 1901, said that "assuredly not only the prosperity, but even the existence of this Empire will be found to depend upon the more complete application of scientific knowledge and methods to every department of industrial and national activity." To-day we see that application in much fuller progress than when Huggins spoke only a quarter of a century ago, and already we know how truly he prophesied.

It is not for a moment to be supposed, because the State has come to take a more active and practical interest in scientific research, that there is therefore any occasion for the lessening of interest on the part of societies and individuals. The State interest involves that other interest, and invites it. It can never become the exclusive function of the State to aid the individual research worker. The State may, and does, co-operate in aiding him, as, for example, through the universities and the Royal Society. Nevertheless, there are whole departments of research which do not come within the range of public assistance, but are no less valuable because they do not. Therefore the support of science remains the concern of our scientific societies, educational institutions, industrial organisations, and private benefactors, no less than it ever did; nay, the very fact that the State has lent its aid should encourage them to continue their aid and to reinforce it—indeed, there is satisfactory evidence that this actually happens. One example will suffice which indicates, incidentally, that from the purely materialistic point of view scientific research is not a luxury; for the community it is probably the cheapest possible form of investment. The Government's fuel research station has not yet proved the commercial possibility of the low-temperature treatment of coal which would result in the more economical production of smokeless fuel, oils, and gas; but in attempting this difficult task it has already, by results unforeseen when the task was undertaken, shown at any rate the possibility of economies for the State and for some of its major industries which are well in excess of the cost of the research itself.

There are parallels in many respects, as has been often pointed out and as often forgotten, between the periods of our history following the Napoleonic Wars and the Great War. The application of science in industry and daily life received impetus in the earlier of these periods in such directions as the introduction of steam motive power; it is receiving it now, as it has been attempted here to show. The auspices now are more favourable. Science is more powerful. Men more adequately and more generally recognise its power, and therein should lie a certain ethical value for it as offering a new point of view, in the manifold interest of which all can share. Should not the application of science, for example, offer a new field for community of interest, not only between one industrial organisation and another, but also within the whole body of workers in any single organisation?

In order, however, that the community may fully realise all that it owes, and all that it might owe, to the advancement of science, the channels of communication between research and the public mind have to be kept clear, maintained and widened. The non-scientific public is accustomed to view science as it might view a volcano; prepared for the eruption of some new discovery from time to time, but accepting the effects of the eruption without realising the processes which led up to it during the preceding period of quiescence. The period of preparation by research before science can offer the world some new benefit may be long, but the scientific machine is always running quietly in the laboratory. There is an example ready to our hands. We recall the introduction of wireless telegraphy and telephony as a scientific gift of quite recent years. Do we all realise that it was here in Oxford, at the meeting of the British Association so long ago as 1894, that the first public demonstration of wireless signalling by means of electro-magnetic waves was given by Sir Oliver Lodge? It was the work of science to develop the methods then demonstrated until they have been brought to their present marvellous uses. On the other hand, it is often the case, whether in industrial or agricultural, domestic or whatever application, that science has knowledge at command, awaiting use, long before mankind can be brought actually to apply it. Though we have quickened, we are not yet so quick in the uptake of the results of applied scientific research as, for example, some of our commercial competitors. The public support of scientific research, upon all these grounds, should be accorded freely, with understanding, and with patience.

Views and Reviews.

SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS.[1]

THE ANALYSIS OF LINE SPECTRA.

IN his presidential address to Section A (Mathematics and Physics), Prof. A. Fowler refers especially to recent developments in the analysis of the more complicated types of line spectra. The way to the analysis of such spectra was opened up by Catalán's discovery, in 1922, that in the spectrum of manganese and certain other elements there are terms of higher multiplicity than the triple terms previously recognised. Systems of terms with multiplicities up to octets have been found, and the main features of the structures of the spectra of a large number of elements have been worked out by Catalán, Meggers, and others. No exceptions to the law of alternation of even and odd multiplicities in passing from element to element across the periodic table have been found, and the first spark spectrum of an element has the same even or odd multiplicity as the arc spectrum of the preceding element. The types of the spectroscopic 'ground terms,' representing the deepest energy levels of the respective atoms, have also been identified for numerous elements, though their actual values are not always determinable.

The more recent results of the analysis of complex spectra have thus provided an ordered knowledge of a multitude of facts which have an important bearing upon the theory of spectra and on the arrangement of electrons in the outer parts of atoms. Theoretical workers have kept pace with the experimental progress, and the deeper spectroscopic terms can be calculated for any specified electron arrangement by means of formulæ developed by Hund. The scheme of electron distribution suggested independently by Main Smith and Stoner can now be applied with considerable confidence to all the elements from 1 to 92, and the theoretical predictions as to the characteristics of the spectra will doubtless be of great assistance in the analysis of spectra which have not yet been disentangled.

Reference is made to some of the experimental methods of spectroscopy, from which it would appear that the present resources are adequate for the elucidation of the majority of the outstanding problems.

THE SCOPE OF ORGANIC CHEMISTRY.

PROF. JOCELYN THORPE discusses the field which lies before the organic chemist in his presidential address to Section B (Chemistry). During the fifty years that have elapsed since van 't Hof published the theory on which modern structural organic chemistry is based, great and important advances have been made in our knowledge of the chemistry of carbon. The tetrahedral theory of carbon structure provided a means of attack which has enabled the organic chemist not only to gain an insight into the conditions underlying the formation of simple molecules, but also has rendered it possible for him to prepare synthetically many of the products formed during life processes. Nevertheless, he is still far from gaining a knowledge of the mechanism underlying Nature's chemistry. The van 't Hof theory has served the chemist well and has carried him far, but he is now seeking another lead to carry him still further forward.

Structural organic chemistry must conform to the modern views of the physicist regarding molecular structure, and it is clear that some form of the electronic hypothesis will have to be adopted; but at present, although there are many such hypotheses, they all have one feature in common—they are qualitative not quantitative—they explain but they do not predict. In this respect, therefore, they differ fundamentally from the great conceptions of Dalton and of van 't Hof.

The scope of organic chemistry includes biochemistry, but the modern tendency is to approach biochemical problems from the biological side rather than from the point of view of structure. If biochemistry is to justify its name, greater efforts will have to be made to develop the science from the organic chemical side, otherwise any reasoned system of advance will be impossible. Our forest products need far more attention. Originally most of the useful organic products were derived from materials obtained from the plants and grasses present in our forests. By means of these substances it was found possible to correlate structure with physiological action and to produce compounds of enhanced value synthetically. It is certain that many such substances still remain to be discovered.

The scope of organic chemistry includes also the dyestuffs and petroleum products. The former constitutes probably the most remarkable example of the application of the van 't Hof theory to scientific and ultimately to commercial needs, and teaches a lesson which no one can afford to ignore. Great and successful efforts have been made during the past ten years to render Great Britain self-contained as a dyestuff producing centre, but the need for fundamental research must not be overlooked. Petroleum stands sadly in need of scientific treatment if the wasteful and uneconomical processes engendered by the abundance of this material are to be replaced by the economical and frugal methods which can only be determined by systematic scientific research. Moreover, the modern tendency to construct engines of increased compression ratio means that there will be an increasing demand for the higher boiling hydrocarbons as motor fuel. Polymerisation and depolymerisation must therefore be made the subjects of systematic investigation.

THE LOWER CARBONIFEROUS (AVONIAN) ROCKS OF ENGLAND AND WALES.

AFTER reference to the death at Oxford nearly ten years ago of that brilliant worker on the Lower Carboniferous rocks, Arthur Vaughan, Prof. S. H. Reynolds in his presidential address to Section C (Geology) summarises the progress of knowledge on a variety of geological topics, which are unrelated, except in so far as they are concerned with the study of the Avonian.

The subdivisions of the Avonian rocks are first discussed and Vaughan's earlier and later views are indicated. There has been considerable increase in our knowledge of the unconformities and breaks in the succession of the Carboniferous rocks, and the phasal equivalents were dealt with in some detail; suggestions are made in the hope of lessening the confusion which has arisen from the inconsistent use of certain symbols. Though the Millstone Grit lies outside the scope of the address, its relations to the underlying strata are described, and the varying relationships to the rocks below of the Millstone Grit (*sensu lato*) in the Bristol district, South Wales, and the Yorkshire Dale country respectively were indicated.

---

[1] The collected presidential addresses delivered at the meeting are published under the title "The Advancement of Science: 1926," at 6s., or obtainable at the bookstall at Oxford by members at 4s. 6d.

The problem of the classification and nomenclature of the Dibunophyllum zone (*sensu lato*) and its equivalents in the north of England is a controversial one. The goniatite work of Mr. W. S. Bisat has, however, led to the rocks of the Culm or shaly phase being known with an accuracy which is sometimes lacking in areas where the rocks are of the calcareous type.

Our knowledge of reef-knolls, pseudobreccias, and algal limestones is summarised, and the address concludes with sections devoted to dolomitisation and chert.

BIOLOGY AND THE TRAINING OF THE CITIZEN.

PROF. GRAHAM KERR, in his presidential address to Section D (Zoology), emphasises the condition of dangerous instability occasioned through the evolution of the modern civilised State not having been accompanied by a corresponding evolution in the training of its citizens. One of the chief dangers lurks, curiously, in what was one of the most important factors of human evolutionary progress, namely, the development of language, for this, through modern applications of science such as printing and radio telephony, has come to interfere with the natural working of the principle of leadership—upon which human progress is so dependent. The natural leaders in communal advance throughout the ages have been the men of outstanding constructive ability; leadership has now, however, been made accessible to those whose ability is not constructive but is rather that of the advocate.

The great dangers of the position so arising can only be avoided by immunising the citizens by means of education, and Prof. Kerr urges the importance of including a grounding in the main principles of biology in the reformed educational system. A grasp of such main principles as evolution, inheritance—including the fact of its incompleteness, *i.e.* what is ordinarily called variation—the struggle for existence, communal evolution, and the inter-communal struggle, would, by inducing in the citizen's mind the biological outlook, broaden his vision and enable him to see his way round dangerous obstacles in the path of social advance. He would appreciate the biological aspect of economics, and, realising that the wealth of the community lies in the capacity of its citizens, would recognise how greatly it is to the commercial interest to increase that capacity by the training of the individual. Mass production in industry depends for its success on uniformity of raw material; such uniformity is absent in the human raw material, and therefore the principle of mass production should, as regards the education of the citizen, be confined within the narrowest limits consistent with practical considerations. With the limitation of mass education would come a quickening into renewed life of the primitive relations of parent and offspring—the deadening of which is one of the deplorable phenomena of existing conditions. The quickened interest in the training of his individual child would stimulate the interest of the parent in our whole system of education—the lack of such interest being again one of the great weaknesses of our present-day democracy.

It is a necessary feature of advance in civilisation that the individual citizen, his abilities, mental and physical, no longer kept up to the highest pitch by the pressure of the struggle to exist, tends to degenerate and depend to a greater and greater extent upon the community. This increased dependence carries with it increased obligations of an ethical kind towards the community—discipline, self-sacrifice, patriotism, loyalty. The shackling of personal liberty in the bonds of duty to the community would again be a return to ancient custom dictated by biological principles.

In conclusion, Prof. Kerr urges that the biological view of society which, while recognising differences in detail, whether in ability or in manners, never loses sight of the fact that behind these lies a human nature fitted out with the same common strengths and trammelled by the same common weaknesses, greatly conduces to the smooth working and onward progress of the social mechanism.

THE ECONOMIC DEVELOPMENT OF TROPICAL AFRICA.

THE task of developing Africa is complicated, as is shown by the Hon. W. Ormsby-Gore in his presidential address to Section E (Geography), by two factors, climate and the wide differences in traditions and capacities between the white ruling race and the native population. As a result of climate manual labour cannot be undertaken by Europeans. The African is the most adaptable of all the races of the human family; but the changes which have been produced so far are not more than skin deep. We know little of the history and mental traditions and aptitudes of the African native. Year by year anthropology is adding to our knowledge, but we are still at the stage of collecting data, and it is difficult to ensure that scientific investigation shall keep pace with the practical day-to-day running of Government administration and economic development. Nevertheless, we must clear our ideas on certain fundamental questions.

The first problem is the health of the African population. It is difficult to say with certainty what is the effect of European impact on vital statistics. In tropical Africa, though there are no scientific data, there can be little doubt that the population diminished between 1900 and 1924. This is due mainly to sleeping sickness and venereal disease; but the principal cause is infant mortality, which under the age of twelve months in the purely native area of Tanganyika has been estimated to be so high as 400 per 1000.

Rapid economic development has given rise to a number of social problems as a result of the accession of wealth among native producers. It has affected the notions of land tenure, and the individual has become emancipated from communal control. The nature and sanctions of tribal authority are undergoing rapid change, especially spiritual and moral. In the coast towns a large portion of the native populations has become entirely detribalised. They are imitating Western civilisation and demanding Western education; but in education the real needs of the people and the right methods of bringing out their innate capacity on modern scientific lines have not been studied. The disrupting tendencies in Africa to-day are so many that constructive thinking is urgently necessary, if African communities are not to be reduced to disorganised mobs. The introduction of new arts and industries has created a class of wage earners unknown in the old Africa; but the incentives to labour are small. There is danger of degeneration unless the young men are trained to work either as direct producers or wage labourers.

There are four main duties upon which we have to concentrate. First, the various problems of 'public health'; second, the improvement of the standard of the natives as producers of food and economic crops; third, to further transport facilities; fourth, to educate the native in such a way that he may advance in the scale of civilisation and assimilate such new moral controls as will fit him to withstand the dangers and make the best use of increasing wealth.

INHERITANCE AS AN ECONOMIC FACTOR.

THE purpose of Sir Josiah Stamp's address to Section F (Economic Science and Statistics) is to consider the whole subject of inheritance in its relations to economic science and the community. The conclusions reached are as follows:

1. In the past century unprecedented economic advance has been due in the main to the greater use of invention and fixed capital. This has, in turn, made new accumulation of savings possible, and has been made possible by the growing fund of accumulation. In this accumulation the principle of inheritance or bequest has played an important part. Where there has been freedom from the shackles of a family diffusion system the greater progress has been possible. The individual motives which are operative under such a system are stronger than ever, but operate over a diminishing part of the field; they are also stronger over a short period, and of diminishing effect over a long period of time. In other words, communal saving *via* company reserves (not subjected to the individual volition for saving against spending), and *via* repayment of debt through funds derived from taxation, and *via* large capital efforts (housing, etc.) partly financed through taxation, is an increasing proportion of the total. Although some of the values set up by such collective sums may figure in individual estate values, they are not created or destroyed by interference with, or promotion of, the right of inheritance.

2. The remaining considerable section of capital accumulation is still powerfully affected by inheritance rights, and would be more affected than heretofore by interference with rights in the direct line, though less affected than hitherto by rights out of that line.

3. The sense of 'social injustice' is directed against inequality of wealth, of which inequality through inheritance is not now the larger part. This sense, if limited to inheritance features, has less economic reaction than is generally supposed. In any case, it is a sense which is not scientifically based. It is probable that the average man has a slightly smaller *proportionate* share of the aggregate than he would have had if there had been no inheritance system, but a substantially larger *absolute* amount, because he shares a larger aggregate or better standard of life than he would have had under a system with no such aid to accumulation.

4. The particular claims for unlimited rights of bequest, as settling the best economic direction and control, are gradually losing their force.

5. The principles upon which death duty taxation is at present based might be improved. The actual sum now being raised is not necessarily more harmful economically than a similar sum raised by additional income-tax, but it is more repressive in accumulation than the same sum would be if a less sum were raised at lower rates on the first succession, and the balance were raised at higher rates on succeeding successions.

POSITION AND PROSPECTS OF ELECTRICITY SUPPLY.

SIR JOHN SNELL, the president of Section G (Engineering), is giving an address on the present and future development of electricity supply. His predictions about the future are based on the latest and most accurate data, and they summarise the results of many lengthy and laborious calculations. Sir John gives first a historical résumé of the progress that has been made during the past forty years. He lays special stress on the work done by Ferranti and Crompton. It is interesting to remember that although Sir Charles Parsons perfected his steam turbine only about thirty-five years ago, yet of the total prime movers now used in electrical generating stations, less than 10 per cent. are reciprocating engines. He points out that the average load factor, that is, the ratio of the actual power delivered to the maximum possible power, is, in Great Britain, less than 25 per cent. Hence the capital expenditure is four times as great as it would be if the plant worked continuously at full load. For economy, therefore, it is of vital importance to have a high load factor. Stress is laid on the importance of having common sources of supply for power, light, and railway traction. In this way a high load factor can be obtained.

The present output of the public generating stations in Great Britain is 7000 million units annually. Government publications estimate that in fifteen years the output will be three times as great. This is a low estimate, as no account is taken of the great probable future extension of railway electrification. The electricity returns record an average rate of increase in the sale of electricity between 1913 and 1924 of 25·8 per cent. per annum. If this continue, the progress of the industry will be extremely rapid.

It is necessary, therefore, to take long-sighted views of the future. In an industrial country like Britain, in order to live and continue to exist as a great nation, it is essential that abundant power be available. The bulk of this power must be derived from coal In Scotland and North Wales large hydro-electric systems are in operation. In the Grampians, in Ayrshire, and in Lanarkshire water-power systems are being erected Detailed investigation is being made as to the tidal power available in the Severn estuary. It is estimated that a 1000 million units of electricity could be distributed from this source alone. Compared with other countries, however, Britain is poorly endowed with water power.

The importance of economising the consumption of coal is emphasised. Some of the devices suggested only economise fuel at the expense of undue capital expenditure. Increasing the size of the plant and employing bigger stations will undoubtedly economise coal. Sir-Charles Parsons has shown that with a steam pressure of 500 lb. per square inch and a 97·5 per cent. vacuum, a full load thermal efficiency (steam to electricity) of 33⅓ per cent. is available. With an initial steam pressure of 1000 lb. per square inch, a thermal efficiency of 35 per cent. can be obtained. It is probable that in a few years electricity will be generated at large stations at a cost not exceeding 0·3*d*. per unit. This would mean that if the price of coal be about 20*s*. per ton, the *average* price paid by a consumer would, in a few years' time, be about 2*d*. per unit for lighting and 1*d*. per unit for power. Some consumers in remote districts will have to pay more and others less than this. Although a steady development is discernible, it is certain that there is a great future before electricity supply. It is our duty to lay down suitable lines along which the industry may develop so that succeeding generations may reap a bountiful harvest from our foresight.

THE REGIONAL BALANCE OF RACIAL EVOLUTION.

PROF. H. J. FLEURE in his address to Section H (Anthropology) tries to interpret the present-day distributions of physical characters of man on evolutionary lines rather than on the more purely taxonomic lines that have been generally recognised in earlier studies. The general evolution of man is touched only lightly to suggest relations between lengthening of prenatal life on one hand and increased brain growth and decreased hair and jaw development on the other. Attention is concentrated upon men of modern type, known from the European Aurignacian period onwards, and comparative survey suggests that certain skull changes accompanied the evolution of modern types, that evolution probably occurring over a broad zone from Cap Verde to Persia. The arguments for this area are partly palæoclimatic. Early drifts southward from this early home are held to have given rise ultimately to the pigmy peoples (heads not lengthened), Bushmen and Tasmanians (heads often lengthened), Australians (heads much lengthened), with diversities of colour and hair. It is suggested that the people on the northern fringe of the early home, like some on the southern fringe, may have escaped the head lengthening seen in others, and that from these, better grown and less dark than those on the south, the sub-brachycephalic and ultimately the brachycephalic peoples of the world's highland zone may have originated.

The way northward between the Elburz Mountains and the Hindu Kush is held to have been opened up to modern men with the final retreat of the ice, and drifts through it went mainly northeastwards leaving the high Mongolian plateau and Tibet on the right. The extreme conditions of the high Mongolian plateau in their probable relation to racial evolution and drifts into China, etc., are mentioned, and the question of race types in Europe is argued out on similar principles. It is suggested that evolutionary change owes a great deal to cumulative changes of environmental influences in plastic infancy. As, however, no two embryos are exactly alike, the hereditary units in some may vary towards, in others away from, the new standards arising from the cumulative changes of environmental factors and as a consequence health and growth and survival may be affected. In other words, 'selected' germinal variations may follow after somatic variations and may thus help to secure the newly gained features to the race.

FUNCTION AND DESIGN.

PROF. J. B. LEATHES' presidential address to Section I (Physiology) deals with the interesting subject of function and structure in the living organism. The parts of which a living organism is composed assist in the maintenance of its life. For physiology, which studies the manner of their ministrations, their morphological structure is organic design. This structure, essentially chemical, serving in the maintenance of life, must always display the peculiar property distinctive of matter in which the phenomena of life are exhibited, that of transforming adjacent matter which is not alive into its own similitude and so, perishable though it be, maintaining itself by spontaneous self-regeneration. A chemical structure so designed as to perpetuate a perishing existence is a necessary hypothesis for biology.

Twentieth-century chemistry, which already, by defining the catalytic nature of enzymes and the general nature of the material of life, has shown the immensity of the field to be explored, may yet also dispel some of the obscurity that covers it by indicating structures that have in some degree the property which the hypothesis requires, structures that assimilate the disposition of adjacent foreign matter to their own, and so in spite of their instability tend to perpetuate themselves. Of all degrees and qualifications that chemistry can put after or before its name, 'biological' will then be that of which it will have most occasion to be proud.

Living material constituted so as to behave in this way appears to be largely, though certainly not entirely, protein in character. The almost infinite number of forms that protein substances may take, even without changing the proportions in which the amino acids of which they are composed occur in them, fits with the variability of forms of living matter. If some of these variations, retaining the power of self-regeneration, are sensitive to recurring external disturbances, and react to them in such a way as to favour the manifestation of this power, these variations are more likely to survive.

The evolutional history of life must express the behaviour of the chemical constituents of the material that lives, the distinctive property of which is that of spontaneous self-regeneration. A modification of living matter which retains this property, if it assists in the maintenance of life, must persist; function alone can give permanence to structure. Modifications without organic design, that obstruct or merely do not assist, must share in the decay, but cannot share in the reconstruction of living matter.

PSYCHOLOGICAL ASPECTS OF OUR PENAL SYSTEM.

DR. J. DREVER points out in his address to Section J (Psychology) that the evolution of punishment and a penal system exhibits four phases, which may be designated the vindictive, the retributive, the protective or deterrent, and the reformatory. The vindictive phase is not punishment in any strict sense. Nevertheless, it represents the psychological origin of punishment. An individual who has suffered at the hands of another responds with the impulse of anger, which is satisfied by the infliction of some hurt on the culprit. The hurt inflicted may bear no direct relation, either in kind or in degree, to the injury done, but merely to the intensity of the anger. When some crude notion of justice comes into existence and determines the kind of hurt that may be inflicted on the wrongdoer, the vindictive passes into the retributive phase. This in turn passes into the deterrent phase, when it is realised that punishment looks to the future as well as the past, and that its function, from the point of view of society at least, is to protect against the repetition of a delinquency. As civilisation advanced it began also to be realised, at least in theory, that no amount of wrongdoing on the part of the delinquent absolves society from responsibility for the results produced on him and on others by the way in which he is treated by its representatives, acting under social laws. The realisation of this truth, and the perception at the same time of the fact that one way in which society may protect itself against wrongdoing is by the reform of the delinquent, marks the transition to the reformatory phase.

At the present time it will be generally agreed that, so far as society uses punishment at all, it ought to do so with some definite end in view, and therefore with an eye to the future rather than the past. It would also be generally agreed that this end is primarily its own protection, and, as subsidiary to this, the producing of such a psychological change in the delinquent that the wrongdoing will not be repeated. Some writers have suggested that we ought to regard the action taken by society as treatment rather than punishment, the suggestion involving the view that delinquency should be considered as the outcome of something not unlike disease. There is, however, really no warrant for excluding either the idea or the fact of punishment, which exercises an important influence in the direction of reform in various ways. At the same time, it is true that if, and as, society progresses, we may expect the need for special emphasis on the deterrent influence of punishment gradually to diminish, and the reformatory aim to come more and more into the foreground.

If punishment looks to the future rather than to the past, it is evident that the vitally important psychological problems of punishment are not those involved in the question of criminal responsibility, which is really a question inherited from an outworn penal philosophy, and not, from the social point of view, an urgent practical problem at all. The important psychological problems are rather those involved in a thorough knowledge of the psychological situation with which we are faced in dealing with the individual delinquent, and of the psychological effects likely to be produced by the action taken in the name of society. The first step in penal reform at the present time should be to provide for the securing of such knowledge by the institution of psychological clinics for the examination of delinquents, and more particularly juvenile delinquents.

CHANGING ASPECTS OF BOTANICAL SCIENCE.

PROF. F. O. BOWER, in his presidential address to Section K (Botany), refers first to the calamity which has fallen upon the Section, in the sudden death of the president-elect, Dr. William Bateson. Instead of attempting to fill the broad biological rôle which would have been natural to Bateson, Prof. Bower centres his address round the dates of the previous meetings in Oxford. After a brief reference to the stormy meeting of 1860, he points out from recent writings how Darwin's views, as stated in "The Origin of Species," still stand in essentials as a great philosophical pronouncement. He directs particular attention, however, to Ray Lankester's introduction of the conception of homoplasy, which followed as a natural sequel to it. This was applied first in animal morphology, but Prof. Bower illustrates it by reference to homoplastic likeness even in internal tissues of plants, an aspect that is still in its infancy.

Passing to 1894, the central feature of that meeting was Strasburger's enunciation of his generalisation on the periodic reduction of chromosomes. It fell like a bomb-shell upon the old controversy on alternation in plants. But it was soon recognised that here was something more fundamental than somatic alternation. Like the fabulous genie let loose from its bottle, the conception of a nuclear cycle in all plants that show sexuality dominates ever more and more the field of morphology. That cycle may be regarded as the foundation upon which somatic development may or may not be imposed. Provided the events of syngamy and meiosis be constant, the alternating generations must have always been distinct: if not, then there is a possibility of alternation not by 'interpolation' but by 'transformation.' The resolution of this problem can be given only by close comparison of facts derived from nearly related organisms. But until this final resolution comes, it is possible to hold either a theory of 'transformation' or of 'interpolation.' Prof. Bower still thinks that the greater probability appears to lie with the latter, as regards green archegoniate plants. It is open to anybody to see in the Archegoniatæ a separate evolutionary problem from that of any of the great lines of Algæ. Wide homoplasy may be invoked, and an origin of the sporophyte in land plants contemplated by interpolation. The discovery of the Rhynie fossils has strengthened this view by providing early synthetic links between Bryophytes and Pteridophytes, and by thus drawing the Archegoniatæ more definitely together.

As to the botany of the present period in Britain, its relation to previous periods can best be traced through the pages of the *Annals of Botany*—that stately series of forty volumes which have since August 1887 emanated from the Oxford Press. The first volumes bear evidence of a preponderance of organographic and systematic interest. Then anatomy and cytology followed in increasing proportion, and later there has been a preponderance of memoirs relating to physiology. The drift of research has clearly been from systematic and descriptive science to a prevalent study of function. Doubtless time will right the balance of opinion again: but meanwhile a cool philosophical outlook will estimate no one branch of the science as of greater importance than another.

MAN AND METHOD IN SCIENTIFIC EDUCATION.

SIR THOMAS HOLLAND'S presidential address to Section L (Educational Science) discusses two questions relating to scientific education: first, the best arrangement of curricula and examinations, and secondly, the cultural value of education in scientific subjects. Under the Royal College of Science system, to which the name 'tandem' system has been given, one subject is studied at a time, two subjects for half a year in each academic year during the first two years of the course, and one subject at an advanced stage during the third year. Examinations are held at the end of each course and closely follow the teaching. The alternative system, based on the University of London examinations, involves simultaneous study of three or four subjects during the first year, leading to the Intermediate Examination, followed in the case of pass students in science by two years of simultaneous study of three subjects, or, in the case of honours students, to the intensive study of a principal and a subsidiary subject.

Sir Thomas Holland's favourable opinion of the 'tandem' system is confirmed by the opinion of many professors who have had experience of the system in the first instance as teachers. He recommends it especially for students who are to devote their lives to scientific research. "Our professors," he says, "still adhere to the tandem principle, although one detects in the time-tables a slight yielding to the demands of the more complex life; but an extension of the course from three to four years in most of the 'schools' has helped still to preserve the simplicity of the students' night thoughts." It is not easy to quote the merits of the two systems. For those who are to find a career in business or administration in which many unrelated questions will have to be handled daily and with promptness, mental mobility may be increased, or, at any rate, more rigidly tested, by the composite system of training and examination. The 'tandem' system, as carried on at the Royal College of Science, has been formally approved by the University of London. Whatever other merits it may have, it has induced the University to relax its cast-iron regulations. Sir Thomas Holland points out that the 'tandem' system is applicable not only to different subjects, but also to different sections of the same subject, such as the petrological and palæontological groups in geology.

The remainder of Sir Thomas Holland's address is devoted to the question of 'humanising' scientific education. Are we not inclined to forget that the Renaissance, the great world-revolt from formalism and theological bondage, was a revival not only of literature and art but also of 'the spirit of research' regarding natural laws? In course of time, classical learning tended towards specialisation in its linguistic, grammatical, and rhetorical aspects. "Its main object became obscured and stricken with a formalism and even pedantry." Nevertheless, Sir Thomas pays generous tribute to the classical curriculum in which our chief public men and our army of administrators, at home and overseas, who have made the British Empire what it is, have been nurtured; and insists that while in scientific education attention must be given to the professional and vocational aspects, we must see to it that science and technology are taught in a way which will develop character and capacity for affairs.

FOOD SUPPLY AND POPULATION.

IN 1898 Sir William Crookes directed attention to an approaching scarcity of wheat in the world owing to the exhaustion of the nitrogen in the soil. Crookes's prophecy may seem to have been wholly falsified, but none the less we cannot continue to ignore Malthus's conclusion that the food supply of the world must eventually begin to lag behind the increase of population. Mr. Keynes has given reasons for the conclusion that the course of wheat prices and real wages since the War already indicates the approach of scarcity, and though Sir William Beveridge has rejoined that the limits of agricultural expansion are still remote, it is desirable to examine the fundamental relation between land cultivated and population maintained. This is done by Sir Daniel Hall in his presidential address to Section M (Agriculture).

By various means of approach it can be shown that, under existing conditions of farming, about 2½ acres of cultivated land are employed for the maintenance of one unit of population—man, woman or child. This area varies in different countries, according to the quality of the land and the system of agriculture followed. It may be so low as 1⅛ acres in Denmark with its intensive arable farming: so high as 4 acres in Spain with great areas of poor pasturage.

In the ordinary way, however, expansion of the population demands a corresponding increase in the cultivated area, and the gigantic increase in the world's population during the nineteenth century was the direct outcome of the settlement of the Americas, Australia, and kindred 'new countries.'

Reasons can be given for supposing that an expansion of the area corresponding to the present rate of increase in the white population cannot be continued. Suitable land is no longer available in quantity commensurate with the demand. It remains to increase the production from the existing farmed area, and though possibilities in this direction are enormous, because, for example, the great wheat-producing areas of the world are farmed at a very low level of yield per acre, such increase of production will involve higher cost of production per unit. The only means of escaping from higher costs lie in the applications of science, such as the improvements due to the plant breeder, or the cheapening of fertilisers brought about by the manufacture of synthetic nitrogen products. The low returns derived from agriculture at the present time militate, however, against intensification of production; indeed, in most civilised countries a 'flight from the land' of both men and capital is manifest because its earning capacity is low compared with that derived from industry and commerce. Intensification of production is only likely to begin when stimulated by a definite rise in the prices of agricultural produce, but this must occur as the land available for settlement proves insufficient to absorb the present surge of population before the checks that are in action prove effective.

Printed in Great Britain by R. & R. CLARK, LIMITED, *Edinburgh.*

NOW READY

IN TWO HANDSOME VOLUMES

Royal 8vo. Pp. xxviii + 1563. With 565 illustrations and 20 coloured plates. Price 84s., plus postage: inland, 1s. 3d. Weight for abroad, 10 lbs.

PROTOZOOLOGY

BY

C. M. WENYON

C.M.G., C.B.E., M.B., B.S., B.Sc.(Lond.),

Director-in-Chief of the Wellcome Bureau of Scientific Research, formerly Protozoologist to the London School of Tropical Medicine.

BAILLIÈRE, TINDALL & COX,

7 & 8 Henrietta Street, Covent Garden,

London, W.C.2

CROSBY LOCKWOOD & SON'S
NEW TECHNICAL BOOKS

MODERN SOAP AND DETERGENT INDUSTRY. By G. MARTIN, D Sc., Ph D , F I.C. A Complete Practical Treatise in Three Vols. Vol III MANUFACTURE OF GLYCEROL (Including Index to Complete Work.) 276 pp Illustrated. Royal 8vo. Net 30s

CHEMICAL SYNONYMS AND TRADE-NAMES. By W. GARDNER, Works Chemist A Dictionary and Commercial Handbook. 3rd Edition Revised and much Enlarged. 364 pp Royal 8vo. Net 30s

LOCATION OF MINERAL FIELDS. By M H. HADDOCK, F.G S., A M I M.E 296 pp 113 Diagrams 10 Plates Crown 8vo. Net 8s. 6d

METALLOGRAPHY OF STEEL AND CAST IRON. By W. E. WOODWARD, M A , M.I & S.Inst 156 pp. Photomicrographs and Diagrams Demy 8vo. Net 15s

SCIENCE OF FLIGHT AND ITS PRACTICAL APPLICATION. By P. H SUMNER, late Staff-Officer, Air Ministry A Preliminary Study of the Principles of Flight and Practical Aircraft, for those interested in Aeronautical Progress and Development In Two Vols Vol I. AIRSHIPS AND KITE BALLOONS 120 pp Profusely Illustrated. Demy 8vo Net 18s.

HYDROLOGY AND GROUND WATER. By J M. LACEY, M Inst C E A Practical Text-Book for the use of Civil Engineers, Surveyors, Students, and all those who deal with the control of water 168 pp Illustrated. Demy 8vo Net 12s. 6d.

PRACTICAL GLASS MANIPULATION. By D B. BRIGGS, M A., A.I.B., F.C S Illustrated. Crown 8vo Net 2s 6d

APPLIED CHEMISTRY. By C. K. TINKLER, D Sc., etc , and HELEN MASTERS, B Sc., etc. A Practical Handbook for Students of Household Science and Public Health In Two Vols Vol. II. FOODS. 268 pp 23 Illustrations Demy 8vo. Net 15s

Complete Catalogue post free on application.

Crosby Lockwood & Son, 7 STATIONERS' HALL COURT, LONDON, E.C.

TEXT-BOOKS OF ANIMAL BIOLOGY

Edited by

PROFESSOR JULIAN S. HUXLEY

COMPARATIVE PHYSIOLOGY

By LANCELOT T. HOGBEN, Assistant Professor in Zoology, McGill University.

Demy 8vo. Illustrated. Pp. xiv + 219.

Price 7*s*. 6*d*. net.

Further volumes in active preparation.

ANIMAL ECOLOGY, by C. S. ELTON.

VERTEBRATE MORPHOLOGY, by C. R. DE BEER.

EXPERIMENTAL ZOOLOGY, by JULIAN S. HUXLEY.

ANIMAL MORPHOLOGY, with special reference to Invertebrates, by W. GARSTANG.

A SERIES OF BIOLOGICAL HANDBOOKS

General Editor:

PROFESSOR J. ARTHUR THOMSON

THE BIOLOGY OF FISHES

By HARRY M. KYLE, D.Sc.

Demy 8vo. With 77 Illustrations in the Text and 17 Half-tones. Pp. xvi + 396.

Price 16*s*. net.

Earlier volumes of the Series.

THE BIOLOGY OF THE SEA-SHORE, by F. W. FLATTELY, M.Sc., and C. L. WALTON.

THE BIOLOGY OF BIRDS, by Professor J. ARTHUR THOMSON, M.A., LL.D.

THE BIOLOGY OF FLOWERING PLANTS, by MACGREGOR SKENE, D.Sc.

Fully illustrated. Each 16s. net.

SIDGWICK AND JACKSON LTD., 44 MUSEUM STREET, W.C.1

MACMILLAN'S NEW AND RECENT BOOKS.

CRYSTALLINE FORM AND CHEMICAL CONSTITUTION. By A. E. H. TUTTON, D.Sc., M.A.(Oxon), F.R.S., Past President of the Mineralogical Society, London; Author of "Crystallography and Practical Crystal Measurement." With 72 Illustrations. 8vo. 10s. 6d. net.

THE JOURNAL OF EDUCATION.—"A book for which the only adjective seems to be 'enthralling.' . . . The teacher who buys this book for his school science library will probably end by keeping it for himself."

THE FAMILIES OF FLOWERING PLANTS. I. DICOTYLEDONS. Arranged according to a New System based on their Probable Phylogeny. By J. HUTCHINSON, F.L.S., Assistant in the Herbarium, Royal Botanic Gardens, Kew. With Illustrations by W. E. TREVITHICK and the Author. 8vo. 20s. net. KEY TO THE FAMILIES OF THE DICOTYLEDONS. Reprinted from "The Families of Flowering Plants." 8vo. Manilla Cover. 2s. net.

THE THEORY OF SOUND. By LORD RAYLEIGH, Sc.D., F.R.S. Vol. I. New Impression. 8vo. 15s. net.

*** Previously published Vol. II. 15s. net.

A DICTIONARY OF APPLIED PHYSICS. Edited by SIR RICHARD GLAZEBROOK, K.C.B., Sc.D., F.R.S. In 5 Vols. Medium 8vo. Fully Illustrated. £3 : 3s. net each. The set of five volumes, £14 : 14s. net.

Vol. I. MECHANICS—ENGINEERING—HEAT.
" II. ELECTRICITY.
" III. METEOROLOGY, METROLOGY, and MEASURING APPARATUS.
Vol. IV. LIGHT, SOUND, and RADIOLOGY.
" V. AERONAUTICS, METALLURGY—GENERAL INDEX.

*** Full descriptive Prospectus post free on application.

THE PHYSIOLOGY OF THE CONTINUITY OF LIFE. By D. NOËL PATON, M.D., B.Sc., LL.D., F.R.S., Regius Professor of Physiology, University of Glasgow. With Illustrations. 8vo. 12s. net.

EVOLUTION. By J. GRAHAM KERR, F.R.S., Regius Professor of Zoology in the University of Glasgow. With 2 Plates in colour and 53 Illustrations in the Text. 8vo. 12s. net.

CONTEMPORARY REVIEW.—"Professor Graham Kerr has a charming prose style; he is a practical field naturalist of immense experience; he knows his own mind, and is not afraid to express quite bluntly his own views. He restates the Darwinian doctrine of natural selection, reinforced by Mendel's principles of heredity, by the insistence on the utility of particular characteristics amongst animals living freely, and by modern advances in physiological knowledge, with great power."

AN INTRODUCTION TO THE THEORY OF INFINITE SERIES. By T. J. I'A. BROMWICH, M.A., Sc.D., F.R.S., Fellow and Lecturer of St. John's College, Cambridge. Second Edition Revised with the assistance of T. M. MACROBERT, D.Sc., Lecturer in Mathematics in the University of Glasgow. 8vo. 30s. net.

NATURE.—"Not only to the mathematician is the book indispensable; it is also the best possible guide to any one who encounters mathematical analysis in his work. The second edition will increase the very high reputation gained by the first."

HIGHER MATHEMATICS FOR STUDENTS OF ENGINEERING AND SCIENCE. By FREDERICK G. W. BROWN, M.Sc.(London), F.C.P., Senior Mathematical Master, West Ham Secondary School. Crown 8vo. 10s.

EDUCATION.—"Everything in the book is well done. It shows that the author is a mathematical enthusiast and is bent on teaching mathematics in the proper way. . . . Mr. Brown has compiled a book that will be of inestimable service to many a teacher."

INTERMEDIATE MATHEMATICS (Analysis). By T. S. USHERWOOD, B.Sc., Wh.Ex., A.M.I.Mech.E., and C. J. A. TRIMBLE, M.A. Crown 8vo. 7s. 6d.

NATURE.—"The authors of this text-book on mathematics to the intermediate degree standard have already established a reputation by their previous works which is fully maintained in the present. The book is well planned."

*** ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

BROOKLYN BOTANIC GARDEN MEMOIRS

Volume I.: 33 contributions by various authors on genetics, pathology, mycology, physiology, ecology, plant geography, and systematic botany. Price $3.50 plus postage.

Volume II.: The Vegetation of Long Island. Part I. The Vegetation of Montauk, etc. Pub. 1923. 108 pp. Price $1.

AMERICAN JOURNAL OF BOTANY

Devoted to All Branches of Botanical Science

Established 1914. Monthly, except August and September. Official publication of the Botanical Society of America. Subscription, $6 a year. Volumes I.-XII. complete, $86. Single numbers, 75 cents post free. Prices of odd volumes on request. Foreign postage: 40 cents.

ECOLOGY

Devoted to All Forms of Life in Relation to Environment.

Established 1920. Quarterly. Official publication of the Ecological Society of America. Subscription, $4 a year. Back volumes, I.-VI., $4.25 each. Single numbers, $1.25 post free. Foreign postage: 20 cents.

GENETICS

A Periodical Record of Investigations bearing on Heredity and Variation.

Established 1916. Bi-monthly. Subscription, $6 a year. Single numbers, $1.25 post free. Back volumes, II.-X. only, $7 each. Foreign postage: 50 cents.

Orders should be placed with

The Secretary, BROOKLYN BOTANIC GARDEN,
BROOKLYN, N.Y., U.S.A.

THE JOURNAL OF GENERAL PHYSIOLOGY.

Edited by W. J. CROZIER, JOHN H. NORTHROP, W. J. V. OSTERHOUT.

CONTENTS OF VOL. IX., No. 6, JULY 20, 1926.

KUNITZ, M. An empirical formula for the relation between viscosity of solution and volume of solute.

CAMPBELL, F. L. Relative susceptibility to arsenic in successive instars of the silkworm.

COOK, S. F. The toxic action of copper on *Nitella*.

HITCHCOCK, DAVID I. The size of pores in collodion membranes.

NORTHROP, JOHN H. Duration of life of an aseptic *Drosophila* culture inbred in the dark for 230 generations.

NORTHROP, JOHN H. A convenient method for the formol titration.

HAWKINS, JAMES A. A discussion of recent studies on the metabolism of normal and malignant cells.

MURRAY, HENRY A., JR. Physiological ontogeny. A. Chicken embryos. X. The temperature characteristic for the contraction rate of isolated fragments of embryonic heart muscle.

MURRAY, HENRY A., JR. Physiological ontogeny. A. Chicken embryos. XI. The pH, chloride, carbonic acid, and protein concentrations in the tissues as functions of age.

DAVIES, P. A. Effect of high pressure on germination of seeds (*Medicago sativa* and *Melilotus alba*).

KRAMER, S. P. Bacterial filters. A preliminary note.

GROLLMAN, ARTHUR. Ultrafiltration through collodion membranes.

PONDER, ERIC. A contribution to the theory of phagocytosis.

MURRAY, CECIL D. The physiological principle of minimum work applied to the angle of branching of arteries.

INDEX TO VOLUME IX.

Subscription Price per Year (One Volume), $5.00.

Published bi-monthly by

THE ROCKEFELLER INSTITUTE for MEDICAL RESEARCH,
Avenue A and 66th Street - - New York, N.Y.

L. REEVE & CO., LTD.

RECENT PUBLICATIONS.

Winter Blossoms from the Outdoor Garden.

By A. W. DARNELL, with 24 coloured and plain Plates. A descriptive list of exotic Trees, Shrubs, and Herbaceous Plants that flower in the outdoor garden in the British Isles in December, January, and February. For the use of Amateur Gardeners.

Ready shortly. Order now. Demy 8vo.
Price £1 : 1s.

Citrus Growing in South Africa.

By R. H. DAVIS. Fully illustrated. Price £1 : 5s.

A Book of South African Flowers.

Fully illustrated in colour and half-tone. Price £1 : 1s.

Bacteria in Relation to Soil Fertility.

By J. E. GREAVES, M.S., Ph.D. Illustrated. Price 10s. 6d.

Flora of the Malay Peninsula. (5 Volumes.)

By H. N. RIDLEY, C.M.G., F.R.S., F.L.S. Illustrated. Volume 1, £3 : 3s. Vols. 2 to 5, each £2 : 2s.

List of other Colonial Floras and complete Catalogue free on application.

6 Henrietta Street, Covent Garden, W.C.2.

ANNOUNCEMENT OF THE CONTENTS OF THE AUGUST NUMBER OF THE

PHILOSOPHICAL MAGAZINE AND JOURNAL OF SCIENCE

Published the First Day of every Month. Price 5s.

The Effect of Tension on certain Elastic Properties of Wires. By E. EDWARDS, M.A., B.Sc., I. BOWEN, M.Sc., and S. ALTY, M.Sc. (Plate VII.)

The Surface Tension of Liquid Metals.—Part I. Tin and Lead. By L. L. BIRCUMSHAW, B.A., M.Sc.

Determination of the Modulus of Elasticity by Dynamical Methods. By H. W. SWIFT, M.A., B.Sc.

The Variation of Pressure with Temperature in Evacuated Vessels. By N. R. CAMPBELL.

A Bath for Observations at Lower Temperatures. By W. H. PATTERSON.

Molecular Association and the Equation of State. By M. F. CARROLL, M.Sc. (Lond.).

Phase-effect and the Localisation of Sound: an Examination of the Myers-Wilson Hypothesis. By H. BANISTER, B.Sc. (Lond.), Ph.D. (Cantab.), St. John's College, Cambridge.

The Elasticity Coefficients and the Thermodynamic Integration Factor for the Solid State. By A. PERES, Rockefeller Foundation Visiting Professor of Physics, Chulalongkorn University, Bangkok, Siam.

Eddying Flow from Annular Nozzles. By E. TYLER, M.Sc., and E. G. RICHARDSON, B.A., M.Sc., Ph.D. (University College, London).

Some Considerations of the Reaction Constant Equation, and a Simple Method of Determining the End Point. By S. E. SHEPPARD.

Temperature Stresses and Deflexions in the Fins and Barrel of an Air-cooled Internal Combustion Engine Cylinder. By A. M. BINNIE, M.A. (Cantab.).

The Photoelectric Emission from Platinum as Influenced by Heating. By LARS A. WELO, Ph.D.

The Transference of Energy in Collisions between Electrons and Molecules. By J. S. TOWNSEND, M.A., F.R.S., Wykeham Professor of Physics, Oxford, and C. M. FOCKEN, B.Sc., Lincoln College, Oxford.

Notices respecting New Books.

176 *Pages with* 1 *Plate and numerous Illustrations in the Text.*

Subscription for 1926, £4, including six double numbers, post free to any part of the world. Any double numbers issued beyond six charged extra.

TAYLOR & FRANCIS,
Red Lion Court, Fleet Street, London, E.C.4

SAFETY IN MINES RESEARCH BOARD.

RESEARCH APPOINTMENTS.

The Safety in Mines Research Board requires a RESEARCH ASSISTANT for work in connexion with Colliery Wire Ropes, and a JUNIOR RESEARCH ASSISTANT for work on materials and structures used for the support of underground workings Applicants must possess good scientific qualifications, including a University degree (or its equivalent) in Engineering, have a good knowledge of testing materials and be good draughtsmen, but special knowledge of Metallurgy is not required For the senior post previous research experience is necessary.

Preference will be given to ex-Service candidates.

Scales of Salary —Assistant, £290-£15-£350; Junior Assistant, £160-£10-£190 In addition a fluctuating Cost of Living Bonus is payable, making the present minima of the scales £377 and £258 respectively.

The posts are whole-time ones subject to the provisions of the Federated Superannuation System for Universities, and tenable in London.

Forms of application, which must be returned not later than August 25, can be obtained from the Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, London, S.W.1.

DUSTLESS ROOMS

On all Laboratory, Library, Museum, School, etc., Floors and Linoleums of every description

USE FLORIGENE (Regd.)

(Florigene means Floor-Hygiene)

It is IMPORTANT TO NOTE that ONE APPLICATION of "Florigene" ALLAYS the DUST and DIRT for 2 to 12 months, according to traffic, not only during each Sweeping (without Sprinkling of any kind), but also throughout all the intervening periods—which is of greater hygienic importance Easily applied

These sanitary and labour-saving advantages are NOT attained by sweeping-powders or any other method.

Send for Particulars, Medical Reports, and Testimonials to the Sole Makers

Estab over The "DUST-ALLAYER" Co. 25 years.

4 VERNON PLACE, BLOOMSBURY, LONDON, W.C.1.

Contractors to the British, Indian and Colonial Governments, etc.

THE ADVANCEMENT OF SCIENCE, 1926

Ready August 9

Collected Presidential Addresses delivered at the Oxford Meeting of the

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Inaugural Address by H.R.H. The Prince of Wales, K.G., F.R.S.

Sectional Addresses: The Production and Analysis of Spectra, by Prof. A. Fowler, The Scope of Organic Chemistry, by Prof. J. F. Thorpe; Lower Carboniferous Rocks of England and Wales, by Prof. S. H. Reynolds, Biology and the Training of the Citizen, by Prof. J. Graham Kerr; The Economic Development of British Tropical Africa, by the Hon. W. Ormsby-Gore; Inheritance as an Economic Factor, by Sir Josiah Stamp, Electricity Supply, by Sir John Snell; The Evolution of Human Races, by Prof. H. J. Fleure; Function and Design, by Prof J. B. Leathes, Psychological Aspects of Social Punishments, by Dr. J. Drever; 1860—1894—1926, by Prof. F. O. Bower (Botanical address), Educational address by Sir Thomas Holland; The Area of Cultivation required to feed the Population, by Sir Daniel Hall.

LONDON:
The British Association, Burlington House, W.1

Price Six Shillings

TO KEEP IN TOUCH WITH SCIENTIFIC MATTERS IT IS NECESSARY TO SEE "NATURE" REGULARLY

Subscription rates

Inland		*Foreign*
£2 12 0	*Year*	£2 17 0
£1 6 0	*Half-year*	£1 10 0
13 0	*Quarter*	16 0

All Subscriptions are payable in advance.

Cheques and Postal Orders should be made payable to Macmillan & Co., Ltd.

Please send me "NATURE" for ... months, for which I enclose remittance value

Name

Address

Date

THIS FORM MAY BE HANDED TO A BOOKSELLER OR NEWSAGENT, OR SENT DIRECT TO MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.

H. K.
LEWIS
& CO. LTD.
BOOKSELLERS & PUBLISHERS,
136 GOWER ST.,
AND
24 & 28 Gower Place,
LONDON, W.C. 1.
District Railway Euston Square Station
All Tube Railways Warren Street
Telephone · Museum 1072

SCIENTIFIC BOOKS

Complete Stock of Works and Text-books in all branches of General, Technical, and Medical Science.

Classified List of Scientific, Technical and Industrial Books, post free. All books in General Literature also supplied. Periodicals at subscription rates.

SPECIAL FACILITIES FOR EXECUTION OF ORDERS FROM ABROAD, which can be forwarded under the V.P.P. (C.O.D.) system when desired.

Effectually protective packing used without charge.

LARGE STOCK OF SECOND-HAND BOOKS, 140 GOWER STREET. 'Phone: Museum 4031.

DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

Trustees. Sir J. J. THOMSON, O.M., F.R.S., Sir F. G. KENYON, K.C.B., F.B.A., Prof. A. C. SEWARD, Sc.D., F.R.S., Prof. R. S. CONWAY, Litt.D., F.B.A.

A *free* specimen copy of "Discovery" will be sent to anyone on request.

Contents of the August "British Association Number" include:

SIR OLIVER LODGE'S
REMINISCENCES OF THE LAST BRITISH ASSOCIATION MEETING IN OXFORD, 1894.

Lord Salisbury's Address—Mendeléeff's Periodic Law—The Ether of Space—A Discussion on Flight—Beginning of Radio Telegraphy—The Discovery of Argon.

Illustrated. 1s. Monthly.
Annual Subscription 12s. 6d. post free.

BENN BROTHERS LTD.
154 Fleet Street, London, E.C.4

RECENT BOOKS

THE CAMBRIDGE UNDERGRADUATE 100 YEARS AGO.
By OSKAR TEICHMAN. Crown 8vo, boards. 4s. net. (Postage 4d.) Illustrated with contemporary prints.
"An amusing and interesting scrap-book."—*Observer.*

THE ARAB CIVILIZATION.
By JOSEPH HELL; translated by S. KHUDA BUKHSH. Demy 8vo, cloth. 8s. 6d. net. (Postage 6d.)
"Told with wide-mindedness, sympathy and clearness of vision."—*Muslim Outlook.*

PRACTICAL PHYSIOLOGICAL CHEMISTRY.
By S. W. COLE. Seventh edition. Demy 8vo, cloth. 16s net. (Postage 1s.)
"This most excellent work."—*Lancet*

FUNDAMENTALS OF BIO-CHEMISTRY.
In relation to Human Physiology.
By T. R. PARSONS. Third edition. Crown 8vo, cloth. 10s. 6d. net. (Postage 9d.)
"The book is admirable."—*Lancet.*

THE ELEMENTS OF THE THEORY OF REAL FUNCTIONS.
By J. E. LITTLEWOOD Demy 8vo, cloth. 4s. net. (Postage 4d.)

GEOLOGICAL MAP-READING.
By A. HARKER. Illustrated. Second edition. Demy 8vo, sewed. 3s. 6d. net. (Postage 3d.)

W. Heffer & Sons, Limited,
Cambridge, England. Of all Booksellers.

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals. General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

ADLARD & SON
& WEST NEWMAN
LIMITED

SCIENCE PRINTERS.

Home and Export.

23 Bartholomew Close, London, E.C.1.

MACMILLAN AND CO.'S

STANDARD BOOKS ON ZOOLOGY.

CAMBRIDGE NATURAL HISTORY. Edited by SIR S. F. HARMER, K.B.E., Sc.D., F.R.S., and SIR A. E. SHIPLEY, G.B.E., M.A., F.R.S. In 10 Vols. Fully Illustrated. Medium 8vo. 21s. net each. Also Library Edition In 10 Vols. Fully Illustrated. Half Morocco. In Sets only. Medium 8vo. £15 : 15s. net. VOL. I. **PROTOZOA; PORIFERA (SPONGES); COELENTERATA AND CTENOPHORA; ECHINODERMATA.** VOL. II. **WORMS, ROTIFERS, AND POLYZOA.** VOL. III. **MOLLUSCS AND BRACHIOPODS.** VOL. IV. **CRUSTACEA AND ARACHNIDS.** VOL. V. **PERIPATUS; MYRIAPODS; INSECTS, Part I.** VOL. VI. **INSECTS, Part II.** VOL. VII. **HEMICHORDATA; ASCIDIANS AND AMPHIOXUS; FISHES.** VOL. VIII. **AMPHIBIA AND REPTILES.** VOL. IX. **BIRDS.** VOL. X. **MAMMALIA.**

A TEXT-BOOK OF ZOOLOGY. By PROF. T. J. PARKER, D.Sc, F.R.S., and PROF. WILLIAM HASWELL, M.A., D.Sc, F.R.S. Third Edition, thoroughly revised. With Illustrations. In Two Vols. Medium 8vo. 50s. net.

MANUAL OF ZOOLOGY. By PROF. T. J. PARKER, D.Sc., F.R.S., and W. A. HASWELL, D.Sc., F.R.S. Illustrated. Crown 8vo. 10s. 6d.

ELEMENTARY COURSE OF PRACTICAL ZOOLOGY. By PROF. T. J. PARKER, D.Sc., F.R.S., and PROF. W. N. PARKER, Ph.D. Fifth Edition. Crown 8vo. 15s.

AN ELEMENTARY TEXT-BOOK OF ZOOLOGY FOR INDIAN STUDENTS. Adapted from "An Elementary Course of Practical Zoology" by PROFS. T. J. and W. N. PARKER. With two new chapters based on "Outlines of Evolutionary Biology" by PROF. ARTHUR DENDY, D.Sc., F.R.S. By PROF. B. L BHATIA, M.Sc. Illustrated. Cheaper reissue. Cr. 8vo. 15s. net.

ZOOLOGY FOR MEDICAL STUDENTS. By PROF. J. GRAHAM KERR, F.R.S. Illustrated. 8vo. 25s. net.

EVOLUTION. By J. GRAHAM KERR, F.R.S., Regius Professor of Zoology in the University of Glasgow. With 2 Plates in colour and 53 Illustrations in the Text 8vo. 12s. net.

A COURSE OF ELEMENTARY INSTRUCTION IN PRACTICAL BIOLOGY. By T. H. HUXLEY, F.R.S., and H. N. MARTIN. Revised and extended by PROF. G. B. HOWES and D. H. SCOTT, Ph.D. Cr. 8vo. 12s. 6d.

EXPERIMENTAL ZOOLOGY. By PROF. THOMAS HUNT MORGAN. 8vo. 16s. net.

HUMAN PROTOZOOLOGY. By PROF. R. W. HEGNER, Ph.D., and PROF. W. H. TALIAFERRO, Ph.D. Illustrated. Cr. 8vo. 18s. net.

TEXT-BOOK OF COMPARATIVE ANATOMY. By DR. ARNOLD LANG. Translated by H. M. and M. BERNARD. 8vo. 2 Parts. 17s. net each.

TEXT-BOOK OF PALÆONTOLOGY. Edited by PROF. CHARLES R. EASTMAN, Ph.D. Adapted from the German of PROF. KARL A. VON ZITTEL. With numerous Illustrations. Med. 8vo. Vol. I. Second Edition. 31s. 6d. net. Vol. II. Second Edition. [*In preparation.*]

Vol. III. MAMMALIA. Revised by MAX SCHLOSSER, Ph.D. Translated under the direction of DR. C. R. EASTMAN by LUCY P. BUSH and MARGUERITE L. ENGLER; and the translation revised, with additions, by SIR ARTHUR SMITH WOODWARD, F.R.S. With 374 Illustrations. 25s. net.

ZOOLOGICAL PHILOSOPHY. An Exposition with regard to the Natural History of Animals. By J. B. LAMARCK. Translated, with an Introduction, by HUGH S. ELLIOT. 8vo. 18s. net.

⁂ ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

JOURNAL OF THE ROYAL STATISTICAL SOCIETY.

New Series.
Vol. LXXXIX. Part III. May 1926.
Price 7s. 6d.
CONTENTS.

"The Growth of Mortality due to Motor Vehicles in England and Wales, 1904–23." By Major P. GRANVILLE EDGE, O.B.E. (With Discussion.)
"Statistics of British Shipping" By H W. MACROSTY, O.B.E. (With Discussion.)
Miscellanea:—
The Comparison of Two Sets of Observations. By E. C. RHODES, B.A.
Fertility of Marriage and Population Growth. By L. R. CONNOR.
The Growth of Textile Businesses in the Oldham District, 1884–1924. By T. S. ASHTON
Reviews of Books. Current Notes.
Obituary: Professor TSCHUPROW

ROYAL STATISTICAL SOCIETY, 9 Adelphi Terrace, W.C 2.

JOURNAL OF THE INSTITUTE OF ACTUARIES.

No. 290.—JULY 1926.—Price 5s.
CONTENTS.

An Investigation into the Mortality experienced by Pensioners of the Staffs of Banks and Insurance Companies, with a Note on the Mortality experienced by Deferred Annuitants. By CYRIL F. WARREN, F.I A.
On the Distribution of Life Office Profits. By C. R. V COUTTS, F.I.A. With a Note on some Methods of Approximation employed in calculating the Tables. By C. D RICH, B.A., A.I.A.
On the Bonus Earning Power of a New Business Fund By G. H. RECKNELL, F I.A., F.F.A
Notes on a Stationary Insurance Fund and on a Uniformly Progressive Insurance Fund. By DUNCAN C. FRASER, M.A , F.I.A.
Mortality in India among Insured Lives. By ARTHUR HUNTER, F.A.S., F.F.A.
Legal Notes Reviews. Correspondence.
Investments of British Assurance Companies.

London : C. & E. LAYTON, Farringdon Street, E.C.4.

PATENTS AND CHEMICAL RESEARCH.

By HAROLD E. POTTS, M.Sc.,
CHARTERED PATENT AGENT.

Demy 8vo. Cloth. 8/6 net.

"There can be no question of the Author's grasp of the fundamentals of patent law; the discrimination with which he has selected his leading cases when discussing the validity of patents demonstrates this."—*Nature.*

THE UNIVERSITY PRESS OF LIVERPOOL, LIMITED, HODDER AND STOUGHTON, LIMITED, LONDON.

FOR NEW KIND OF THOUGHT IN SCIENCE

Read NEW REVELATIONS IN ASTRONOMY AND GRAVITATION, by William Henry Parkes.
Price 2/-, post free from the Author at

9 Lancaster Court, Newman Street, London, W.1.

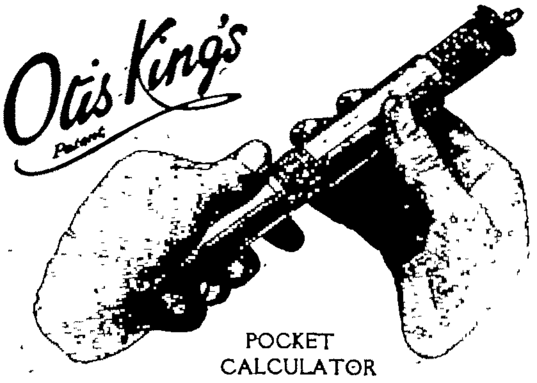
NATURAL SCIENCE
BOOKS AND PERIODICALS
INCLUDING THE PUBLICATIONS
OF THE LEARNED SOCIETIES

CATALOGUES GRATIS **LIBRARIES PURCHASED**

BERNARD QUARITCH LTD.
11 Grafton Street, New Bond Street, London, W.1

GENERAL DISCUSSIONS OF THE FARADAY SOCIETY.

A list of REPRINTS available can be obtained from Messrs. GURNEY & JACKSON, 33 Paternoster Row, London, E.C.4, Official Publishers to the Society. Information relating to the Society may be obtained from the SECRETARY, 90 Great Russell Street, London, W.C.1.



"accuracy is about four times that of the ordinary ten-inch slide rule . . ."

writes a B.Sc., from Canada. This unsolicited letter goes on to state : "My estimate is that I have made about fifty thousand calculations with your product. About twenty-two thousand hydraulic calculations have been made in the last month with a probable error of any one calculation not greater than 5/100 of 1%."

Otis King Model K for multiplication, division, proportion, percentages. Model L gives, in addition, all powers and roots—fractional or otherwise—of all numbers without limit.

Price, packed in leather case, 21/- (special Black Cursor 1/6 extra), post free within U.K.

Write for illustrated and fully descriptive folder.

CARBIC LIMITED
(Dept. N), 51 Holborn Viaduct, London, E.C.1.

Agents in most Dominions and Foreign Countries.

SCIENCE & ULTIMATE TRUTH

Fison Memorial Lecture, delivered at Guy's Hospital Medical School, March 25, 1926,

By

The Very Rev. W. R. INGE, C.V.O., D.D.
Dean of St. Paul's.

8vo. Paper covers, 1s. net. Paper boards, cloth back, 2s. net.

"Some of the most enlightened thought of our time. . . Every one interested in philosophy should read this clear and powerful essay."
Spectator.

LONGMANS, GREEN & CO., Ltd.
39 Paternoster Row, LONDON, E.C.4

Now ready. **Third Edition.**

A TEXT-BOOK OF
EXPERIMENTAL PSYCHOLOGY
By CHARLES S. MYERS, M.A., M.D., Sc.D., F R.S.,
and F. C BARTLETT, M.A.

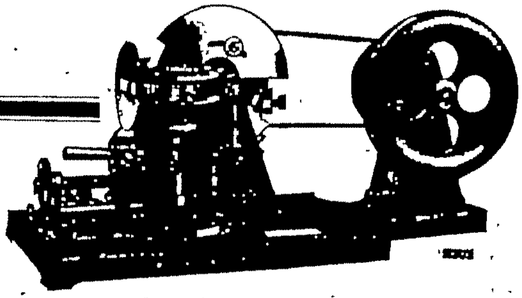
In two parts. **Price 16s net.**

The two parts are also sold separately:—Part I, Text-book, **10s 6d** net; Part II, Laboratory Exercises. With 40 Figures and Diagrams, **7s** net.

"The edition just issued is probably the most complete text-book of experimental psychology in this or any other language. Every page is loaded with trustworthy statements of verified fact, yet the argumentation is so well ordered, and the style so concise and clear, that the book can be read with ease and pleasure."
Nature on the Second Edition.

Prospectus on application.

CAMBRIDGE UNIVERSITY PRESS
Fetter Lane, London, E.C.4



43×20×23.

RAY TRACK APPARATUS

This instrument embodies Mr. T. Shimizu's modification of Prof. C. T. R. Wilson's cloud expansion apparatus. It enables the continuous emission of ionising particles to be observed and photographed. List No. 106-N contains a full description of the apparatus together with reproductions of a number of records which have been obtained.

39

CAMBRIDGE
INSTRUMENT CO LTD

WORKS
LONDON & CAMBRIDGE

Head Office & Showrooms: 45, GROSVENOR PLACE
LONDON, S.W.1

AMERICAN COMPANY:
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

ULTRA VIOLET RAYS

WHICH ARE STOPPED BY
GLASS PASS THROUGH
WINDOLITE,
The Practical Glass Substitute

for windows in **FACTORIES, SCHOOLS,** and **HOSPITALS;**
for **POULTRY HOUSES, BROODERS,** and **CATTLE SHEDS;**
for all **GARDEN USES.**

Light. Flexible. Unbreakable.
Easy to cut and fix.
Particulars post free, or Sample 3 ft. by 3 ft. for 4/6.

WINDOLITE (Dept. M), 179/185 Great Portland St.,
LONDON, W.1.

LABORATORIES
WITHOUT A SUPPLY OF GAS

should write for particulars of the Mansfield Oil-Gas plant which produces gas in a simple manner from heavy oil, such as paraffin.

The gas produced has a calorific power of about 1300 B.T.U.'s per cubic foot and gives perfect oxidising and reducing flames.

The Mansfield plant may be seen in operation in many of the principal laboratories in the British Empire which are out of the reach of a supply of town's gas.

Write for particulars to

MANSFIELD & SONS, LTD.,
23 HAMILTON SQUARE, BIRKENHEAD.

RELIABLE APPARATUS FOR SPECIAL & GENERAL USE

GRADUATED BURETTES, PIPETTES, FLASKS, CYLINDERS
GAS ANALYSIS APPARATUS
MICRO-CHEMICAL APPARATUS
GENERAL LABORATORY APPARATUS & CHEMICALS

Made by

STANDLEY BELCHER & MASON LTD.,
CHURCH STREET, BIRMINGHAM, ENGLAND.

SBM

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

seven cars, the expedition had the great advantage of speed over the previous geological explorers who crossed the Desert with camels only. The geologists and palæontologists of the party, Granger, Berkey, and Morris, with two field assistants, also had the advantage of prolonged experience in the field formations of the western United States, which, between the 50th and 40th parallels of latitude, present conditions remarkably similar to those found in the Desert of Gobi. Raphael Pumpelly in 1864, Ferdinand von Richthofen in 1872, and V. A. Obruchev in 1909, found no fossils, except the single rhinoceros-tooth brought back by Obruchev; and other geologists traversing this region have thought that there were no fossils to be found.

As to geology, the expeditions beginning on April 15, 1922, 260 miles north-west of Kalgan, and encircling in 1922, 1923, and 1925, the entire Gobi district in a 3000-mile radius, discovered no fewer than twenty-three distinct geological formations extending downwards from Lower Pleistocene time into Lower Cretaceous and Upper Jurassic. These have a thickness varying from 50 to 3000 feet, and were deposited either in the great flood-plains of ancient rivers, or in broad river-valleys, or at the base of ancient mountain-chains, or in the torrents of great sandstorms such as the Djadokhta, testifying to the secular vicissitudes of climate, mostly of rainfall, terminating with the pluvial period of the Ice Age, followed by a long period of secular desiccation.

Some of these formations prove to be closely contemporaneous with the Lower Cretaceous Wealden of western Europe, owing to the presence of large iguanodonts, equalling the famous *I. bernissartiensis* of Belgium in size. The oldest are as early as the Oxfordian and Purbeck of Upper Jurassic times. The climax of reptilian life is reached in the marvellous sand-swept deinosaur breeding-grounds (Djadokta formation) of Middle Cretaceous time, where nests of fossil eggs and innumerable skulls and skeletons of Protoceratops are found in almost perfect preservation. This is the richest deinosaur deposit thus far discovered in Eurasia.

As to the fifteen succeeding Tertiary formations, they compose so many unbroken chapters of the history of Mongolian life as extend from the basal Eocene Gashato to Upper Oligocene time, where the giant Baluchitherium occurs, as discovered also in Baluchistan by Cooper of Cambridge, and in Chinese Turkestan by Borissiak of Moscow. The Miocene and the Pliocene periods are represented by four formations.

Thus the scientific staff of the Expedition, between the years 1922 and 1925, has interpreted one of the most typically desert regions of the entire world by means of the twin sciences of palæontology and geology, and the wilderness of Mongolia now blossoms forth with its glorious story of prehistoric life, as the homeland of the greater number of known upland terrestrial vertebrates.

STONE AGE, TERTIARY, AND CRETACEOUS FORMATIONS OF MONGOLIA, IN DESCENDING ORDER

Regions.	*Formations and Thickness estimated in feet.*		*Probable or estimated Geological Age.*	*Human Culture, Mammalian and Reptilian Life-zones.*
Altai Piedmont	Shabarakh Usu	50+	Upper Palæolithic	? Azilian-Campignian
" "	Orok Nor	5–40	Middle Palæolithic	? Aurignacian-Mousterian.
		- -	Lower Palæolithic	? Acheulean or ? Eolithic.
Orok Nor basin	Khunuk	27–120	Lower Pleistocene	? Equus, ? Mastodon
Tsagan Nor basin	Tsagan Nuru Gochu	50± 1000±	Lower Pleistocene	? Equus, ? Struthiolithus.
Eastern Altai Mts	Hung Kureh	1000	Upper Pliocene to Lower Pleistocene	Hipparion Camelus zone
Iren Dabasu basin	Pang Kiang	500	Miocene; age doubtful	Rodents. ? Ochotona
Eastern Altai Mts.	Loh	100–1000	Middle Miocene	Mastodon (Serridentinus) zone.
" " "	Hsanda Gol	3000	Middle to Upper Oligocene	*Baluchitherium grangeri* zone
Iren Dabasu basin	Houldjin	30–50	" " "	" " "
Orok Nor basin	Elegen	0–200	" " "	? Mammals undetermined.
Uliassutai Trail	Baron Sog	5–30	Middle Oligocene	? Large Titanotheres
" "	Ulan Gochu	2–60	Lower Oligocene	? " "
Uliassutai Trail	Ardyn Obo	500	" "	*Brontops gobiensis* zone
" "	Shara Murun	200±	Summit of Eocene	*Protitanotherium mongoliense* zone. *Amynodon mongoliensis*
Shara Murun basin	Tukhum	50+	Upper Eocene	Titanotheres abundant.
Iren Dabasu basin	Irdin Manha	? 100	" "	Eudinoceras, Andrewsarchus zone.
" " "	Arshanto	40–100	? Middle Eocene	Lophiodonts-Schlosseria zone.
Kholobolchi Nor basin	Kholobolchi	1000±	? Lower Eocene	Coryphodon zone.
Eastern Altai Mts.	Gashato	300	Basal Eocene (Palæocene)	Prodinoceras zone Palæostylops
Eastern Altai Mts	Djadokhta	500	Middle Cretaceous	Protoceratops andrewsi zone
N.-E. of Shabarakh Usu	Dohoin Usu	200±		Deinosauria. Crocodilia, Chelonia zone.
Iren Dabasu basin	Iren Dabasu	180	Lower Cretaceous ? Wealden	Iguanodont. Ornithomimidæ
Oshih basin	Ashile	2000	Upper Jurassic	Psittacosaurus zone. Asiatosaurus. Prodeinodon.
Tsagan Nor basin	Ondai Sair	500	" "	Protiguanodon zone.

The British Association at Oxford.

BY the time that the present issue of NATURE is in the readers' hands, the meeting of the British Association for the Advancement of Science will be in full progress. The Sheldonian Theatre, where Mr. Disraeli made the celebrated announcement that he was "on the side of the angels," will have been the scene of yet another important gathering; and the chief social events of the meeting, namely, the receptions by the Vice-Chancellor, the Mayor, and the Dean, Canons, and students of Christ Church, will have taken place at the Examination Schools, the Town Hall, and Wolsey's great foundation respectively.

Among the institutions of Oxford which combine historical with scientific interest, not least must be reckoned the Botanic Garden on the south side of the High Street, opposite Magdalen College. This, the earliest botanic garden now existing in England, was founded by Henry, Lord Danvers, in 1621, and was intended by him to be put in the charge of John Tradescant, gardener to King Charles I., who, however, died before the appointment took effect. The scientific movement in Oxford, which began in the days of the Commonwealth under the auspices of John Wilkins and his associates, and culminated in the establishment of the Royal Society soon after the Restoration, was carried on by Elias Ashmole. It was to Ashmole that the younger Tradescant bequeathed the natural history and antiquarian collection begun by his father, and to Ashmole himself the University was indebted for the gift of the Tradescant collections, to which that industrious collector had made large and important additions.

It was not until 1669 that Lord Danby's 'physick garden,' which had failed to secure the services of either Tradescant, was equipped with a regular professor. This was Dr. Robert Morison, who delivered courses of lectures, one of which was attended in 1675 by John Evelyn. A great benefactor to the establishment was Dr. William Sherard, who left a permanent endowment for the professorship of botany. It was Sherard who invited the famous Dillenius to take up his residence in England, and provided, by the terms of his will, that Dillenius should be the first occupant of the Sherardian chair. Linnæus, who visited Oxford in 1736, was entertained by the professor, and endeavoured, though without success, to convert him to his new system of classification. In spite of their inability to see eye to eye in botanical matters, the two men formed the highest opinion of each other's merits. The Oxford professor, for his part, "detained Linnæus for a month without giving him an hour to himself the whole day long; and at last took leave of him with tears in his eyes, after having given him the choice of living with him till his death, as the salary of the professorship was sufficient for them both." The Swedish botanist declined this generous offer, but after his return home wrote, "In Anglia nullus est qui genera curet vel intelligat praeterquam Dillenius," and moreover, "founded the genus Dillenia, of all plants the most distinguished for the beauty of its flower and fruit, like Dillenius among botanists" (Gunther, quoting Claridge Druce).

The next professor, Dr. Humphrey Sibthorpe, is said to have given only one lecture, and that a bad one; but his son and successor John was a man of different stamp. Besides projecting and partly carrying out a great work on the flora of Greece, he founded and endowed the professorship of rural economy which still exists.

A new epoch of efficiency and activity dawned with the appointment of Dr. Daubeny in 1834. The energy and persistence of the new professor speedily resulted in considerable additions to the buildings and in extensive improvements in the usefulness and attractiveness of the garden. The reforms set on foot by Daubeny have been continued and developed by his successors, notably by Bayley Balfour, Sidney Vines, and the present occupant of the chair of botany, Sir Frederick Keeble.

Part of the extensive scheme devised by Acland for bringing together in one place all the various departments of natural science, with the view of "the development of a complete national education in science," involved the removal of the lecture-rooms, laboratories, and other appliances for botanical study to the neighbourhood of the new museum, while a 'garden of instruction,' some five acres in extent, would have been established in the Parks. A clever skit by Mr. Edward Chapman, of Magdalen College, cast ridicule on the scheme and did much to cause its abandonment. Many, however, will still think that the plan had great advantages; and it is to be observed that it has since been found quite impossible to carry out within the precincts of the ancient garden all the botanical teaching which has now become necessary.

A very attractive feature of the present meeting will be the opportunity of visiting, by the kindness respectively of Mrs. G. H. Morrell, Sir Arthur Evans, and Mr. Henry Balfour, their exceptionally fine gardens and grounds in the immediate neighbourhood of Oxford. The grounds of Headington Hill Hall, the residence of Mrs. Morrell, are far-famed for their beauty, their extent, and their picturesque situation on the side of the hill overlooking the city. From them can be seen the best views of the University and College buildings to be had anywhere. Youlbury (Sir Arthur Evans) and Langley Lodge (Mr. H. Balfour) have also their own points of exceptional beauty and interest. As an example of a city garden, that of Exeter College, with its boundary formed by the Divinity School and the library of Humphrey Duke of Gloucester, cannot easily be surpassed. The party to be given in these pleasant surroundings by the Rector and Fellows of the College is certain to be highly appreciated by their guests.

The conversaziones to be held at the Ashmolean and University Museums on the evening of August 10 will end the public entertainments of the present meeting. Both are likely to be especially attractive to the devotees of the arts and sciences respectively. The short lectures, demonstrations, and exhibits at the University Museum have been chiefly organised by members of the Junior Scientific Society of the University, an association the zeal and activity of which are among the most hopeful signs of present-day life in Oxford.

F. A. D.

Dr. D. H. Scott writes: "In addition to the list given in NATURE of July 31 of distinguished guests from abroad attending the Oxford meeting of the British Association, may I mention that we are also expecting Dr. R. Kräusel, of Frankfurt? In conjunction with Dr. H. Weyland, Dr. Kräusel has made important discoveries in the Middle Devonian flora, showing that the plants of that early period were considerably more advanced than had been realised before. He is giving an account of his results in the Section of Botany."

Obituary.

REV. T. R. R. STEBBING, F.R.S.

THERE must be very many students of the Crustacea scattered all over the world who will read with a sense of personal loss that the Rev. T. R. R. Stebbing is dead. Some of us who are now grey-haired look back to the time when we first discovered the unfailing kindness and patience which allowed the most ignorant beginner to dip into his endless stores of knowledge, and find it hard to realise that we can no longer 'ask Stebbing' when we come to some particularly knotty point in nomenclature or bibliography.

Thomas Roscoe Rede Stebbing was the son of the Rev. Henry Stebbing, D.D. He was born in London on February 6, 1835, and was the seventh in a family of thirteen, several of whom inherited the literary tastes and abilities of their father. From King's College School he went to Lincoln College and later to Worcester College, Oxford. His academic career was distinguished, but his studies were exclusively classical and literary. He obtained a second in *Lit. Hum.* in 1856 and a first in law and modern history in 1857. In 1858 he took orders, being ordained, it is interesting now to recall, by the Bishop of Oxford, Samuel Wilberforce. Masterships at Radley and Wellington were followed by a fellowship and tutorship at Worcester College, of which he was in turn vice-provost and dean.

Stebbing resigned his fellowship in 1867 on his marriage with Mary Anne, daughter of W. W. Saunders, F.R.S., the well-known entomologist, and took pupils, first at Reigate and afterwards at Torquay. At Torquay he became acquainted with some enthusiastic local naturalists, among whom was William Pengelly, under whose inspiration he began to take an interest in natural history. He has told how it was that, already in middle age, he was led to the serious study of zoology. "Having become much interested in Natural Science, and having also been trained in the strictest school of evangelical theology, I had conceived it to be a duty to confute the vagaries of Darwin. But, on reading the 'Origin of Species,' as a preliminary, it has to be confessed that, instead of confuting, I became his ardent disciple." He threw himself into the controversy then raging, and a volume of "Essays on Darwinism" published in 1871, as well as a letter to NATURE in April of the same year, replying to a scornful *Times* review of the "Descent of Man," drew upon him, as we may gather, a good deal of ecclesiastical hostility. From then onwards he continued his advocacy of a liberal theology in essays and magazine articles, some of which are reprinted in his "Faith in Fetters" (1919) and "Plain Speaking" published only a few months ago. Some of these essays now read like echoes of "old, unhappy, far-off things,"—so far off, at any rate, as Dayton, Tennessee!

It was a desire to become acquainted at first hand with some of the facts of Nature on which the evolution theory rested that led Stebbing to take up the study of Crustacea. After some early papers on British species he was entrusted, on the recommendation of his friend Canon A. M. Norman, with the description of the Amphipoda obtained by the *Challenger* expedition. He gave up teaching in order to devote himself to this task, and after some six years' work he produced his report (1888), which fills three of the large quarto volumes of the *Challenger* series. It is not too much to say that this report set a new standard for systematic carcinology, especially in its admirable bibliographical introduction, giving a critical analysis of everything that had been written on the Amphipoda down to the year of its publication. This report and the scarcely less important volume on the Gammaridea contributed to "Das Tierreich" (1906) are Stebbing's best-known works, but a long series of memoirs and lesser papers, extending over more than half a century, contained contributions of fundamental importance on every order of the Crustacea.

Occasional more popular articles and addresses, as well as his "History of Crustacea" (International Science Series, 1893) and the "Naturalist of Cumbrae" (1891), a biography of Dr. David Robertson, give scope for the play of a whimsical and almost boyish sense of fun.

'Scholarly' is the adjective that comes first to the pen in writing of Stebbing's work. Trained exclusively in the disciplines of the older learning and turning to the study of science only in mature life, he brought to it that feeling for antiquity, that sense of the historical perspective of knowledge, which is often wanting in those whose education has been definitely scientific. His erudition seemed boundless, but he wore it with so unaffected a modesty that rash controversialists, less well equipped, were sometimes lured on to their confusion.

Stebbing was elected a fellow of the Royal Society in 1896. He served as a vice-president of the Linnean Society, and later (1903–1907) as zoological secretary. He took a prominent part in the movement for the admission of women to the fellowship of the latter society, and his wife, an accomplished botanist, was one of the first group of ladies admitted. Of the many honours that came to him, none was more valued than the Linnean medal awarded to him in 1908.

Mr. Stebbing died at Tunbridge Wells, where he had resided for many years, on July 9.

W. T. CALMAN.

WE regret to announce the following deaths:

Dr. R. H. Clarke, formerly demonstrator of physiology at St. George's Hospital, London, author of an atlas of sections of the brain of the cat and monkey published in the *Journal fur Psychologie und Neurologie* and joint author with Victor Horsley of a number of papers in *Brain*, on June 22, aged seventy-five years.

M. Albert Frouin, for many years in the physiological research laboratory of the Pasteur Institute, Paris, who has worked on the physiology of digestion, the biochemistry of bacteria, the tubercle bacillus, and particularly the antitubercular action of the salts of the rare earths.

M. Albert Viger, for thirty years president of the French National Horticultural Society, and seven times Minister of Agriculture, on July 8.

News and Views.

DR. A. W. BORTHWICK, formerly lecturer in forest botany at the University of Edinburgh and afterwards serving under the Forestry Commission, was recently appointed to the new chair in forestry at the University of Aberdeen. In his inaugural address, after a preliminary survey of the increasing utility of the products of the forest in supplying many of the everyday needs of the public, and the consequent necessity for the conservation and efficient management of forests, he dealt with the rôle of the university in connexion with the practice of forestry. He considers that a university school of forestry should have three principal aims: (1) To give instruction in the theory and practice of forestry; (2) to conduct research; (3) to advise and assist the owners of forest lands in the management of their woods. "Each of these aims," said Prof Borthwick, "is important in itself, and not the least important is No. 3. The Department can be of direct help to owners of forests and forest lands, by correspondence, lectures, and personal inspection of woodlands, plantations and lands to be planted. In return the Department is kept in close touch with field problems as they arise, and this is bound to be of use in indicating the kind of instruction to be given to young foresters in training, and also in bringing to notice problems for the elucidation of which further research is required. By concentration on (3) such aims and correlating them into an organised unity, the Department will be kept from going to sleep, a condition only too liable to occur when an overdose of academic forestry is indulged in"

IN the above remarks Prof. Borthwick would appear to be referring to British woods alone. Whilst these are of very great utility for the more elementary portions of the practical courses given to the university forestry student (the future commissioned officer), the latter would be very inadequately equipped for his work, either in Great Britain or out in the Empire forests to which service the greater proportion of the university-trained men go, were the instructor to confine the practical work or his own studies to Great Britain Prof. Borthwick correctly recognises the importance of this part of the work, and gives an interesting dissertation on the varied branches of forestry education. But his address does not lay stress on the necessity of giving to the future university graduate in forestry practical courses on a far higher plane than anything which Great Britain can provide. To turn out graduates for service either at home or in the Empire (where the demand is far larger) necessitates a continuous study on the part of the staff of the changing conditions and progress (alluded to by the author himself) constantly taking place in the management of the forests of the world. In practice it has been found that only by such means can the forest officer of the future be sent forth with that wide and unbiassed outlook on forestry problems which it is so desirable that he should start with—in so far as it can be implanted in the minds of young men in the all too short space of a university career.

THE Wellington correspondent of the *Times* announces that Dr. Ernest Marsden, assistant director of education, has been appointed permanent secretary of the new Industrial and Scientific Research Department that is being established in New Zealand. This action has been taken on the recommendation of Sir Frank Heath, Secretary of the Department of Scientific and Industrial Research in London, who has recently completed a tour of investigation in Australia and New Zealand We referred in our issue of May 15, p. 697, to Sir Frank's recommendations for the reconstitution of the Commonwealth Institute of Science and Industry in Australia, and, again, in the issue of July 10, p. 57, to the Bills which have been passed by the Commonwealth House of Representatives to give effect to these recommendations. In introducing the measures, the Prime Minister, Mr. Bruce, referred to the large sums spent on research in public and semi-public institutions in the United States and stated that, for the present, the new Council for Scientific and Industrial Research in Australia will devote its attention to a limited group of problems—liquid fuels, cold storage, and the preservation of foodstuffs, forest products, animal diseases and pests, plant diseases and pests It is to be hoped that the Council's activities will soon be extended, while the Science and Industry Fund of 100,000*l*., which has been established for providing assistance to those engaged in scientific research and in the training of students in scientific research, should prove an important step towards meeting the very real need in Australia for competent research workers.

THE personnel of the Commonwealth Council for Scientific and Industrial Research has been announced in the Australian House of Representatives by the Prime Minister. The members are: *Executive Committee*: Mr. G. A. Julius (chairman), Mr. W. J. Newbigin. and Prof. A. C. D. Rivett. *Chairmen of State Committees*: N.S.W., Prof R. D. Watt (Agriculture); Victoria, Sir David Orme Masson (Chemistry); Queensland, Prof. H. C. Richards (Geology), South Australia, Prof. T. Brailsford Robertson (Biochemistry), Western Australia, Mr. B. Perry (Manufacturing industries); Tasmania, Mr. P. E. Keam (Agricultural and stock-breeding industries). *Co-opted Members*: Prof. E. C. Goddard, Queensland (Zoology and botany); Prof. H. A. Woodruff, Victoria (Veterinary pathology). The Council held its first session on June 22-25, and adopted general plans for work during the next twelve months. Its proposals apply chiefly to primary industries. As was foreseen by Sir Frank Heath, the operations of the Council will be hampered for some time by the lack of a supply of highly trained young investigators. Assistance will be sought from abroad, and extensive plans are being put into effect for sending promising Australian graduates to England and the United States for special training.

THE radio communication Bill, which was to regulate the use of radio in the United States, failed to pass

Congress before the long vacation. During the next six months, therefore, there is a risk of serious confusion in broadcasting development in the States. The Department of Commerce has allotted 89 wave-lengths to 528 stations, and there are 650 further applications for station licences awaiting consideration. Now, however, they are left without authority either to grant or to refuse any application. The Secretary of Commerce, Mr. Hoover, has hitherto been regulating all transmission mainly through a 'gentleman's agreement' with the broadcasters themselves. The Bill discussed in Congress expressly declared that it was the intention of the Federal Government to preserve the channels of radio transmission as "perpetual mediums under the control and for the people of the United States" Licences are limited to two years and are not available to aliens or to any applicant "who has been convicted of monopolising or attempting to monopolise the radio business" Broadcasting is apparently becoming very profitable as an advertising medium in the United States. According to the *Times* of July 27, so much as 50,000*l*. has been offered for the transfer of a licence. Licences were recently issued in Chicago to the Moody Bible Institute and the Chicago Federation of Labour. To farmers in the United States broadcasting has proved to be a great boon. Mr. Pickard, the radio officer of the Department of Agriculture, has stated that broadcasting is doing more for the farmer than any other single contribution of science during the century Farmers living so far as 60 miles from a railway have been induced by radio lectures to change their methods of farming to more profitable systems

ALTHOUGH windmills have been in use for more than a thousand years, yet accurate data as to their efficiency cannot easily be obtained. The Institute of Agricultural Engineering of the University of Oxford has therefore made a useful contribution to our knowledge of the subject by publishing a report on the use of windmills, more especially for the generation of electricity. A windmill experimental station was erected on the Annables estate, midway between Harpenden and Luton. The field slopes south-westward towards the Dunstable road, and seven windmill plants of various types have been erected on it. The site is a good one, as it obtains the benefit of unrestricted winds from all directions. Full results of the economic, technical and meteorological observations extending over a period of one year are given. The cost per electric unit utilised varied between 12 7 pence and 4 0 pence By using improved wheels the cost of production for the smaller and more inefficient mills could be reduced by 30 or 40 per cent. Considering the very small dynamos used, having an output of only a few horse-power, these results are quite satisfactory. Some of the plants begin to operate when the wind attains a velocity of about six miles per hour and cease operating when the velocity falls to five miles per hour. The output increases more rapidly than the velocity of the wind. The results prove that, in districts remote from a public electric supply, small windmill power schemes might prove useful and economical. Those who already own an engine-generating set and desire to supersede or supplement it should consider adopting wind power. It is also to be remembered that on higher sites than Harpenden or on districts nearer the coast better results would probably be obtained. In Denmark and Germany considerable use is made of wind power in generating electricity.

ALTHOUGH it may be pleaded that a state of chaos in human undertakings has a certain evolutionary value, as being indicative of potential progress, the complexity of civilised life nevertheless necessitates the logical classification of a vast amount of important information as a condition of ordered progress. Bibliographies of scientific and technical literature come well within this category, and their number is constantly increasing. Collective indexes are indispensable to the scientific worker, and although they are very costly to produce, the labour and expense involved in their production cannot be obviated Bibliographies of general subjects are less essential and have been comparatively neglected, hence we welcome the publication of "A Bibliography of Research" by the National Research Council of the United States, a small volume containing about 800 references to articles on research that have appeared in scientific, technical and trade journals during the years 1923, 1924 and 1925. To facilitate reference, the material has been subdivided into forty classes, a difficult task which has involved a considerable number of duplicate entries, thus four of five references to the National Physical Laboratory given under the heading 'Physics' are repeated in full, and with different index numbers, under the heading 'Research—General: Laboratories.' The bibliography might also be criticised from the point of view of completeness, to which, however, no claim is made. Thus only one of the annual reports of the Committee of the Privy Council for Scientific and Industrial Research is included; and there are very few references to German (11) and French (18) literatures, whilst other continental countries appear to have been neglected. Although criticisms of this kind are not difficult to make, the publication will undoubtedly be most useful to all interested in the general subject of research, and the National Research Council is to be congratulated upon its production.

IT is gratifying to note that anthropological investigations in Canada continue to be actively prosecuted under official auspices The report of the Department of Mines for the fiscal year ended March 25, 1925, which has just been issued, contains a report of the Victoria Museum covering the work of the anthropological and the biological divisions. Apart from the work of cataloguing, arranging, and preserving specimens, the anthropological staff has been engaged on a number of field expeditions. Mr. Harlan I. Smith visited the Bella Coola Indians of British Columbia, Mr. C. M. Barbeau was engaged among the Gitksan Indians of British Columbia, Mr. D. Jenness continued his work of the previous fiscal year among the Carrier and Sikani Indians of British Columbia, and Mr. F. W. Waugh visited the

Montagnais Indians of the Lower St. Lawrence, whence unfortunately he did not return, as he disappeared mysteriously after visiting an Indian reservation in September 1924, and has not since been traced. A large number of specimens, photographs, and phonograph records were added to the Museum collections as a result of these expeditions, and records and studies of specific subjects under observation have appeared in various scientific journals

THE growth of the regional survey movement as the geographer's special field of research and contribution to our knowledge of Great Britain has been marked in recent years. The Geographical Association in helping to foster this movement has published in the *Geographical Teacher*, vol. 13, No. 75, a list of libraries, museums, universities, and societies which have in their keeping or are undertaking surveys for their respective areas, also a long list of actual surveys and a list of civic surveys that have been published. The Association also hopes to make a special collection in its lending library of works and bibliographies dealing with special regions. A bibliography of Hertfordshire is published as a specimen. The lists given in the present number do not claim to be exhaustive, and will be added to from time to time as more information is sent to the Secretary of the Regional Survey Committee, Geographical Association, Marine Terrace, Aberystwyth. Some useful suggestions are also made for uniform systems of registration on maps.

AT a representative meeting held in March last, it was resolved to found an Institution of Fuel Technology, and a committee was appointed to prepare a constitution. A further meeting was held on July 30, when the draft constitution was formally adopted and the following officers were elected: *President*—Sir Alfred Mond; *Vice-Presidents*—Lord Aberconway, Prof. H. B. Dixon, Sir Robert Hadfield, Bart., Lord Weir, and Mr. D. Milne Watson; *Council*—Mr. R. A. Burrows, Sir Philip Dawson, Dr. F. A. Freeth, Sir William Larke, Dr. R. Lessing, Mr. M. Mannaberg, Sir Edward Manville, M.P., Mr. S. McEwen, Lord Montagu of Beaulieu, Sir Richard Redmayne, Admiral Sir Edmund Slade, Mr Wallace Thorneycroft, Dr M. W. Travers, Prof. R. V. Wheeler, Mr. W. A. Woodeson, Mr. G. R. Thursfield, Mr. T. Hardie, Mr. A. H. Middleton, and Mr. W. M. Selvey; *Hon. Treasurer*—Sir William B. Peat; *Hon. Secretary*—Mr. Edgar C. Evans, Caxton House (East), Tothill Street, S.W. An autumn or winter meeting for the discussion of papers is to be arranged.

A RATHER severe earthquake, strong enough to throw down a few chimneys and to fissure buildings, was felt in Jersey on July 30 at 2.18 P.M. In France it was felt at St. Malo and Rennes; in England, at Bournemouth and other places on the coast of Sussex and Hampshire. In strength and area of disturbance, it closely resembles two others that have visited the same district during the last half-century. The earlier of these, on January 28, 1878, disturbed an area of about 68,000 square miles, including Havre, Rouen, and Paris, as well as London, Bovey Tracey, Brighton, and St. Leonards. Its centre lies probably a short distance to the east of Jersey. Again, on May 30, 1889, another, and stronger, shock was felt over about the same area, and originated in or close to the same focus.

THE meeting of the British Association at Oxford in 1894 is probably best remembered as the occasion on which Lord Rayleigh and Sir William Ramsay, who have both since passed away, announced the discovery of the new gas argon in the atmosphere. In an article in the August issue of *Discovery*, Sir Oliver Lodge gives some reminiscences of the meeting and makes it clear that it should also take its place in the history of radio-telegraphy. At that time, Hertz had recently died and as a memorial to him Sir Oliver had repeated some of his experiments on the transmission of electromagnetic waves at the Royal Institution, using the Branly iron filings coherer and galvanometer as receiver, instead of the original point coherer and telephone. These experiments were shown again at the British Association meeting, and long and short signals corresponding to the Morse code were transmitted through the air from a neighbouring room to the large lecture theatre of the Oxford Museum, where they were demonstrated to an enthusiastic audience by the aid of a Kelvin mirror galvanometer.

WE have recently received from Prof. S. A. Forbes, Chief of the Natural History Survey Division of the State of Illinois, a reprint of a paper entitled "The Lake as a Microcosm," originally read and published in 1887 This paper, of some fourteen pages, was reprinted many years ago, but has long been out of print. The descriptions of conditions—physical and faunistic—apply especially to the lakes of Illinois, and the paper has therefore been much used by the students in the State University, while reference to problems of general interest has led to a demand for it also elsewhere, and to its reissue in the *Bulletin of the Natural History Survey* (vol. 15, article 9).

THE Ministry of Agriculture and Fisheries has recently republished its various leaflets on "Insect Pests of Farm and Garden Crops" in collected form as Section Volume No 11. Altogether twenty-seven leaflets are reprinted and they form a volume of 111 pages, including introductory remarks on the general principles underlying the application of control measures. The production of these leaflets has greatly improved in recent years, and the illustrations are of a higher standard. The information concerning the habits and methods of combating different pests is trustworthy and up-to-date, the results of recent research being incorporated in easily understandable language. There is no doubt that many growers will welcome the appearance of so much practical information in a form more convenient than that of separate leaflets, which are easily lost unless systematically filed. The low price of 1*s.* 3*d.* (post free) should bring the volume within reach of all who are likely to benefit by consulting it. It is obtainable from the Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1.

THE "Statistical Report of the Health of the Navy for the Year 1923" is presented by the Director-General, Surgeon Vice-Admiral Sir Joseph Chambers, K.C.B., and issued by H.M. Stationery Office (5*s.* net). The returns for the total force (89,100) show a marked improvement in the general health of the British fleet compared with the previous two years, the case, invaliding and death ratios all showing a decrease. This is doubtless largely due to the preventive measures now adopted. Health lectures are given by medical officers, and the men are warned of the risks they run in drinking polluted waters, eating raw vegetables and salads, oysters and other shellfish, and the rôle of flies in the spread of disease is explained. All water taken for drinking and cooking from the shore is chlorinated, and all fresh milk used, unless the source is well known, is sterilised. The excreta of all enteric patients are examined during convalescence on three occasions at monthly intervals, so as to eliminate carriers. All officers and men detailed for the Mediterranean, East Indies, and China stations are inoculated against typhoid and paratyphoid fevers before leaving England.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A public analyst for the borough of Northampton—The Town Clerk, Guildhall, Northampton (August 16). An assistant lecturer in agricultural zoology at the North of Scotland College of Agriculture—The Secretary, 41½ Union Street, Aberdeen (August 19). Lecturers in agriculture, botany, and entomology and zoology at the Imperial College of Tropical Agriculture, Trinidad—The Secretary of the College, 14 Trinity Square, E.C.3 (August 21). An assistant lecturer in electrical engineering at the Royal Technical College, Glasgow—Prof. S. Parker Smith, Royal Technical College, Glasgow (August 23). A research assistant for work in connexion with colliery wire ropes, and a junior research assistant for work on materials and structures used for the support of underground workings—each under the Safety in Mines Research Board—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (August 25). A technical officer for design of wireless apparatus for service aircraft and aerodrome use—The Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (August 28, quoting No. A.121). An instructor in bee-keeping in the department of Agriculture of the University of Leeds—The Registrar (August 28). An assistant in the botany department of the University of Aberdeen—The Secretary (August 30). A head of the Department of Industrial Administration and a lecturer in the same subject at the Manchester Municipal College of Technology—The Registrar (September 20).

Our Astronomical Column.

SUNSPOT ACTIVITY.—Of the two naked-eye spots, Nos. 7 and 8, which were on the sun's disc together during the last week of June, the first had entirely disappeared when its position came again into view, and the second had diminished to a relatively small spot. A new group of considerable size has, however, been seen recently in transit across the disc and was a conspicuous naked-eye object to those observers who habitually watch these large spots. In a refracting telescope of 3 or 4 inches aperture, much interesting detail could be seen in the penumbral filaments. In type the group conformed fairly closely to that of a 'normal' stream, with a well-defined circular leader, a composite follower 12° in longitude behind, and a cluster of small unstable spots between. The axis of the stream was inclined about 15° equatorwards. Both the leading and following spots were large enough to be visible separately to unaided vision, especially on July 29, when their separation of 12° solar longitude was equivalent to nearly 4′.

The latitude of the group should be noted. Hitherto, no important group has appeared this cycle so near the sun's equator. In previous cycles, the first very large spots in latitudes so low as 10° have occurred about two years before the respective maxima. Data of position and area (expressed as a fraction of the sun's hemisphere) of the recent spot are as follows:

No	Date on Disc.	Central Meridian Passage	Latitude.	Area.
9	July 24-Aug. 5	July 30·0	11° S.	1/550

NAMING OF MINOR PLANETS.—The three planets that commence the second thousand have received names that recall the circumstances of the discovery of Ceres, the first member of the family, about a century and a quarter ago (*Astr. Nach.* No. 5454). Number 1000, discovered by Reinmuth, has been named Piazzia, after the discoverer of Ceres; 1001, discovered by Beljavsky, has been named Gaussia, after the calculator of Ceres' orbit; and 1002, discovered by Albitzky, has been named Olbersia, after the detector of Ceres at its second opposition. These appropriate names were given by Mr. B. Asplind of Karlstad, Sweden, with the consent of the discoverers.

LUNAR AND PLANETARY TEMPERATURES.—The results of an investigation of planetary temperatures by Menzel, Coblentz and Lampland by means of the radiation transmitted through a water cell, are described in the *Astrophysical Journal*, vol. 63, p. 177. The theory of the method has previously been given by Menzel (*Astroph. Journ.*, vol. 58, p. 65), and rests on the fact that the solar energy reflected from a planet is of short wave-length, whereas the radiated planetary energy is of much longer wave-length. The water-cell transmission gives a measure of the ratio of the short-wave solar energy to the total energy, and hence of the amount of planetary radiation which is able to pass through our atmosphere. This atmospheric transmission depends on the spectral distribution of the radiation, and therefore, finally, upon the planetary temperature. The results of the latest work seem to show that the temperature of Mars may reach 10° C. at perihelion, but with large diurnal fluctuations (the night temperature being probably below -85° C.). The bright areas on Mars appear to be at a lower temperature than the dark areas, and the temperature of the south polar cap ranges from -100° C. to -15° C., suggesting ice or snow as a possible cause. Some results are also given for the moon, Venus, Jupiter, Saturn, and Uranus. There seems to be no evidence of internal heat in any of the giant outer planets.

Research Items.

Royal Costume and Race in Ancient Egypt.—In *Ancient Egypt* for June, Miss M. A. Murray examines details of the dress of kings of the early dynasties of Egypt and suggests that certain inferences bearing upon cultural origins may be drawn from the results. On the slate palette of Narmer, the king is shown wearing a belt at the back of which is an animal's tail with long rippled hair—a bull's tail. Sir Flinders Petrie has pointed out that the bull's tail was a promoter of fertility. While the king was typified by two creatures, the falcon and the bull, he was more truly falcon. The falcon Horus conquered the country, but his religion was exotic, belonging to the king only. Egypt was and remained a cattle-worshipping country, and therefore the king had to become a bull. This was accomplished by a ceremony in which the outward and visible symbol, the bull's tail, was attached to his person. The Sed festival was connected with the tail of the king; but Prof. Newberry has suggested that this was a marriage ceremony. In Crete, when bull-worship was introduced, the queen, through whom, as in Egypt, descent was transmitted, was disguised as a cow for the celebration of the Sacred Marriage with the bull. In Egypt the Sed festival may represent the making of the foreign falcon into a bull at the time of the marriage to the queen of the bull-worshippers. The royal head-dress may suggest the provenance of these rulers The crowns appear to be turbans. The Red Crown of Lower Egypt is of a form now worn by the Marwaris of Rajputana. This head-dress in Egypt is worn only by the king and by foreigners. It is indigenous in Asia and especially Persia and northern India. The connexion between early Egypt and Elam is established and, in view of the connexion between India and Sumeria, it is possible that there may have been a common centre influencing Egypt.

The Last Forest Phase in Britain.—Mr. O. G. S. Crawford in *Man* for July discusses the implication of certain conclusions of geologists and meteorologists which bear directly upon archæology. From 3000 B.C. until 1800 B.C. the climate of Britain was drier than at present. Further, the land stood 60 feet higher than at present, with forest and fen in the area now the North Sea, and forests on the southern and western coasts. This last forest phase may be equated roughly with the British neolithic period, which has two stages, an earlier with no pottery and no agriculture, and small implements, many resembling palæolithic types, and a later, megalithic, stage, with agriculture and many surviving implement-types which show little change. There is no evidence that the people of the first stage are descended from our palæolithic population, and it is possible that they spread across the fen, which is now the North Sea, from Denmark. On the other hand, the megalith builders were a distinct people. The distribution of megaliths arranged in order of development suggests an eastward migration. This is supported by the legendary connexion of Stonehenge and Ireland and the Irish character of Middle Bronze Age pottery in Pembrokeshire. In eastern Wales and in England south-east of the Severn and south of the Humber, later types of megaliths preponderate over the earlier. This suggests, therefore, that an eastward migration occurred at the close of the dry period when the west was becoming appreciably more moist and difficult for agriculture. Were climatic conditions also responsible for the departure of the megalith builders from their homes in France and Spain?

Winter Climate and the Incidence of Pulmonary Tuberculosis.—The view has been expressed that the poor ventilation of houses consequent upon a rigorous winter climate may be an important factor in the causation of pulmonary tuberculosis. Thus, the higher incidence of phthisis in Sweden compared with England and the high incidence of the disease among the Esquimaux have been attributed to the influence of this factor. J. R. Miner has subjected this hypothesis to examination (*Amer. Review of Tuberculosis*, vol. 13, No. 4, 1926, p. 366), taking as his data the mortality statistics for the white population of the United States Registration Area, which covers a wide range of climate, yet refers to a population fairly homogeneous racially, and highly homogeneous in customs and social environment. The death-rates from tuberculosis of the lungs and acute miliary tuberculosis in the various registration States have been grouped according to January mean temperatures. After the application of various corrections, the result emerges that the white death-rate from pulmonary tuberculosis in the United States is higher in those States with a mean January temperature between 30° F. and 40° F. than in colder or warmer regions. No evidence is found to support the view that severe winter climates, or poor ventilation resulting therefrom, are important factors in the etiology of pulmonary tuberculosis.

Scottish Sea Trout.—Mr. G. H. Nall gives us interesting information on the sea trout of the River Ewe and Loch Maree (Fishery Board for Scotland. Salmon Fisheries, 1926, No. 1 (Edinburgh and London: H.M.S.O., 1926.) 4*s.* 6*d.* net), as a result of measurements and scale readings of a very representative number of fish, 1512 in all. Included among these are examples representing the hatches of 12 consecutive years, 1912–1923, fish ranging in size from 3 oz. to 10 lb. and in age from 2½ years to 13 years. Nearly three-quarters of these undertook their smolt migration after three years' river life, thus tending to confirm the theory that length of parr life depends on food supply, northern streams having comparatively low food resources, which leads to long parr life. The record of two fish remaining as parr for six years is interesting, being the first such case recorded for the British Isles. Of the Ewe trout, the scales of which showed spawning marks, 48·8 per cent. spawned for the first time in the second winter after smolt migration and 40·6 per cent. in the third winter. The main runs begin in mid-July and last until autumn. The great majority of fish spawned in successive years. The oldest fish in the collection had spawned eight times and was thirteen years old. In condition, as measured by the standard *K*, these sea trout were good. Sea trout have previously been studied in the River Forth by Menzies and the River and Loch Hope by Nall, who, in this paper, makes interesting comparisons between the fish from the various regions.

Studies in De-differentiation.—Prof. J. S. Huxley has described reduction phenomena in *Clavellina lepadiformis* (*Pubblicazioni della Stazione Zoologica di Napoli*, vol. 7, 1926), in which he confirms Driesch's discovery that whole individuals of this species will undergo de-differentiation or reduction as readily as pieces of the animal. Examination of some of the morphological changes occurring during the process shows that the pharynx and atrium are reduced much more rapidly than any other organs. The nervous system passes through a stage in which the anterior portion is hollow. The heart remains differentiated and active for a long period, but is finally suddenly reduced to a mass of de-differentiated cells. The gonads may be represented at a late stage by a single hollow vesicle. The digestive loop usually remains very little changed until late stages. The atrium may be converted into two separate vesicles by the breaking and subsequent resorption of its dorsal cloacal portion. The epicard is relatively resistant, and in advanced stages of reduction shows horn-like processes which may be attached to the peribranchial cavities. Some organs may disappear, apparently by cell-migration. The view is put forward that the changes cannot be supposed to represent reversions to stages passed through in embryogenesis. The resemblance to such stages is accidental, and is brought about chiefly by mechanical means.

SPERMATOGENESIS IN SPIDERS.—In a paper on the spermatogenesis of the spider, *Tegenaria domestica* (*Bull. Internat. de l'Acad. Polonaise des Sci. et Lettres*, Série B. No. 3-4), Mme Julia Sokolska shows that the number of chromosomes in the male is 18 pairs, together with an unpaired heterochromosome or X-chromosome composed of three equal bodies, which are separate during meiosis, but all usually pass to the same pole in the reduction division The two resulting types of sperm can be identified by the visible presence or absence of these three bodies from the spermatids. Abnormal cases were found, however, in which two of the three elements of the X-chromosome separate from the third in the heterotypic division, as well as cases in which four such bodies were present. These clear-cut results contrast in some respects with those of Dr. E. Warren (*Annals of the Natal Museum*, vol. 5, part 3) on the habits, oogenesis, and early development of a South African spider, *Palystes natalius*. After describing the spinning of the egg-sac and the 'psychological behaviour,' a detailed description of the egg development is given. The author falls readily into the old snare of amitosis, and his observations on this head are unconvincing. In the maturation of the egg two polar bodies are formed, but the second is retained within the egg. The author admits that these divisions are mitotic, but in the five cases observed the chromosomes 'averaged' 16 for the first polar body and 9 each for the second polar body and the egg nucleus. Chromosome counts are now, however, of little value unless they are exact. It is to be hoped that an effort will be made to get more precise results.

STUDIES ON A PARASITE OF THE HESSIAN FLY.—C. C. Hill contributes (*Journ. Agr. Res.*, Washington, vol. 32, No. 3, 1926) an account of *Platygaster hiemalis*, one of the most widespread and effective parasites of the Hessian fly in the United States. In the eastern wheat-growing regions, this Hymenopterous parasite kills annually from 16 to 40 per cent. of the autumn generation of the fly. The eggs are deposited in the egg of the fly and develop polyembryonically (by twinning) or monembryonically; the resulting yield in adults is about a 50 per cent. increase over the number of eggs deposited. The larva consumes the contents of the host, but the latter, before succumbing, usually succeeds in forming a puparium. Within this the cocoons of the parasite are formed, and an average of six adult parasites emerge from each host. The adult is about 1 mm. long, very active, flies readily, and is positively phototropic. The female is able to reproduce parthenogenetically, and impregnated females usually deposit both fertilised and unfertilised eggs at each oviposition. Approximately 66 per cent. of the adults are females. The female lays from one to eight eggs at a time, and shows marked ability to recognise eggs of the fly in which she has already oviposited. In one instance a female, crawling over a leaf which bore 42 eggs of the fly, oviposited in 24 of these in fairly regular order on the first tour; on the return she brushed all the eggs with her antennæ and attacked two that had not previously been pierced, but only one of those previously visited was pierced a second time. Females have been observed to examine with their antennæ the area on a wheat leaf from which the egg of the Hessian fly had been removed, and even to attempt to oviposit thereon. It would appear that chemotropism plays an important part in the location of the host-egg. *Platygaster hiemalis* passes the winter and early spring in the embryonic stage; by the end of August the adults are ready to emerge from their cocoons during the oviposition period of the Hessian fly in the fall of the year.

WEST INDIA HURRICANES.—An important publication upon the hurricanes of the West Indies has been issued by Father Sarasola, Director of the newly organised National Observatory of Colombia ("Los Huracanes de las Antillas." Notas Geofisicas y Meteorologicas Num. II., Bogota, 1925). In addition to marshalling a large number of facts about these destructive visitations, he discusses methods of forecasting and reviews current theories regarding the origin of tropical cyclones. It is pointed out that whereas the cyclones of temperate latitudes are most severe in winter when 'polar front' discontinuities of temperature and humidity are sharpest, tropical cyclones are most active in the warmest season. The view is favoured that tropical cyclones are fundamentally connected with the conflict of air currents, and in this connexion it seems a pity that the author appears to overlook what is really very convincing evidence that this view is correct. Tropical cyclones occur mainly in late summer and autumn towards the margin of the tropics on the western sides of the oceans in both hemispheres, precisely when and where one Trade system having crossed the equator encounters currents from the opposing Trade system, the one exception to the rule being the South Atlantic, which is hurricane-free in the absence of a seasonal migration of the North-east Trade across the equator. This is the significant geographical background of tropical cyclones, and should be observed by all writers who investigate the structure of these storms in detail. Whether there is anything corresponding to the 'discontinuities' of temperate latitude cyclones on 'polar front' principles is not yet clear, but it is likely that there are considerable differences of humidity, if not of temperature, between the opposing currents feeding a tropical hurricane Father Sarasola's work contains much local detail in relation to the storms of the Caribbean Sea; the wider influences bearing on the subject are not neglected, a good deal of attention being given to solar activity in relation to the weather.

WIND AND SPEED OF WAVES.—In a paper entitled "Observations of Wind, Wave and Swell on the North Atlantic Ocean" in the *Quarterly Journal of the Royal Meteorological Society*, vol. 51, No. 218, Dr. Vaughan Cornish records his observations on the relationship between velocity of wind and waves. He found a close agreement between the wind and the velocity of the waves under the conditions of the final stage reached after a prolonged wind. The discrepancies between the two figures which were apparent in some observations were almost entirely due to swell. A crossing swell effects considerable reduction in the speed of the waves, a concurrent swell little reduction in speed and a diminution in height of the waves. When two sets of swell cross the waves, their effects in reduction of wave speed are additive. This would explain the rapid rise of waves with wind on large lakes and inland seas when there is little swell to hamper the wave-making action of the winds. Dr. Cornish gives his figures in full and describes the methods he devised to measure the velocity of the wind.

SUBSIDENCE OF KILAUEA VOLCANO.—A rough estimate has been made of the total volume of subsidence of Kilauea during the years 1921–24 (*Volcano Letter*, No. 74, May 25, 1926). At Halemaumau the amount of subsidence in this interval was 13 or 14 feet, and at a distance of twenty miles to the north-east it was little more than an inch. Assuming that the subsidence was symmetrical about Halemaumau as a centre, the total volume of subsidence would be about one-seventh of a cubic mile.

COLOURS DUE TO IRON IN MINERALS AND ROCKS.—In the *American Journal of Science* for July 1926 Mr. G. R. MacCarthy presents the results of a comprehensive study of the colours produced in rocks by various types of iron compounds. It is shown that the natural yellows, browns and reds are due to the presence of ferric compounds. Hydrous ferro-ferric minerals are blue in colour, and are responsible for the blues frequently exhibited by clays and shales. The suggestion that these tints are produced by disseminated organic matter is refuted. Greens are considered to be the result of mixtures of iron-blues and iron-yellows, for no evidence of the existence of any single green compound has been found. The chocolate-red of hæmatite sometimes approaches purple, but the true purple colours of shales and slates are ascribed to mixtures of iron-reds and iron-blues Anhydrous ferro-ferric compounds produce only greys and blacks, like the carbonaceous matter that is generally present in black argillaceous rocks. The rôle of iron as an inorganic colouring agent has thus been rationally extended over the whole range of colours found in sediments.

CONTRASTED TYPES OF MUD-CRACKS.—Continuing his valuable work on the structural features of sediments, Mr. E. M. Kindle has published and described a most instructive suite of photographs of various types of mud-cracks (*Trans. Roy. Soc. Canada*, 20, sec. 4, 1926, p. 71). A series from the playas of north-western Nevada shows polygonal shrinkage cracks (*a*) with flat tops, (*b*) with curled-up edges, (*c*) with rounded margins, and (*d*) with a reticulation of small polygons within the larger ones. The curling-up tendency is associated with the presence of abundant colloidal matter in the clay, while the downward rounding of other mud-cracks indicates a notable percentage of sodium chloride in the material undergoing desiccation. Another series of desert mud-cracks shows a number of radiating rosette-like fissures, due probably to convection currents in the oozy mud during the initial stages of desiccation. In another type, from Jervis Island in the Pacific and from Southern Australia, the ordinary polygonal cracks are not open fissures, but are outlined by narrow ridges composed largely of alkali sulphates and other salts. It is thus clear that the muds of saline lakes, fresh-water lakes and the sea-shore, develop shrinkage cracks of sharply contrasted types, and the recognition of similar features in older sediments may therefore provide valuable evidence bearing on the origin of the latter, and particularly of continental facies of sediments.

RANGE OF α-RAYS OF THORIUM C + C′.—Experiments with a modified form of the Wilson cloud apparatus, enabling a large number of photographs to be taken one after another under conditions which made it possible to measure the range of the α-rays accurately, are described by Fräulein L. Meitner and Herr Kurt Freitag in the *Zeitschrift fur Physik* of June 16. Altogether three thousand photographs were taken. Thorium C breaks up partly into thorium C′ with emission of a β-particle and partly into *C″* with emission of an α-particle, the mean range of the latter being 4·8 cm. Thorium C′ sends out an α-particle with mean range 8·6 cm. and gives thorium lead. The ratio between the numbers of these two classes of α-particles was determined by counting to be 34·3 : 65·7, which agrees well with the value obtained by Marsden and Barratt using the scintillation method. The ranges in different gases were determined and the mean relative braking power of these gases calculated. The variations of the range on either side of the mean were determined in the different gases and compared with the values deduced by Bohr from the classical theory; good agreement was found. The existence of a group of α-rays with 11·5 cm. range in air discovered by Rutherford and Wood was confirmed and a new group with 9·5 cm. range was found. There were on the average 200 of the 11 5 cm. range particles and 70 of the 9·5 cm. range to 10^4 ordinary thorium C′ α-particles. The existence of α-particles of greater range than 12 cm, announced by Bates and Rogers has not been confirmed; particles with longer range than this are clearly shown to be hydrogen rays.

DRAWING INSTRUMENTS.—Among other sets of instruments manufactured by Messrs. Harling, 117 Moorgate, London, E.C.2, at their new factory in Upper Clapton is a wallet case, B.E. 114, which we have had the opportunity of testing. This case contains a 4½-inch divider with hair-spring adjustment and movable needles; 3-inch bow pen compass and a bow pencil compass of the same size, both instruments having double knee joints, while the ink point of the pen is made of stainless steel. All these instruments are made of hand-drawn electrum; the head joints work on steel cones and are fitted with a device for maintaining the handle upright. The case also includes a set of three spring bows, the steelwork of which is made of stainless steel; these instruments have central screw adjustments, and are both light and rigid in use. There are also a 6-inch drawing-pen, made of stainless steel with a lift-up nib permitting of cleaning and instantaneous resetting to the same width of line, and another 6-inch drawing-pen, also of stainless steel, but without the lift-up arrangement. A pricker is included. All the above described instruments are thoroughly well made; the design is good and the instruments are suitable in a high degree to the work of an engineer's drawing office. The last instrument in the case is a portable beam compass with divider, pen, and pencil points. The duralumin beam of this instrument is made in three lengths with push-in joints, and makes up to 29½ inches. The travelling heads are driven by means of milled rollers. The section of the beam is wedge-shaped, and each head has a spring which presses the head into the wedge and also presses the roller against the top side of the beam. The design is good, the heads move easily, and are rigid whilst circles are being drawn. Unfortunately, sufficient care has not been taken in manufacture to get all three bars of exactly the same cross-sectional dimensions; two of the bars in the set submitted for examination are very good in this respect, and the heads pass easily over the joint of these bars. The other joint is bad owing to the defect mentioned, and the head requires assistance to pass the joint.

Kammerer's Alytes.

(1) By Dr. G. K. Noble, American Museum of Natural History, New York, N.Y.

There is in existence, resulting from the much-discussed experiments of Kammerer (1919, *Archiv. f. Entwicklungsmechanik,* 45, pp. 323-370, pls. x.-xi.), only a single specimen said to show the modifications described by him. This specimen is preserved in the Biologischen Versuchsanstalt, Vienna, and is the one which Kammerer recently brought with him to England and used to support his contention that he had produced heritable modifications in the midwife toad (Kammerer, 1923, Nature, 112, pp. 237-238).

Although this specimen had presumably been carefully studied in England—for Kammerer (*loc. cit.* p 237) claims: "Dozens of scientific men have seen the pads and are now convinced"—a preliminary examination of it by me in Vienna revealed such unexpected features that Dr. H. Przibram and I have found it advisable independently to make a thorough macroscopic, histological and chemical examination of the critical features of the specimen.

It will be remembered that Kammerer claimed to have produced heritable nuptial pads in a batrachian which normally lacks them. I found the specimen to have its left manus blackened both on its dorsal and ventral surfaces, the extent of the darkened area being fairly well shown in a photograph of the specimen made in Cambridge (Kammerer, 1924, "The Inheritance of Acquired Characteristics," New York, Fig. 9). A slight blackening was also to be seen on part of the right manus. Neither manus had the appearance of possessing nuptial pads, but both seemed to have been injected with a black substance, for the blackening included some of the capillaries.

An examination of the blackened areas under moderate magnification with a binocular microscope revealed that the colouring was not epidermal, that is, in epidermal spines, but in the derm. No trace of spines, points, brushes or other asperities could be seen on the integument of the prepollex, or surrounding region of either hand. The left wrist of the specimen had been lacerated. A slight pushing aside of the muscles revealed that the ventral wrist muscles and part of the palmar muscles were surrounded by a black colouring matter on all sides. This substance was in such abundance that it readily washed out in the dissecting dish water which filled the spaces between the exposed muscles. It was clear that these blackened areas were not nuptial pads; that is, patches of pigmented asperities, for the epidermis was not thrown into spines. Further, the colouring matter was not epidermal, but was distributed in great masses under the skin, between the muscles, and even in many of the capillaries on both dorsal and ventral surfaces of the left manus.

Dr. Przibram and I have independently made sections of the integument from the prepollex region of the left manus of the specimen under discussion. This is the region which in the water-breeding Salientia most frequently bears asperities. It is at the base of the first finger. Further, it was the region of maximum blackening in Kammerer's specimen. Although the specimen was poorly fixed, the epidermis in this region was intact, except along one edge where it was beginning to be shed. No suggestion of asperities are visible in my sections. The surface of the epidermis is perfectly smooth. The black colouring matter is seen to lie in great masses in the derm and among the muscle fibres, while some of the capillaries are choked with the same substance. It is therefore clear that no modifications occur in the prepollex region of Kammerer's specimen, other than those produced by poor fixation and the black substance. Dr. Przibram has confirmed from his own sections my observations that no suggestion of asperities are present in this specimen.

The black substance, so irregularly distributed through the muscles, has the appearance of India ink, for under the highest powers the granules are black, not brownish black (or lighter) as most amphibian melanins. However, a critical test as to the nature of this substance is necessarily a chemical one. Oppenheimer (1909, "Handbuch der Biochemie des Menschen und der Tiere," Jena), in describing the properties of melanin, states that it may be changed into a lighter-coloured substance by treating it with concentrated nitric acid. Further, this product is soluble in alkalis. I have carried out a series of experiments with different kinds of amphibian integuments, some injected with India ink, and others merely fixed in alcohol or formol, and have found the test to be critical in distinguishing melanin from India ink. With Dr. Przibram's permission I removed a piece of integument from the palm of Kammerer's specimen at the base of the second finger. A large mass of black substance adhered to the dermal portions of the skin. The piece was cut into three parts and each treated for different periods, first in concentrated nitric acid, and after washing, in concentrated ammonium hydroxide. In spite of this variety of treatment, known to be critical in all cases, the black colouring matter remained intact, while the few small and widely separated melanophores readily observable under the binocular, disappeared. In this resistance to the treatment the colouring matter resembled the India ink masses in our controls. Dr. Przibram has carried these experiments further, and writes: "The black substance has also been subjected to the treatment with antiformin and withstood this reagent, which dissolves all melanins known to now" We may conclude that the substance which gives the dark appearance to the left manus of Kammerer's specimen is not melanin.

It has therefore been established beyond the shadow of a doubt that the only one of Kammerer's modified specimens of Alytes now in existence lacks all trace of nuptial pads. The question remains: Might not this specimen at one time have possessed them? There are available three kinds of evidence bearing on this point: (1) sections said to have been made from the pad of the modified specimens; (2) photographs showing more or less clearly some indication of the pads; and (3) testimony of observers who believe they saw asperities in the modified specimen.

Kammerer (1919, *op. cit.*, Pls. x. and xi.) has produced figures of histological preparations said to be made from the nuptial pad region of his specimens, or to be more exact, (translation) "through the skin of the first (inner) finger." Similar preparations were sent by Dr. Kammerer some time ago to Dr. E. Uhlenhuth, who has kindly loaned them for examination. Further, other microscopical preparations similar to those described by Kammerer are preserved in the Biologischen Versuchsanstalt in Vienna, as a material result of Dr. Kammerer's studies. Both sets of preparations agree fully with the description given by Kammerer. The controls figured by Kammerer, as well as those in Vienna and New York, exhibit a smooth epidermis, while that labelled as coming from the modified individual is thrown into numerous cornified and pigmented spines. It has been claimed that these spines are distinctive in form, and hence the pads must have been produced experimentally in Alytes.

Now, it is a well-known fact that the nuptial spines (and also the pad glands) vary enormously in size within a species. Champy (1924, "Les Caractères Sexuels," Paris, Fig. 104) has well shown how these may vary within the species *Rana temporaria*. My sections of the nuptial pads of *Bombinator igneus* differ enormously from those figured by Lataste of the same species (Kammerer, 1924, *op. cit.*, Fig. 11, sketch 8), for my animal was a terrarium animal in not very good health before it was killed. However, I have attempted in a series of forms to discover breeding pads which agreed in histological detail with the sections sent Dr. Uhlenhuth. My sections of *Bombinator maxima* agree most closely with Kammerer's sections. There is no difference in the height of the spines, their distance from each other, their form, the character of the cores within the spines, etc., between some parts of the pad in this species and parts of the sections sent Dr. Uhlenhuth. But the spines differ in proximity and height in different parts of the pads, which only goes to show that the exact form of these spines is of no value in distinguishing many species of frogs. Kammerer's sections fall within the range of variability shown by the genus Bombinator (more properly called Bombina).

The second group of evidence is to be derived from the photographs. I fail to find anything distinctive in the photograph of the specimen made in Vienna (Kammerer, 1919, *op. cit.*, Pl. x.) or that taken in Cambridge (Kammerer, 1924, *op. cit.*, Fig. 9). Dr. Przibram believes that still a third photograph, one made in Vienna (see the following note) proves conclusively that asperities were present. This photograph is not available to me, but I do not understand how asperities so small as those in Kammerer's sections would show up as Dr. Przibram points out. What proof have we that these "two or three spines" are not foreign bodies; and why do they not show up in the rather good photograph made in Cambridge (Kammerer, 1924, *op. cit.*, Fig. 9)?

In marshalling the third group of evidence, Dr. Przibram has brought together some distinguished names. With all deference to these gentlemen, I would say that the epidermis of Kammerer's specimen which is underlaid by the black substance appears, in part, slightly irregular. This appearance is probably due to the unequal distribution of the black substance below. At least, it required on my part the most careful manipulation of the lighting to prove that these irregularities were not in the epidermis. Further, I fail to see how any one qualified to pronounce on the presence or absence of nuptial pads could have examined the black discolorations on the forelimbs of Kammerer's specimen without noticing their artificial character.

A final objection which might be raised to the conclusions reached above is that some evidence has been recently presented (Kändler, 1925, *Jen. Zeitschr. f. Naturw.*, 60, pp. 175-240, Pls. 9-10) to show that the male Alytes may sometimes produce an incipient breeding pad. It is not my purpose to discuss whether the slight crenulations in the surface of the epidermis can be interpreted as an incipient pad. The breeding asperities Kammerer claims to have produced are true nuptial spines similar to those of Bombinator and cannot be compared with the epidermal irregularities of the prepollex or surrounding regions in an occasional male.

The only specimen resulting from the experiments of Kammerer has been the source of much heated argument in NATURE. By describing accurately, for the first time, the modifications in this specimen, we have proved conclusively that no pads are present. Whether or not the specimen ever possessed them is a matter for conjecture.

(2) By Dr. HANS PRZIBRAM, Biologischen Versuchsanstalt, Vienna.

It is clear from the foregoing account that the only one of Kammerer's experimentally modified Alytes still preserved cannot in its present state be regarded as a valid proof of the nuptial pads artificially produced in this species. We must endeavour to decide if the state the specimen is in now agrees with the state at the time of its preservation and before. The specimen is poorly fixed and preserved. Moreover, the epidermis is at several places ready to be shed or even shedding. It is a known fact, as Prof. Franz Werner, of Vienna, asserts, that during repeated handling and shaking the nuptial asperities get lost easily. The specimen has made the voyage to England and back again, and it does not look the better for it. Fortunately, there are photographic plates in existence showing the state of the specimen before it left Vienna for Cambridge and during its stay in England. One of these photographs was taken in the presence of Dr. J. H. Quastel in the atelier of Reiffenstein (Vienna), and the negative travelled with Dr. Quastel to England and has been in the possession of Mr. M. Perkins (Trinity College, Cambridge) since April 1923. A reprint of it is given in Kammerer's "Neuvererbung," Stuttgart-Heilbronn, W. Seifert-Verlag, 1925 (Abb. 9, facing p. 20).

Dr. Quastel asserts in a letter to me, dated Trinity College, Cambridge, March 27, 1926, "with confidence that in the large negative of Alytes (taken by Reiffenstein) there are no traces of any manipulation or retouching of the actual image of the Alytes." Since he is not an expert in photographic matters, he has had the negative examined by an expert photographer, Mr. W. Farren, who gives the following statement: "76 Regent Street, Cambridge, March 26, 1926.—I have examined carefully the negative of Alytes, and while it appears to have been intensified and a string across the background retouched, there are no signs of any retouching or interference with the image of the specimen itself, or of that part of the background with which it is in contact." Mr. Perkins writes (March 20, 1926): "The only retouching which the plate has ever shown is a certain obliteration of the thread which supports the specimen, and the fact that retouching has been applied to this, in order to make it uniform with the background, enables one to state positively (from comparison) that neither the image of the specimen itself nor any point of its outline has ever been interfered with by retouching or any other process, more particularly does this apply to the external (concave) margin of the palm, where two or three spines are obviously and clearly visible. In April 1923 I had many opportunities of examining the specimen, and was always able to see the spines, whether by means of a lens or a dissecting microscope, exactly as in the photograph in question." Dr. Quastel also testifies that the copy represents the state of the specimen when it was photographed in Vienna. There seems, therefore, to be no doubt of the genuineness of the negative and photograph. Moreover, many other zoologists had examined the specimen during its stay in England, some of whom Prof. MacBride gives a list of in a recent letter to me (dated February 26, 1926, Imperial College of Science, South Kensington, London): E. Boulenger, H. M. Vevers, Cannon, F. S. Harmer, J. Stanley Gardiner, Borradaile, and F. Potts.

Further proofs that the Alytes in question has borne nuptial callosities in the epidermis may be found in the microscope sections of the skin that had been removed from the same specimen during the height of the breeding season from the other (right) hand. The comparison both of Kammerer's pictures in his original paper (*A. f. Entwickl. mech.*, 45, 323, 1919, Pls. x., xi.) or in his "Inheritance of Acquired Characteristics," Boni and Liveright, New York, 1924 (Figs. 10-11, facing p. 62) and of the section photographed in America with nuptial pads of other Anura, show clearly that the callosities differ from all other known pads, resembling most those of other Discoglossidæ, as Bombinator, but still *Discoglossus pictus* (after Lataste; see Kammerer, 1924, Fig. 11 N. 3). This had already been pointed out by Mr. Perkins (NATURE, August 18, 1923, p. 238). Lastly, it may be mentioned that quite recently the possibility of Alytes developing nuptial pads has been shown in a specimen found in Nature and examined by R. Kändler (*Jenaische Z.*, 60, 175, 1924, Pl. 10, Fig. 12). Although it is only just a beginning of callosities in one male taken in Westfalen (Germany), when compared with the usual smooth surface of the Alytes hand it becomes significant. Kändler found the callosities in this one male on the palmar and dorsal side of the thumb, on the inner side of the third and fourth finger. The callosities resemble those which Kammerer figured for the F_2 generation of water-bred Alytes (*l.c.* Pl. xi Fig. 4). There were no typical nuptial pad-glands. Kändler also questions if those described by Kammerer were of this character, as Kandler's females showed the same type of gland with granular content too. But no females showed callosities. Kandler has also figured the nuptial pad of other Anura, *i e. Bombinator igneus* (Pl. 10, Figs. 8A, 9). This figure is in accordance with that of Lataste.

Whilst it is possible to come to a probable solution with respect to the spiculæ, we have not been able to elucidate the origin of the black substance It is clear that it has nothing to do with the black pigment often seen in nuptial pads of Anura other than Alytes, or with the patches described and in the progeny of non-egg-carrying Alytes males by Kammerer, 1909 The only possibility we can think of is that some one has tried to preserve the aspect of such black nuptial pads in fear of their vanishing by the destruction of the melanin through exposure to the sun in the museum case, by injecting the specimen with India ink. Kammerer himself was greatly astonished at the result of the chemical tests, and it ought to be stated that he had been asked and had given his consent to the chemical investigations. He would suggest that somebody had made such injections to get him into difficulties were it not that he remembers the black substance to have been in the same place and amount even in the living animal (letter to Przibram, February 18, 1926). So the case remains obscure.

We may conclude as a result of these observations .

(1) The only one of Kammerer's specimens of Alytes still preserved is not valid as a proof of the nuptial pads, at least not in its present state of preservation.

(2) No asperities are to be seen now, but by photographs taken before the specimen was sent to England it must be inferred that the spiculæ have been lost through the shaking of the voyage and repeated handling.

(3) Photomicrographs of the sections said to have been prepared from the skin of the same specimen some time before its preservation in the height of the breeding season show in several points different characters from nuptial pads of other Anura, even of Bombinator, coinciding more closely with those of Discoglossus (next relative to Alytes), and the picture of a rudimentary nuptial pad found on a male Alytes in Nature by Kändler (1924).

(4) The black substance in the whole specimen has nothing to do with melanin and is not restricted to a nuptial pad region.

(5) With this conflicting evidence it is greatly to be desired that the experiments of Kammerer on Alytes may be taken up again by some one of equal skill in rearing Anura.

The Progress of Geological Survey in Great Britain.

THE area described in the first[1] of the Memoirs of the Geological Survey of Great Britain referred to below lies in Ross-shire and Sutherland The north-western corner is occupied by Lewisian, Torridonian and Cambrian rocks, all of which have been involved in the great Caledonian thrusts of the N W. Highlands Of special interest are the alkaline igneous rocks of Loch Ailsh. They form a composite laccolith of post-Cambrian and pre-thrusting age, made up of types ranging from perthosite (a new type composed principally of perthite) to pyroxenite, and resembling in many ways the well-known Oslo suite of rocks made classic by Brögger. Convincing evidence is adduced to show that the alkaline character is original, and quite independent of the intimate association of the intrusion with the Cambrian dolomites Another feature of petrological importance is the description of the newer igneous rocks, which here present clear evidence of permeation and hybridisation.

The area dealt with in the second memoir[2] in our list, Golspie, lies to the east of the preceding, and includes the coast of Sutherland from Dornoch to Helmsdale. The earlier chapters are devoted to the physical features, and to the schists and gneisses belonging to the Moine series and the older and newer igneous rocks associated with them. The marginal complex of injected and other metamorphic rocks around the Rogart granite is fully described, and hybrids like those alluded to above also occur. The Old Red Sandstone covers considerable areas in the sheet, and along a narrow coastal strip Mesozoic rocks are present, ranging from the trias to the Kimeridgian. The final chapter gives an account of glacial phenomena, peat deposits, and raised beaches.

Iona and Staffa are visited every summer by an increasingly large number of tourists, and those who are interested in geology will appreciate the publication of a Memoir referring to this region.[3] Those who are not will become interested despite themselves, for the islands abound in geological features which are part of their attraction. The famous Ardtun Leaf Beds and Macculloch's Tree are fully described; and the columnar basalts of Fingal's Cave and other parts of Staffa are discussed on the lines followed in the recent Memoirs on the Isle of Mull.

The account of the geology of the extreme north of England given in the Memoir on Berwick and the neighbouring country[4] is welcome as a sign that the re-survey of Northumberland is now well under way. The chief points of interest are the descriptions of the Scremerston coalfield and the very striking coast sections to the north of the Tweed. Memoirs on the sheets to the south are due for early publication, and should be of importance in so far that they will contain references to the northern boundary of the Whin Sill. It is in itself significant that this Memoir, the first of the promised series, contains no mention of any igneous rocks.

---

[1] The Geology of Strath Oykell and Lower Loch Shin. (Explanation of Sheet 102 of the Geological Map of Scotland.) By Dr. H. H. Read, J. Phemister and G Ross, with contributions by C. H. Dinham and M. Macgregor. Pp. vi+220+2 plates. 6s. net

[2] The Geology of the Country around Golspie, Sutherlandshire. (Explanation of Sheet 103 of the Geological Map of Scotland), including a description of the Mesozoic Rocks of East Sutherland and Ross. By Dr. G W. Lee, Dr. H. H. Read, G. Ross and J Phemister. Pp. vi+143+1 plate. 3s. 6d. net.

[3] The Geology of Staffa, Iona, and Western Mull. (A Description of Sheet 43 of the Geological Map.) By E. B Bailey and E M. Anderson, with contributions by G. A. Burnett, J. E. Richey, Dr. G. W. Lee, W. B. Wright and G V. Wilson, and Petrological Notes by Dr. H. H. Thomas. Pp. iv+107+1 plate. 3s. net.

[4] The Geology of Berwick-on-Tweed, Norham and Scremerston. (Explanation of New Series One-inch Sheets 1 and 2.) By A. Fowler. Pp. ix+58+2 plates. 1s. 6d. net.

The greater part of the Pottery coalfield of North Staffordshire is included in the sheet described in the Memoir on Stoke-upon-Trent.[3] An account of the coal measures with their important coal seams and iron ores naturally takes first place. There is also a valuable chapter on faults and folds; and as a feature appearing for the first time in this edition, descriptions of the post-Triasic Bullerton dyke and of the other intrusions of the area are given. It is interesting to notice that Dr. Scott, who has studied the Tertiary and Carboniferous alkaline rocks of Scotland, directs attention to the petrological affinities of the former with the intrusive rocks of North Staffordshire. He thinks that the Rowley Regis and Clee Hill rocks are likely to be also of Tertiary age.

Passing now to Epping Forest and the eastern suburbs of London,[4] we find only Eocene, Pleistocene and later deposits. The Chalk, however, underlies the whole area, and the question of deep-seated water supplies is discussed, and illustrated by a contour map of the sub-Tertiary Chalk surface. On the south the subsoil consists mainly of the deposits made by the Thames; the central part is chiefly London clay; while to the north the region is diversified with hills capped with Bagshot sand and glacial deposits. These beds are discussed with special reference to sanitation and agriculture.

---

[3] The Geology of the Country around Stoke-upon-Trent. (Explanation of Sheet 123.) By Dr. Walcot Gibson, with contributions by C. B. Wedd and Dr. A. Scott. Third edition. Pp. vii+112. 2s. 6d. net.

[4] The Geology of the Country around Romford. (Explanation of Sheet 257.) By H. G. Dines and F. H. Edmunds. Pp. xiii+53+2 plates. 1s. 6d. net.

London and Edinburgh: H.M. Stationery Office; Southampton: Ordnance Survey Office, 1925 and 1926.

Air Pollution and its Prevention.

THE citizens of Leeds, under the auspices of the Mayor and City Council, have instituted a campaign against smoke to commemorate in a practical form the tercentenary of the granting of the statute to the city. In connexion with this effort, a pamphlet entitled "Clean Air for Leeds" has been prepared by a Committee, of which Prof. J. B. Cohen is chairman, formed on the invitation of the Lord Mayor to consider the question of "a cleaner city on the lines of smoke abatement" The pamphlet has been prepared for free distribution, and aims at informing the public as to the present condition of the smoke problem.

Leeds is to be congratulated on facing her own smoke problem in this way. A visitor, unless from another Midland city, cannot help being struck by the prevailing sooty blackness of the buildings. It is surely a merciful provision of Nature that people adjust themselves so easily to environment; had this not been so, life in some of our smoke-blackened cities must appear scarcely worth living. It is, however, this adjustment to environment which blinds our eyes more or less to the true condition of affairs. Leeds has a useful field for effort here. The pamphlet gives a short analysis of the problem of smoke abatement and the remedies available. The sources of air pollution, cause, nature, and effects of smoke are all dealt with briefly.

The general conclusions of the Departmental Committee on Smoke Abatement are quoted, and it is clear enough that this committee had no hope of a solution of the problem by the initiative of local authorities unless subject to the stimulus of Government. The new Bill now before Parliament must provide the necessary stimulus or it will not go very far towards a solution.

The Leeds pamphlet should be of great use in keeping the problem before the public mind. Reference is made on page 24 to the standard gauge used by the Advisory Committee on Atmospheric Pollution, and the Leeds committee criticises this gauge on the grounds that "the amount of solid matter is largely dependent on the situation with regard to the wind and the nature of the ground on which the gauge rests." The Committee then proceeds to recommend a method devised by Prof. Cohen many years ago, involving the exposure, in different localities, of glass plates, upon which some of the deposited matter adheres. These plates are afterwards washed in running water under a tap, and the deposit estimated by its opacity, or other means. The Advisory Committee, we believe, had this method before it when considering the most suitable means for measuring deposited impurity, and the method was discarded as not fulfilling the necessary conditions. While the exposed plate method has all the drawbacks attributed by the Leeds committee to the standard deposit gauge, it has also others of its own, which influenced the Advisory Committee in deciding to adopt the gauge method. The plates cannot be any more independent of position or wind than the gauges, while the deposit retained by the plates is not the total but some unknown and variable fraction of it, depending on the stickiness of the deposit, whether the plates are wet or dry, the weather, and so on. It may also be supposed that a plate which has received a first deposit of tarry soot will be more effective as a trap than one which starts with a less sticky layer of ash or grit. The only sound procedure is to catch in some way the whole of the deposit—hence the Advisory Committee's standardised gauge.

It is to be hoped that Leeds will not depart from this method of measuring deposit, as a great part of the value of the results lies in their being comparable with those from other cities.

The open coal fire is discussed in the pamphlet, and the conclusion is given that raw coal cannot be burnt in an open grate without the production of smoke. The use of smokeless sources of heat is recommended, of which gas, coke, and electricity are specifically mentioned and discussed. The advantages of the gas fire, its cleanliness and cheapness, are referred to, while the use of coke in domestic fires is advocated, but, as the pamphlet goes on to say, "it is not every kind of fireplace nor every kind of coke which is suitable for burning in an open fire." The relative costs of heating by coke, coal, gas, and electricity are discussed; the figures arrived at indicate coke to be much the most economical source of heat.

A section at the end deals with the law relating to the smoke nuisance, and the new Government Bill is discussed. The committee, in its final recommendations, lays great stress upon the need to educate the public in the use of smokeless methods, and, on the whole, it is to be congratulated on its public-spirited efforts to clean the air of Leeds.

University and Educational Intelligence.

CAMBRIDGE.—The trustees of the Busk Studentship in Aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, have awarded he studentship for the year 1926–7 to Mr. P. B. Walker, of Peterhouse.

LONDON.—The Rogers Prize of 100*l*. for 1926 has been awarded to Dr. Robert Coope for an essay entitled "The Value of the Various Methods of Investigating Diseases of the Pancreas."

The University Studentship in Physiology for 1926–1927, of the value of 50*l*. and tenable for one year in a physiological laboratory of the University or of a school of the University, has been awarded to Mr. E T. Conybeare, who proposes to undertake research in physiology at Guy's Hospital, particularly on the clinical side, and possibly also to extend his work on anæthesia in relation to its clinical application.

The University College Committee will shortly appoint either a full-time assistant or two part-time assistants in the Department of History and Method of Science. Candidates must be graduates either in biology, or in physics, or in astronomy. A good working knowledge of at least two foreign languages is desired.

MISS HELEN MASTERS has been appointed Head of the Domestic Science Department and the Training College for Teachers of Domestic Science of the Battersea Polytechnic, London, S.W.11, in succession to Miss Marsden, who is retiring after nearly twenty-seven years' service. Miss Masters holds the King's College Post Graduate Diploma in Household and Social Science, and has been, for the past fifteen years, on the staff of the Household and Social Science Department of King's College and has acted as examiner in domestic science for the University of London.

THE secretary of the Council on Medical Education and Hospitals of the American Medical Association has contributed to *School Life* for April an article on "Rural Schools as Centres of Medical Service and Community Life." The position of the country doctor in the United States has for many years been becoming more and more precarious owing to an increasing tendency on the part of residents in country districts to resort to town practitioners. Meanwhile the rural school consolidation movement has been proceeding apace. The consolidated and improved rural school has definitely proved its worth and gone far beyond the experimental stage. The plan, which is being rapidly adopted throughout the States, involves the transportation of pupils from all parts of a large district to and from the consolidated school in motor omnibuses, and this makes it necessary also that the roads leading to the school from all directions should be kept in fair condition. "Why," asks Dr. N. P. Colwell, the writer of the article, "should not the locations of these schools become rural community centres for other than educational purposes?" A health centre or clinic either in the school or in a separate building could serve not only the children attending the school but also other people living in the district, and the motor omnibus service could doubtless be induced to co-operate. Such a scheme, either by itself or in conjunction with a guarantee by a number of influential residents, would, it is suggested, suffice to secure for the district the services of a competent physician.

Contemporary Birthdays.

August 10, 1865. Sir Charles Frederick Close, K.B.E., F.R.S.
August 10, 1862. Prof. William Joseph Hussey.
August 11, 1852. Prof. Harold Baily Dixon, C.B.E., F.R.S.
August 12, 1860. Sir Sidney Gerald Burrard, K.C.S.I., F.R.S.
August 13, 1861. Prof. Herbert Hall Turner, F.R.S.
August 13, 1879. Dr. Philip Gosse.

Sir CHARLES CLOSE, formerly an officer in the Royal Engineers, was Director-General of the Ordnance Survey from 1911 until 1922. He is an active general secretary of the International Geographical Union.

Prof. HUSSEY, director of the Detroit Observatory of the University of Michigan, was born at Mendon, Ohio. From 1911 until 1917 he was director of the Observatorio Nacional de La Plata, Argentina. He has done excellent work in choice of sites for observatories in Southern California, Arizona, and Australia, working for the committee on observatories of the Carnegie Institution. Prof. Hussey was awarded the Lalande prize of the Paris Academy of Sciences in 1906 for double star discoveries and investigations. He is a foreign associate of the Royal Astronomical Society.

Prof. H. B. DIXON was educated at Westminster School and Christ Church, Oxford. His life's work was carried out at Manchester as occupant of the chair of chemistry in the University there, in succession to Sir Henry Roscoe. The Royal Society awarded Prof. Dixon a Royal medal in 1913, on the ground of his eminence in physical chemistry, especially in connexion with explosions in gases. He was president of the Chemical Society, 1909–11. Prof. Dixon, it may be recalled, was president of the chemical section at the last meeting of the British Association held in Oxford, namely, that in 1894. He gave an address on "An Oxford School of Chemists."

Sir SIDNEY BURRARD was Surveyor-General of India from 1910 until 1919; formerly he held office as Superintendent of the Trigonometrical Survey of India at Dehra Dun. Whilst in charge he was responsible for the success of the most extensive system of geodetic triangulation ever inaugurated. His works on the geography and geology of the Himalayas and Tibet (in conjunction with the late Sir Henry Hayden); on the effect of the Himalayas on the plumb-line in India; and on isotasy, have given him special repute as a scientific investigator.

Prof. TURNER was born at Leeds, and was educated at Clifton College, and also at Trinity College, Cambridge. Formerly chief assistant at the Royal Observatory, Greenwich, he was next appointed Savilian professor of astronomy in the University of Oxford. He has done yeoman service for the British Association, having been one of the general secretaries from 1913 until 1922. He was president of the Royal Astronomical Society, 1903–5. Prof. Turner is Hon. D.Sc. Leeds and Sydney, and a corresponding member of the Paris Academy of Sciences.

Dr. GOSSE is the grandson of that engaging personality, Philip H. Gosse, F.R.S., who died in 1888, author of works on marine zoology, and on the microscope. Educated at Haileybury and St. Bartholomew's Hospital, Dr. Gosse is assistant superintendent of the Radium Institute. He acted as naturalist to the FitzGerald expedition to the Andes (1896).

Societies and Academies.

PARIS.

Academy of Sciences, June 28.—A. **Lacroix**: The fused veins of meteorites and their analogy with the 'pseudotachylites' of distorted terrestrial regions.—Charles **Moureu**, Charles **Dufraisse**, and Paul Marshall **Dean**: A dissociable organic peroxide: rubrene peroxide. The hydrocarbon rubrene described in an earlier communication, when exposed to sunlight in benzene solution, rapidly absorbs oxygen, thereby losing both colour and fluorescence. From the solution a white crystallised product containing solvent of constitution is obtained, which dissociates on heating into solvent, rubrene and oxygen. It is pointed out that the existence and dissociation of this peroxide is of great theoretical interest.—Léon **Guillet**: The cementation of steels by silicon. The object of these researches was to obtain a film of high silicon steel on a mass of mild steel retaining the mechanical properties of the mild steel with a chemically resistant skin. In all of the experiments cited the cemented skin was too fragile.—**Neymann**: The laws of probability which tend towards the law of Gauss, remaining infinite in the neighbourhood of a point.—Jules **Drach**: The integration of the equations $r+f(s, t)=0$.—Silvio **Minetti**: The radius of convergence and the singularities of a class of analytical functions defined by Taylor's development.—R. **Gosse**: A special class of equations of the form $s=f(x, y, z, p, q)$.—G. **Alexitch**: Conjugated trigonometrical series.—André **Charrueau**: Some geometrical properties of surfaces of equilibrium relative to a liquid mass of revolution, in uniform rotation round its axis of revolution.—J. **Villey**: A simple model of electrometer of low capacity.—H. **Pelabon**: Detection (of electromagnetic waves) by metallic contacts. A symmetrical detector. A stable detector can be made from two steel balls of the same diameter (3 cm.) suspended from an insulating support by copper wires 15 cm. long. The effect appears to be independent of the nature of the interposed dielectric.—**Volmar**: The photolysis of the alcohols. The photochemical decomposition of the alcohols under the influence of the radiation of the quartz mercury vapour lamp takes place in two stages, the dehydrogenation of the alcohol giving aldehyde and ketone and the photolysis of the latter.—Henri **Belliot**: Experiments on photographic inversion.—Victor **Henri** and Sv. A. **Schou**: The ultra-violet absorption spectrum of the vapour of formaldehyde. New type of spectrum of Y-shaped molecules. The movements of rotation of an asymmetric molecule possessing three unequal moments of inertia cannot be resolved mathematically, but when two of the moments are equal an expression for the energy of the molecule can be found (Sommerfeld, Born, Reiche). The vapour of formaldehyde is composed of such molecules, and a study of the absorption spectrum shows that its structure corresponds very exactly with the formulæ for symmetric molecules having two different moments of inertia. Other substances which may be expected to show similar spectra are phosgene, thiophosgene, acetone.—**Consigny**: The influence of metallic screens on the form of the ionisation curves of the α-rays.—R. **Mellet** and M. A. **Bischoff**: Chemical reactions and volumetric titrations in Wood's light. The fluorescence of the solution is used as the indicator; possible uses of the method are given.—M. **Bourgeaud**: The electrometric study of the allotropic forms of mercuric sulphide.—P. **Job**: Some applications of the spectrographic method to the study of complexes in solution. The substances examined were a solution of iodine and potassium iodide in alcohol, potassium mercurichloride in aqueous solution, and the double bromide of cadmium and potassium. In the first of these the iodide of potassium behaved as though present in triple molecules, giving the complex $(KI)_3$.—J. **Errera**: The polarisation of a medium and its molecular structure. The electrical moments of the dihalogen derivatives of benzene.—Edmond **Vellinger**: The rotatory power of organic bodies as a function of the pH: glucosamine. A curve is given showing the rotatory power of glucosamine as a function of the pH. It resembles the curve obtained by Mlle. Liquier for asparagine. A formula is developed from theoretical considerations which corresponds closely with the experimental results.—A. **Travers** and **Houot**: The tempering of type-metal alloys. The dilatometric study of monotype and stereotype alloys shows clearly, after three months, the influence on these alloys of time elapsed after tempering. The contraction appears to be mainly due to the proportion of tin.—G. **Flusin** and H. **Giran**: The estimation of calcium carbide in calcium cyanamide. The acetylene produced by the action of water on the calcium carbide present is passed into ammoniacal silver nitrate solution, the mixed precipitate of silver acetylide and sulphide treated with hydrochloric acid, the chloride dissolved in ammonia, and the solution titrated with standard potassium cyanide.—A. **Kirrmann**: Magnesium reactions starting with 1.3 dibrompropylene. The reaction of this dibrompropylene with methyl magnesium bromide is very complex, and the following products have been isolated: ethane, erythrene, bromobutene, octadiene, and a hydrocarbon which is probably $C_{10}H_{16}$.—Paul **Baud**: The pulp of the agave as a source of industrial alcohol.—P. **Idrac**: Records of the electrical field of the atmosphere up to a height of 20,000 metres. Results of experiments made at the Trappes Aerodynamical Observatory with captive balloons. There are some irregularities, but on the average the electrical field decreases up to 9000 metres. The mean result gives a field of 10·4 volts per metre at 4000 metres, 5·6 volts at 6000 metres, and 2·3 volts at 8000 metres. At higher altitudes the values are much higher, being 30 or 40 volts per metre in the neighbourhood of the isothermal layer (10,000 to 12,000 metres).—Georges **Corroy**: The Spiroferideæ of the European Lias.—H. **Colin** and A. **de Cugnac**: The various types of the grass family according to the nature of their reserves of hydrocarbons.—S. **Metalnikow** and V. **Chorine**: Conditional reflexes in immunity.—A. **Alivisatos** and Fernand **Mercier**: The action of crystallised violet on the cardio-vascular apparatus of the dog. Crystallised violet (hexamethylpararosaniline chloride) appears to act on the heart in a manner resembling the digitalis alkaloids. It exerts a stimulating action on the pneumogastric nerve, to which is added a specific action on the myocardium, producing an augmentation of the tonus and energy of the heart.—J. J. **Thomasset**: The presence of cells in the dentine of some elasmobranchs.—Paul **Chabanaud**: The frequency, symmetry and specific constancy of external hyperostoses in various fishes of the family of Sciænoides.—P. **Portier**: The genesis of the secondary nucleus of natural pearls.—Mme. Anna **Drzewina** and Georges **Bohn**: The action of metallic silver on the sperm and larvæ of the sea urchin. A discussion of the sterilising action of silver vessels.—H. **Barthélémy**: Biometrical and experimental researches on the hibernation, maturation, and supermaturation of *Rana fusca*.—A. **Vandel**: The relations between sexual reproduction and parthenogenesis in the terrestrial Isopod *Trichoniscus* (*Spiloniscus*) *provisorius*.

CAPE TOWN.

Royal Society of South Africa, May 19.—E. L. **Gill**: An early embryo of the blue whale. The embryo was taken from a blue whale (*Balænoptera sibbaldi*) at Saldanha Bay and is at the stage reached by the human embryo at about the twenty-eighth day. Though still in the main a generalised vertebrate embryo, it shows hints of cetacean characters in the small eye, large jaw elements, short neck and reduced branchial arches, large genital papilla, and close segmentation. The fore-limb bud is large, but there is no visible trace of a hind limb. In size (about 6·5 mm.) it agrees closely with other embryos of the higher vertebrates (*e.g.* chick, rabbit, man) at the same stage of development.—C. von **Bonde** and D. B. **Swart**: The structure of the plathander (*Zenopus lævis*) (Pt. i.). The animal presents many primitive features, being related ecologically with the Dipnoi and morphologically with the Anuran and Urodelan amphibia. Notable points with regard to the external features are (*a*) the abundance and properties of the secretion of the slime glands; (*b*) the presence of definite groups of dermal sense organs; (*c*) the presence of an eye tentacle in the adult; (*d*) the cloacal lips in the female.—L **Mirvish** and L. P. **Bosman**: Note on the calcium content of blood The effect of the injection of extracts of various body tissues, including ovarian and luteal extracts, upon the calcium content of blood has been examined.

SYDNEY.

Linnean Society of New South Wales, April 28.—J. **McLuckie** and A. H. K. **Petrie**: An ecological study of the flora of Mount Wilson. (Part iii.) The vegetation of the valleys. The plant communities represented are the Ceratopetalum-Doryphora association, the *Eucalyptus goniocalyx-E. Blaxlandi* association, the *Eucalyptus piperita* consociation, and the *E. hæmastoma* var. *micrantha* consociation.—C. **Barnard**: Preliminary note on branch fall in the Coniferales. The development of foliar shoots and the associated shedding of branches can be correlated with the phylogeny of the tribes of the conifers. The presence of distinct dimorphism in the branches of conifers seems to be a primitive feature, gradually lost in higher types.—H. J. **Carter**: Revision of the Australasian species of Anilara (Buprestidæ) and Helmis (Dryopidæ), with notes, and descriptions of other Australian Coleoptera.

VIENNA.

Academy of Sciences, June 10.—R. **Weiss**, A. **Spitzer** and J. **Melzer**: On tri-phenyl-methanes, the benzol nuclei of which are bound to each other (ii.). Trimethylene - triphenylmethane - triketondicarbonacids.—O. **Wettstein**: A new race of mice in Austria, *Evotomys glareolus ruttneri*.—O. **Koller**: Two new forms of fish from the Island of Hainau, a species of Cyprinid and a subspecies.—J. **Schorn**: History and results of seismology in Northern Tyrol.—A. **Defant**: Primary and secondary, free and forced, pressure waves in the atmosphere.—A. **Schedler**: Air pressure waves and correlations over the North Atlantic Ocean.—A. **Roschkott**: Studies on oscillations of air pressure in the region of the Azores highlands.—F. M. **Exner**: Relations of air-pressure anomalies on the earth to each other.—R **Rotter**: On condensations of unsaturated compounds with diazo-methane.—F. **Knoll**: The differential geometry of the spacial vector field.

WASHINGTON, D.C.

National Academy of Sciences (Proc. vol. 12, No. 6, June).—William **Hovgaard**: Bending of a curved tube of circular cross section. A formula is developed which when applied to pipe bends gives results in good accord with experiment.—E. O. **Salant**: The heat capacity of solid aliphatic crystals (ii.).—R. J. **Havighurst**. (1) The effect of crystal size upon the intensity of X-ray reflection. With a crystal having a linear dimension greater than 10^{-4} cm., intensity is modified by 'extinction,' which may be primary (due to each little block acting as a perfect crystal) and secondary (due to shielding of the inner blocks by those near the surface). Work on powdered sodium chloride, calcium fluoride and calcite indicates that primary extinction is absent in crystals grown from solution and less than 10^{-3} cm. in thickness, so intensity measurements can be used to determine electron distributions. Single crystal measurements of the alkali halides require correction for secondary extinction. (2) The intensity of reflection of X-rays by lithium, sodium and calcium fluorides. Measurements of intensity enable the relative value to be calculated of a factor, the "atomic structure factor," which at small angles of reflection approaches the number of electrons in the atom. This factor is plotted against sin θ (where θ is the angle of reflection) and, finally, atomic scattering curves are drawn; those for fluorine from the different salts are nearly alike, suggesting a force field of constant magnitude, while those for sodium from the chloride and fluoride differ considerably. The total number of electrons gives only a rough idea of the order of the atoms as regards scattering power.—J H **Van Vleck**. Note on the postulates of the matrix quantum dynamics. The Hamiltonian equations, the commutability relations, the Bohr frequency condition and the conservation of energy equation can be taken as the fundamental postulates. The Ritz combination principle and the quantum conditions become not merely *sufficient* but also *necessary* for the last two postulates.—Joseph Miller **Thomas**: Conformal invariants. A complete set of integrability conditions which express the laws of transformation of a set of conformal invariants are obtained.—Helen **Barton**: Generalisation of Kronecker's relation among the minors of a symmetric determinant. Kronecker's relation is a special case of a more general relation.—Oliver D **Kellogg**: On the classical Dirichlet problem for general domains.—Ernest W. **Brown**: The evidence for changes in the rate of rotation of the earth and their geophysical consequences (*v.* NATURE, July 31, p 170).—Christine **Ladd-Franklin**: The reddish blue arcs and the reddish blue glow of the retina: seeing your own nerve currents through bioluminescence. A band of bright red light thrown on a screen in a dark room appears to have slightly reddish-blue arcs projecting from it on both sides. What is seen, as an entopic phenomenon, is certain fibres of the optic nerve on the surface of the retina. These fibres, when stimulated, seem to give off an 'emanation' which causes fluorescence in the retina.—Thorne M. **Carpenter**: The metabolic effect of enemata of alcohol, dextrose and levulose in humans. Ethyl alcohol is rapidly and nearly completely absorbed; it promotes the elimination of water without removing other constituents of the tissues, increases pulse rate and lowers the respiratory quotient, indicating that alcohol is utilised in the tissues. Dextrose and levulose are not absorbed so rapidly or completely; the respiratory quotient increases with the former, indicating increased utilisation of carbohydrate. Levulose caused the greatest decrease in nitrogen elimination. It is suggested that, administered by rectal injection, these substances are metabolised throughout the body in a manner similar to that in which material is utilised in muscular work.

Official Publications Received.

Statens Skogsforsoksanstalt. Skogsforsoksanstaltens Exkursionsledare, 11: The Experimental Forests of Kulbackslidén and Svartberget in North Sweden. 1: Geology (Description and Maps), by Olaf Tamm; 2: Vegetation (Description and Maps), by Carl Malmstrom. Pp. 87. 2 kr. Statens Skogsforsoksanstalt Flygblad, No. 35: Skogstradens Fruktsattning år 1925. Av Gosta Mellstrom. Pp. 22. Skogliga rön, No. 4: Några Riktlinjer for Torrlaggning av Norrlandska Torvmarker. Av Carl Malmstrom. Pp. 26. Skogliga rön, No. 5: Ett Observandum vid Skogsodlingar. Av O. Eneroth. Pp. 7. (Stockholm: Centraltryckeriet.)

Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. Boletim Meteorologico, Anno de 1921: Observações meteorologicas feitas no Observatorio do Instituto Central, do Rio de Janeiro, e nas Estaçoes da rêde Nacional. Pp. vi+159. (Rio de Janeiro.)

Report of the Director of the Royal Observatory, Hongkong, for the Year 1925. Pp. 16. (Hongkong.)

Proceedings of the Royal Society of Edinburgh, Session 1925–1926. Vol. 46, Part 2, No. 21: The Slow Oxidation of Phosphorus Trioxide. Part 2: The Production of Phosphorus Tetroxide by direct Oxidation of Phosphorus Trioxide. By Dr. Christina Cruickshank Miller. Pp. 230-244. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 9d.

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 3, No. 13: A Study of the Hokien and the Tamil Skull. By Prof. Gordon Harrower. Pp. 573-599+1 plate. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 4s. 6d.

Regenwaarnemingen in Nederlandsch-Indië. 1: Java en Madoera, 1923. Pp. 127. (Weltevreden: Landsdrukkerij.)

Transactions of the Royal Scottish Arboricultural Society. Vol. 40, Part 1, March. Pp. x+69+26+4 plates. (Edinburgh: Douglas and Foulis.) 5s.

Proceedings of the United States National Museum. Vol. 68, Art. 17: The Minerals of Obsidian Cliff, Yellowstone National Park, and their Origin. By William F. Foshag. (No. 2618.) Pp. 18+4 plates. Vol. 68, Art. 18: Revision of the American Leaf Hoppers of the Jassid Genus Typhlocyba. By W. L. McAtee. (No. 2619.) Pp. 47+6 plates. Vol. 68, Art. 19: A Revision of the American Lice of the Genus Pediculus, together with a Consideration of the Significance of their Geographical and Host Distribution. By H. E. Ewing. (No. 2620.) Pp. 30+3 plates. Vol. 68, Art. 22: Descriptions of new West Indian Longicorn Beetles of the Subfamily Laminae. By Warren S. Fisher. (No. 2623.) Pp. 40. Vol. 68, Art. 24: A Collection of Pleistocene Vertebrates from Southwestern Texas. By Oliver P. Hay. (No. 2625.) Pp. 18+8 plates. (Washington, D.C.: Government Printing Office.)

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 106 Jahresversammlung vom 8 bis 11 August 1925 in Aarau. Pp. 141+187+64. (Aarau: H. R. Sauerlander et Cie.)

Aeronautical Research Committee. Reports and Memoranda, No. 992 (Ae. 203). The Measurement of Torque Grading along an Airscrew Blade. By Dr. G. P. Douglas and L. P. Coombes. (A. 2 d Airscrews 53—T. 2102.) Pp. 11+10 plates. 9d. net. Reports and Memoranda, No. 994 (Ae. 205): The Variation of the Performance of an Aeroplane with Wing Loading. By W. S. Farren. (D1. Special Technical Questions 143—T. 2128 and A.) Pp. 22+10 plates. 1s. 6d. net. Reports and Memoranda, No. 1002 (Ae. 210): An Experimental Investigation into the Properties of certain Framed Structures having Redundant Bracing Members—Report No. 4. By Prof. A. J. Sutton Pippard and G. H. W. Clifford. (B. 2 g Strength and Design-General, 68—T. 2189.) Pp. 11+2 plates. 6d. net. Reports and Memoranda, No. 1006 (M. 35): On the Concentration of Stress in the Neighbourhood of a small Spherical Flaw, and on the Propagation of Fatigue Fractures in 'Statistically Isotropic' Materials. By R. V. Southwell and H. J. Gough. (M.C. 27.) Pp. 22+2 plates. 1s. 3d. net. Reports and Memoranda, No. 1008 (E. 17): Note on 'Detonation' Temperatures in Closed Vessel Explosions, by R. W. Fenning; Work performed at the National Physical Laboratory for the Engineering Research Board of the Department of Scientific and Industrial Research. (I.C.E. 519.) Pp. 4+1 plate. 6d. net. (London: H.M. Stationery Office.)

Proceedings of the Society for Psychical Research. Vol. 36, Part 98, June. Pp. 79-170. (London: Francis Edwards.) 6s. net.

United States Department of Agriculture. Department Bulletin No. 1393: The Granary Weevil. By E. A. Back and R. T. Cotton. Pp. 36. 10 cents. Farmers' Bulletin No. 1483: Control of Insect Pests in Stored Grain. By E. A. Back and R. T. Cotton. Pp. ii+30. 10 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 43: Motivation of Arithmetic. By Prof. G. M. Wilson. Pp. iii+60. (Washington, D.C.: Government Printing Office.) 10 cents.

Smithsonian Miscellaneous Collections. Vol. 78, No. 2: Mexican Mosses collected by Brother Arsène Brouard. By I. Thériot. (Publication 2867.) Pp. 29. (Washington, D.C.: Smithsonian Institution.)

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1926. Pp. 56. Bulletin No. 31: Report on Drying of Hay by Heated Air. By Prof. J. Hendrick. Pp. 12. Report on the Work of the North of Scotland College for the Year 1924–25. Pp. 30. (Aberdeen.)

Mysore Geological Department. Records, Vol. 23, 1924, Part 2. Pp. v+87-123. (Bangalore: Government Press, 1926.) 2 rupees.

Journal of the Indian Institute of Science. Vol. 8B, Part 2: The Aluminium Anode Film Dielectric. By M. Subramaniam. Pp. 11-21+9 plates. 1 rupee. Vol. 9B, Part 1: Double Synchronous Speed Alternators. By K. P. Roy. Pp. 7+4 plates. 1 rupee. (Bangalore.)

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 10: Silage Experiments at Nagpur. By Dr. Harold E. Annett and A. R. Padmanabha Aiyer. Pp. 189-209. (Calcutta: Government of India Central Publication Branch.) 10 annas; 1s.

League of Nations. Health Organisation: Malaria Commission. Report on the First Results of Laboratory Work on Malaria in England. By Dr. S. P. James, assisted by P. G. Shute. (C. H./Malaria/57 (1).) Pp. 30. (London: Constable and Co., Ltd.)

Records of the Survey of India. Vol. 20: The War Record, 1914–1920. (Published under the Direction of Col.-Comdt. E. A. Tandy.) Pp. xxv+155+27 plates+9 maps. (Dehra Dun.) 3 rupees; 5s. 3d.

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1925. Pp. 7. (Zomba.)

Mines Department. Fourth Annual Report of the Safety in Mines Research Board; including a Report of Matters dealt with by the Health Advisory Committee, 1925. Pp. 63. (London: H.M. Stationery Office.) 1s. net.

Experimental Researches and Reports published by the Department of Glass Technology, The University, Sheffield. Vol. 8, 1925. Pp. iii+190. (Sheffield.)

Report for 1925 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool. Edited by Prof. James Johnstone. Pp. 63. (Liverpool: University Press of Liverpool, Ltd.; London: Hodder and Stoughton, Ltd.) 2s. 6d.

Joint Board of Research for Mental Disease, City and University of Birmingham. Annual Report of the Laboratory for the Year ended March 1926. Pp. 12. (Birmingham: Asylums Department, The Council House.)

Engineering Abstracts from the Current Periodical Literature of Engineering and Applied Science, published outside the United Kingdom. New Series, No. 28, July. Pp. 260. (London: The Institution of Civil Engineers.)

Abisko Naturvetenskapliga Station. Observations météorologiques à Abisko en 1923. Rédigées par Bruno Rolf. Pp. iv+63. Observations météorologiques à Abisko en 1924. Rédigées par Bruno Rolf. Pp. iv+66. (Stockholm.)

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 3, No. 8: Zur Thermodynamik der Kondensation an Hygroskopischen Kernen und Bemerkungen uber das Zusammenfliessen der Tropfen. Von Hilding Kohler. Pp. 16. 1 kr. Band 3, No. 9: Malarens vattenstånd åren 1857–1925. Av Folke Bergsten. Pp. 20. 1.50 kr. (Stockholm.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 22, Part 9: Studies in American Phaseolineae. By C. V. Piper. Pp. viii+663-701. (Washington, D.C.: Government Printing Office.) 10 cents.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 16: Some Experiments on Motion of Fluids, Parts 1, 2 and 3. By Torahiko Terada and Kunio Hattori. Pp. 87-112. 1.20 yen. No. 17: Linien konstanter Stromungsgeschwindigkeit. Von C. Wieselsberger. Pp. 115-125. 40 sen. (Tôkyô: Maruzen Kabushiki-Kaisha.)

The Quarterly Journal of the Geological Society. Vol. 82, Part 2, No. 326, July 3rd. Pp. 101-331+plates 7-21. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

Russian Society of the Amateurs of the Universe's Knowledge (Mirovédenie): Bureau of Scientific Observations. Report on the Phenological Observations from 1925. (In Russian.) Pp. 68-93. (Leningrad.)

The Institute of Physics. Report of the Board for the Year 1925. Pp. 16. (London.)

Board of Education. Report on the Science Museum for the Year 1925. Pp. 24. (London: H.M. Stationery Office.) 1s. net.

Diary of Societies.

AUGUST 6 TO 11.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Oxford).

Friday, August 6.—At 10 A.M.—Addresses by Sectional Presidents: G.—Sir John Snell: The Present and Future Development of Electricity Supply.—L.—Sir Thomas Holland. Discussion (Section C): Problems of the Thames Gravels.—Discussion (Section M): Agricultural Education.

At 11 A.M.—Discussion (Section L): Scholarships.

At 11.30 A.M.—Addresses by Sectional Presidents: D.—Prof. J. Graham Kerr: Biology and the Training of the Citizen.—J.—Dr. J. Drever: Psychological Aspects of our Penal System.—Discussion (Section K): Sex Determination in Plants.

At 2.30.—Discussion (Section I): The Relationship of Vitamin B to Bios.—Discussion (Section L): The Cinema in Education.

At 3.15.—Discussion (Section I): The Meaning of the Symptoms of Beri-beri.

At 3.30.—Discussion (Section L): Wireless in Education.

At 8.—Prof. A. S. Eddington: Stars and Atoms (Evening Discourse).

Monday, August 9.—At 10 A.M.—Addresses by Sectional Presidents: A.—Prof. A. Fowler: The Analysis of Spectra.—H.—Prof. H. J. Fleure: The Regional Balance of Racial Evolution.—M.—Sir Daniel Hall: The Limits of Agricultural Expansion.—Discussion (Section B): Tautomerism.—Discussion (Section L): Recent Advances in Educational Science.

At 11 A.M.—Discussion (Section K): Vegetative Propagation.—Discussion (Section D): The Training of a Zoologist.

At 2.—Discussion (Sections D, H, J): Heredity in its Physical and Mental Aspects.

At 8.—Prof. H. F. Osborn: Discoveries in the Gobi Desert by the American Museum Expeditions (Evening Discourse).

Tuesday, August 10.—At 10 A.M.—Prof. J. S. Huxley: The Study of Growth and its Bearings upon Morphology (Lecture).—Discussion (Section L): The Public School System.

At 11 A.M.—Discussion (Sections C, D, K): The Conception of a Species.

At 11.30 A.M.—Discussion (Section M): The Feeding of the Dairy Cow.

At 12 noon.—(Section I) by Dr. J. S. Haldane: Acclimatisation to High Altitudes (Lecture).

At 2.—Conference of Delegates of Corresponding Societies.

At 2.30.—(Section J) by Miss W. Spielman: Recent Progress in Vocational Selection (Lecture).

At 5.—Sir F. Keeble: The Nervous System of Plants (Lecture).

Wednesday, August 11.—At 11 A.M.—Discussion (Section E): Regional Work in Geography.

At 12 noon.—Concluding General Meeting.

SATURDAY, AUGUST 14, 1926.

CONTENTS.

	PAGE
Economics of the Coal Industry	217
The Protection of Wild Life in Australia. By Dr. James Ritchie	218
The Peoples of Northern Nigeria. By B. Z. S.	219
Upper Air Phenomena	221
Our Bookshelf	222
Letters to the Editor:	
X-Rays—Internal Absorption and 'Spark' Lines.—Dr. H. Robinson	224
A New Type of Absorption Spectrum: Double Rotational Quantification in Formaldehyde.—Prof. Victor Henri and Svend Aage Schou	225
Surveys of the Great Pyramid.—F. S. Richards; Sir Flinders Petrie, F.R.S.	226
Magnetic Susceptibilities and Dielectric Constants in the New Quantum Mechanics.—Dr. J. H. Van Vleck	226
The Attractions of the Ends of Chromosomes in Trivalents and Quadrivalents.—Dr. John Belling	227
Scientific Neglect of the Mas d'Azil.—H. G. Wells	228
The Eggs of the Pilot-fish (*Naucrates ductor*).—Keppel H. Barnard	228
Spinning Electrons.—I. I. Rabi	228
Biology and the Training of the Citizen. By Prof. J. Graham Kerr, F.R.S.	229
Domestic Refrigeration	234
Science in Antiquity. By Dr. J. Newton Friend	236
The British Association at Oxford. By F. A. D.	238
News and Views	239
Our Astronomical Column	242
Research Items	243
The Gustatory Sensory Reflex	246
International Ornithological Congress at Copenhagen	247
The Lister Institute of Preventive Medicine	248
University and Educational Intelligence	248
Contemporary Birthdays	249
Societies and Academies	250
Official Publications Received	252
Diary of Societies and Congresses	252

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Economics of the Coal Industry.

MR. FRANK HODGES recently addressed the Royal Society of Arts upon the all-important subject of the economics of the coal industry, and his very thoughtful and well-reasoned address may be unreservedly recommended to all interested in the matter, that is to say, at this moment to every thinking man throughout Great Britain. The authoritative statistics which Mr. Hodges produces show more clearly than words the basal reasons for our difficulties, and most of them are summed up in the following quotation:

> "The Ruhr hours are 8 hours for each man, and those of Upper Silesia, in Poland, are 8½ hours for each man. Wages costs in Great Britain are per ton 12*s.* 3*d.*; in the Ruhr they are 7*s.* 10*d.*; and in Poland 3*s.* 8*d.* The wages of all persons employed in British mines are 10*s.* 5*d.*; in the Ruhr 7*s.* 4½*d.*; in Polish Upper Silesia 3*s.* 6*d.* per shift.
>
> The latest figure of output per shift in Great Britain was 18·4 cwts.; in Germany 21 cwts.; in Upper Silesia 22·06 cwts."

Mr. Hodges points out the inevitable result of these figures, namely, that in the coal export trade "Great Britain has lost both relatively and absolutely in the coal business of the world." It is not so many years ago since a general strike in Great Britain would have produced something like a panic, not only in this country but also throughout industrial Europe, which at one time was practically dependent upon Great Britain for its coal supplies. To-day, Europe cares nothing whether the British coal mines are working or idle; nay, more, the rest of the world is quite capable of supplying British needs. Mr. Hodges points out cogently that this unpleasant fact is due to our high prices and low output per man. He does not deal with the contributory cause, namely, that British coal miners have by repeated strikes taught the rest of the world how to do without British coal. It is because of these strikes that other nations have been forced to develop their own coal resources as well as other sources of power, notably water power, which have replaced British coal. A notable example in point is Switzerland, which has developed its hydro-electric powers and electrified its railways, mainly because, as a Swiss engineer put it, they are determined to have a source of power that *will not go on strike.*

The point cannot be too strongly stressed that a definite proportion of the old-time export coal trade of Britain is gone for ever. The only way to secure some share in what is still left is to bring down British prices of coal production to a competitive basis. Mr. Hodges seems to think that some relief may be obtained by a better use of the coal so as, in his words, to "bind up production of the raw fuel with the production of electricity and gas and by-products." At best, however, this remedy can only be a palliative; however well the coal is utilised when it is produced, nothing will ever avail to counterbalance the cardinal fact that British coal costs too much to produce. Other nations can use coal as effectively as we can, and if they produce it more cheaply than we do, they will still be ahead of us in world competition. In justice to Mr. Hodges, it must be said that he appears to appreciate this fact, and is clear on the point that the only remedy is lower wages or longer hours of work. He has come to the conclusion that, of the alternatives, "a modification of hours . . . is the least of two evils." His proposed remedy is a 45 or 46 hour week; it is highly probable that many of those who have studied the subject carefully will scarcely be inclined to agree with him that this is going quite far enough, or to hold, as he does, that if the working week is increased to 48 hours, other countries in Europe will increase their hours also. This proposition may well be doubted in view of the fact that wages per hour in Britain are practically twice as high as they are even now in the Ruhr.

There will no doubt be a general consensus in favour of Mr. Hodges' suggestion that there should be a five-years' agreement in order to get the industry back on to a sound basis. He realises quite clearly that reorganisation of the collieries, where such is required, cannot be done without an influx of fresh capital, and that to get such an influx, terms acceptable to the capitalist must of necessity be offered. Mr. Hodges, like every other intelligent man, sees that British coal miners must accept the inevitable, and that it is useless to fight against natural laws and economic facts. Our only hope of salvation lies in producing coals more cheaply; whether the coal miner prefers to attain this end by working longer hours or by accepting lower wages, is a question which he ought to be allowed to decide for himself. One or other alternative, or a compromise involving something of each, is the inevitable solution, and it is for the coal miner to say which he prefers. If neither is accepted, then we must be prepared to contemplate an end to British coal mining.

The Protection of Wild Life in Australia.

Save Australia: a Plea for the Right Use of our Flora and Fauna. By various Writers. Edited by Sir James Barrett. Pp. viii+231. (Melbourne and London: Macmillan and Co., Ltd., 1925.) 8*s*. 6*d*. net.

THE march of civilisation inevitably betokens the retreat of the native plants and animals of a country. For long the retreat passes unnoticed: the early settlers, battling with Nature for a foothold, have little inclination to survey any but the most immediate effects of their handiwork, and it is left for their more leisured successors to develop the æsthetic sense which laments the disappearance of the primeval natives of the land. It is on this account the more gratifying to find that a comparatively new country like Australia, with its unique fauna and flora, has tackled the problem of its disappearing animals and plants with an energy which puts to shame the puny efforts made in the 'old country.'

Four main causes are said to account for the disappearance of Australian animals. Two are inevitable, and are practically beyond the modifying power of man. (1) His settlements and cultivation open up the country at the expense of the shelters, the feeding-places and the breeding-places of many of the wild animals. (2) Epidemic disease may sweep with dire effect through the populations of large areas, as in 1898–99 and 1901–2–3, when koalas, dasyures, certain bandicoots and other forms were almost exterminated in a tract from central Queensland to Victoria. The other two causes are looked upon as equally serious, and they are preventable. (3) The deliberate introduction and setting free of such aliens as the fox, the cat, the rabbit, and many species of European birds has, either by direct destruction or by the consumption of the food-supply and occupation of nesting sites, played havoc with many of the natives. Mr. Le Souef alleges that the fox has cleared off practically all the small ground animals outside the coastal districts in eastern and southern Australia, and the immunity of the inhabitants of the coastal districts is due to the presence of the poison tick, *Ixodes holocyclus*, which is fatal to foxes and dogs. (4) Deliberate destruction for the fur trade is making heavy inroads upon the native stock. From 1919 to 1921 the exported pelts of a few typical animals were: opossum, 4,265,621; ring-tailed opossum, 1,321,625; koala, 208,677; wallaby, 1,722,588. There is at present no control of, or any check upon, such exports, and slaughter on such a scale can end only in virtual extermination. Some half-dozen marsupials in Western Australia are now on the verge of extinction, though their disappearance cannot readily be attributed to man's interference.

Each of the Australian States has set about protecting its own fauna in the only way in which a fauna can be adequately safeguarded, that is, by the creation of reserves in which the animals are immune from any but controlled interference. The reserves are created by the legislature, but the system of control lacks unity, in so far as it is vested in two or more independent departments of the State, while in many places the difficulty of policing large areas with inadequate staffs plays into the hands of unscrupulous collectors. There is something to be learned, however, from the graded system which has been adopted, and of which the Western Australian reserves may be taken as examples.

Here there are four types of State-protected areas, differing a little in stability, in the primary purposes for which they were created, and in control. Class A Reserves comprise national parks, sanctuaries for native plants and animals, and cave and scenery reserves, so created that they cannot be alienated except by special Act of Parliament, an unlikely event in the present state of public feeling towards the protection of wild life. The ordinary reserves, for the preservation of the native fauna and flora, are under the control of the Ministry of Lands, and are less assured in standing, since they may be alienated by the Governor and Executive Council, without reference to Parliament. Mr. W. Catton Grasby, however, is of opinion that most of these will ultimately become permanent. Of these two types, in Western Australia alone there are some forty reserves, covering in all an area of more than a million and a quarter acres. In addition to the set reserves there are forest reserves, under the Forestry Department, and game sanctuaries (thirty-six in number) under the Fisheries Department, in each of which protection is enforced.

Queensland has well over a hundred sanctuaries, including such large areas as Hinchinbrook Island (97,280 acres), Bellenden Ker Reserve (79,000 acres), and Stradbroke Island (78,720 acres); New South Wales possesses about fifty reserves, the largest of which is practically the whole of Cumberland county, with its two National Parks, specially patrolled; and each of fifteen principal sanctuaries in South Australia represents a fair-sized area of country.

The legislation adopted for the protection of native animals differs in the different States. In some (*e.g.* Western Australia) a long list of protected animals and birds is scheduled, and there even the owner of land cannot take or kill except under certain specified conditions, the general principle being laid down that all native game, whether on Crown lands or not, is the property of the Crown. Queensland, on the other hand, through its Department of Agriculture and Stock, has adopted what is known as the " black list " system, the names of non-protected creatures being listed, while emphasis is laid on the fact that all other " wild animals and birds " are totally protected throughout the whole year. Already every Queensland trapper has to obtain a permit, and every 'bird and animal' dealer a licence.

Another noteworthy step in the progress of Australian protection was marked by the passing in 1912 of a special Act for the conservation of the native flora of Western Australia. It is a model of thoroughness. Scheduled trees, shrubs and plants may not be destroyed or mutilated on Crown lands or lands reserved. No flowers that bear evidence that the plant from which they were taken was mutilated may be sold or exposed for sale. The police may examine and retain such flowers and plants, and the Government railways may refuse to carry them.

Thanks to the efforts of the Australasian Association for the Advancement of Science, the Royal Societies of South Australia and Western Australia, and other learned bodies, backed by strong public opinion, steps have been taken which should go a long way towards conserving the native fauna and flora for all time, so far as conservation lies within the power of man. These fine efforts make a strange contrast with the indifference of the British legislature to the native animals and plants of Great Britain, the existence of many of which is even more seriously threatened. The law has made not a single effort to protect our unique or disappearing plants, fishes or mammals, except in a statute, precariously renewed year by year, on behalf of the grey seal. Surely the time is approaching when the State, following the lead of its own colonies and of almost every other nation in the world, must cease leaving to private ownership the responsibility of safeguarding our native possessions, and must take steps, by creating national reserves or otherwise, to perpetuate the interesting fauna and flora as well as the notable Nature monuments of Great Britain.

JAMES RITCHIE.

The Peoples of Northern Nigeria.

The Northern Tribes of Nigeria: an Ethnographical Account of the Northern Provinces of Nigeria, together with a Report on the 1921 Decennial Census. By C. K. Meek. Vol. 1. Pp. xviii+312+61 plates. Vol. 2. Pp. viii+277+25 plates. (London: Oxford University Press, 1925.) 36*s*. net.

THE facts embodied in this book were for the most part collected during the census of 1921, though they have very little to do with the ideas that are commonly attached to the word 'census,' for the officers concerned were encouraged to combine with their statistical work as much ethnological investigation as was possible. Mr. Meek thus had an immense amount of territory to cover, and this presumably is the reason for the somewhat scrappy quality of much of the work, as well as the difficult and even illogical arrangement of the chapters. This said, there is little but praise for the book, which brings a large number of new facts before the anthropologist for comparative use, and may for years be trusted to act as a dictionary which should be put in the hands of every officer in Northern Nigeria.

After a short account of the anthropo-geography of the country, extending over an area of some two hundred and fifty-four thousand square miles, the author, having mentioned some of the chief tribes, considers the 'racial elements' composing them: Negro, Hamite, Semite, with perhaps an evolving Semito-Negroid, which he thinks may in time become a definite type. The Nupe and the Yoruba are recognised as having a non-negro element, while among the negroes great diversity appears in the physical characters. Thus the brachycephalic Bantu-speaking Bafum from the Cameroons are almost pygmies, and the tall massive Jukun seem to approximate to the tall Nilotes of the Sudan. With such extremes, and with so little knowledge of the tribes, the author was probably wise to adopt a temporary classification based on language. A chapter headed "History and Tradition" is to be taken in its broadest sense; beginning with palæoliths, and including celts and arrow-heads, it continues with a discussion of objects which are certainly no later than Muhammadan times. Mr. Meek pays considerable attention to early foreign influence, and here perhaps is at his least critical: "Objects dug up in the Yoruba country by Frobenius have been dated by Egyptologists as belonging to the sixth century B.C." Again, "Egyptian goods had penetrated to Kordofan as early as 3000 B.C."; *i.e.* in common chronology, in proto-dynastic times. Surely all this requires revision? On the other hand, the author's treatment of Muhammadan history and tradition is excellent, and makes clear the complicated relations which have brought about the present condition of the northern Muhammadan states—Bornu, Kano, and Sokoto.

This roughly covers the first half of the first volume; then come chapters on technology—including an account of glass-making—followed by others on social organisation. The first chapter of the section headed "Social Organisation" is devoted to animal and plant taboos. Here the author points out that these beliefs occur among the Muslim as well as the pagans:

> "Animal tabus are universal in Nigeria . . . Muslim families still have their sacrosanct animals. They are known in the *lingua franca* as *kan gidda*, which means 'the head' or 'the source of the house.' Muslims have told me that the totem witnessed the foundation of the house. They will not usually go so far as to say that their family was actually descended from the totem, but I have known professing Muslims who said that the totem contained the spirits of their forefathers. The *kan gidda* is . . . the family badge. The species is sacrosanct; it is therefore never eaten (any one inadvertently eating the flesh of his totem would immediately vomit). The revered animals are usually non-domestic, but no Zaberma will eat the camel's flesh, and the Toronkawa—a Fulani Muslim sub-tribe to which belongs the royal house of Sokoto—abstain from the flesh of goats. . . . Thus . . . in spite of their professed religion, many Muslim tribes retain a strong sense of mystic relationship with their totemic animals."

Among the pagan, perhaps the most interesting examples of animal taboos are those connected with the leopard. Thus among the Longuda—

> "certain individuals who believe themselves immune from attack by leopards will refrain from eating leopard's flesh, though they will take part in a leopard hunt. A Wukari Jukun who kills a leopard parades the town with the dead animal mounted on a mat. The people salute the animal with the uplifted arm as they would a chief. Though the slayer of the leopard is given numerous gifts, he is nevertheless required to perform propitiatory rites, which include three days' solitude in the bush."

Rites indicating the royalty of the leopard also occur in East Africa; *e.g.* among the Acholi.

Mr. Meek's suggestion that the term 'animist' should be substituted for pagan does not seem very desirable, while with regard to the names of the different forms of cult of the dead, it seems doubtful whether most of these do not interdigitate in one tribe or another. A considerable number of tribes worship the sun, and of these Mr. Meek states:

> "The Sun is their Supreme Deity, the All Father, the Giver of Rain, the Ripener of Crops, but so remote and otiose that he can only be approached through the host of intermediaries already described—the spirits of ancestors who dwell near him, and those nature spirits who are demi-gods and his servants. He is too far removed to need the propitiation of sacrifice; but in times of stress his devotees vaguely hold out their hands to him in prayer. The Sun-worshippers seem to regard the Sun primarily as the Ripener of Crops."

The distribution of sun worship in Africa is of great interest, though too wide to be discussed here; but it is noteworthy that, while absent among the Nilotes, traces of it are to be found in the Sudan in the hill districts of Kordofan, while it is well developed in Dar Fung. In addition to the cult of numerous spirits and fetishes, and even personification of qualities (such as hunger among the Waja), the author states that all tribes recognise a supreme deity, remote and not to be approached directly; he is usually sky-dwelling, and is sometimes actually the sun; in some instances he may be considered to have charge of the souls of the dead.

The section on marriage is particularly interesting, though perhaps it is one of the most tantalising in the book; for here are given items of importance from the marriage regulations of various tribes. Such items are of some value as indicators of custom, but not much more while they remain isolated from the social system in which they occur. However, there is much in the information that Mr. Meek has given to modify the generalisation that he himself has made on the extremely low status of women (cf. pp. 201, 204): that they are mere property to be acquired in marriage, and that the higher the bride-price the lower the status of woman, as an object to be bargained for. Among the cattle-owning tribes of N.E. and S. Africa the reverse is certainly true: a high bride-price is an honour to a woman, and so great is the esteem for cattle, so sacred their character, that the transaction of the bride-price is not really one of purchase at all. It is possible that in Nigeria, where the bride-price is usually paid in cowries or cash, it does more nearly approximate to a purchase; but from the customs that Mr. Meek quotes, it is clear that wives, though they may be inherited, are not treated as slaves, and that the bride-price acts in Nigeria, as it does elsewhere in Africa, as a guarantee of the stability of marriage. Patrilineal peoples usually consider that the bride-price secures the children for the husband, whether he is the actual father or not.

Marriage by exchange, as well as a legalised form of wife-stealing, are described. The former, by which two men exchange sisters instead of paying a bride-price, though found in other parts of the world, is rare in Africa; it has, however, been recorded among the Senoufo of the French Sudan. The function of the extended family, and its bearing on the economic life of the people, is well described. These are factors not usually sufficiently realised by administrators.

The divine character of the King is recognised in Northern Nigeria, and associated with divine kingship are those customs and beliefs that seem to be essential to high authority in Africa. The king is responsible for the rain supply, and the fertility of the land is intimately connected with the king's own virility; hence the king must not be ill or grow old, and so is killed ceremonially either before old age approaches or after reigning a definite period. The most perfect example that Mr. Meek gives is that of the Jukun. Here the king controls the rain; he is so sacred that if he touched the ground with uncovered hand or foot the crops would be blighted. At the end of seven years, at the harvest festival, the king was slain ceremonially (it is interesting to note that quite recently the Jukun chief refused to hold his festival for fear of having to submit to the ancient rite). Two women are associated with the king. One, the king's sister (in the classificatory sense), is also able to control the rain, and is treated with deference by the king himself. The other is the favourite wife of the late king, and is thus the reigning sovereign's official 'mother.' She is consulted on all important matters, and has great privileges; should she not be treated with due respect, the spirit of her late husband would take vengeance on the country. Among several other tribes the divine kingship is quite as definite, though in some cases the king himself takes poison instead of being killed. An interesting case where the rite has become symbolised is given: the Daura have a tradition of killing a dragon, but the dragon's name was Sarki, and the dragon-slayer called Ma-kas-Sarki, Hausa words for 'chief' and 'slayer of the chief.'

There is a section on languages by Mr. N. W. Thomas. The last ninety pages of the work are devoted to the census proper.

The scope of these two volumes indicates the vast amount of anthropological work that remains to be done in Nigeria, and it is to be hoped that Mr. Meek may himself be able to undertake some of it in detail.

B. Z. S.

Upper Air Phenomena.

The Uppermost Regions of the Earth's Atmosphere: being the Halley Lecture delivered on 5 May 1926. By G. M. B. Dobson. Pp. 22+4 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 2s. 6d. net.

THE publication of Dr. Dobson's Halley lecture is opportune, since it reviews, in such detail as is possible in small compass, the present state of our knowledge of the constitution of the upper atmosphere and of the chief natural phenomena occurring above the isothermal layer. Some of the phenomena, such as those due to the aurora and to meteorites, are directly visible to the eye, while others, such as the occurrence of ozone and the presence of ionised conducting layers, are appreciated by observation with special apparatus. Apart from the relation between radio and ionisation in the upper atmosphere, the public may find some interest in the fact that the natural phenomena occurring in this region are associated with an important shielding action exerted by our atmosphere, since it is the absorption of the medley of electromagnetic waves and radiations of α, β and γ type, as well as uncharged matter derived from the sun and cosmic sources, which is responsible for the effects observed. The more scientific public will welcome the publication as a concise review of the main facts in a field of endeavour to which Dr. Dobson has made extremely important contributions.

The complete interpretation of the observations demands not only a knowledge of the types of the waves, radiations and matter projected into the atmosphere, but also of the absorbing material—the density and constitution at great heights. Neither of these two can be calculated unless the temperature is known, as well as the proportion of light gases in the lower layers.

The author deals first with the aurora and considers there is little doubt that it is due to electric discharge caused by charged particles projected from the sun, and points out that a knowledge of the nature and velocity of the radiations would enable more information to be obtained by spectroscopic means about the layers in which they are being absorbed. However, the presence of some lines due to nitrogen has been established, though the origin of the most prominent green line is still the subject of discussion and experiment in cryogenic laboratories. Reference is also made to the measurements of auroral height by simultaneous photographs from widely separated stations (illustrated by photographs), and to the faint green line observed in the light of the night sky and considered to be unconnected with the polar aurora.

The information obtained from observation of the small particles of iron or stony material known as meteors, while being vaporised by the high speed of their travel through the atmosphere, is next considered. Observation at two stations of the apparent path among the stars enables the height of appearance and disappearance, the length of path, speed and brightness to be determined. By calculation from these, it is possible to infer that the temperature of the isothermal layer (about 220° Abs.) continues to a height of some 55 km. in mean latitudes, while the temperature rises to about that at ground level above 60 km. Confirmation of a discontinuity in the atmosphere at this height is given by the fact that very few meteors disappear about the level of 55 km. The suggestion is that this rise in temperature is due to the formation of ozone from oxygen by the action of ultra-violet radiation from the sun, and by the absorption of some of the sun's rays by the ozone so formed. It is the layers ionised by ultra-violet radiation from the sun, and the electric currents set up in these ionised layers by tidal movement of the atmosphere, which are considered to be responsible for the diurnal variation of the earth's magnetic field. Reference is not made to the large variation observed at stations near the auroral zones and its great enhancement in winter on magnetically disturbed days. The importance of this observation lies in the possibility that the ionisation due to the aurora in these zones may be comparable with that due to sunlight—a matter of possible interest in the transmission of radio signals within and across the polar regions.

The author includes brief references to night luminous clouds and the propagation to great distances of the sound caused by large explosions, quoting with approval Mr. Whipple's suggestion that the temperature increase above 60 km. may be responsible for the bending down of the sound waves which have penetrated to this height.

The paper naturally does not discuss in any detail the most recent views regarding the effect of the ionised layers and their height on radio transmission. We can, however, regard it as a matter for congratulation that the increasing use of radio is likely to enhance general interest in the study of those natural phenomena which cause ionisation in the upper atmosphere.

Our Bookshelf.

Allen's Commercial Organic Analysis. Edited by Samuel S. Sadtler, Dr. Elbert C. Lathrop, and C. Ainsworth Mitchell. Vol. 4: Special Characters of Essential Oils; Resins, India-rubber, Gutta-percha, Balata, and allied Substances; the Constituents of Essential Oils, and allied Substances; the General Characters and Analysis of Essential Oils. By the Editors and the following contributors: E. K. Nelson, G. A. Russell, Ernest J. Parry, John B. Tuttle. Fifth edition, entirely rewritten. Pp. x+648. (London: J. and A. Churchill, 1925.) 30s. net.

An increase of 174 pages in this volume compared with the corresponding volume in the previous edition, published sixteen years ago, gives some indication of the advance in the chemistry of essential oils in recent years. Except for a short section of 55 pages on rubber, this book is practically confined to the subject of essential oils and resins. In its present form it is indispensable as a reference book. With a more intimate connexion between the sections than in earlier volumes, it has been possible to restrict the number of contributors so that more uniformity in the general treatment might be expected. The only British contributor is Ernest J. Parry, the well-known authority on essential oils. He has written the sections on (*a*) resins, (*b*) the constituents of essential oils and allied substances, and (*c*) the general characters and analysis of such substances. His contributions cover more than half the whole book.

The unsatisfactory arrangement in the fourth edition, with special consideration of hydrocarbons and ketones only, has been changed and a more general treatment of the subject given. Some repetition in methods and descriptions occurs and a fair number of misprints and small errors have been noticed. The statement (p. 68) that spike (lavender) oil is dextrorotatory or that West Australian sandalwood oil (p. 133) "is practically identical chemically" with oil from other sources, does not agree with the reviewer's observations. It is hoped that in later volumes improvements may be made in the index, which is not sufficiently complete for a standard reference book, while some attempt might be made to give cross-references to other volumes in the complete work.

J. Reilly.

The Sacred 5 of China is the 5th Book on China. By Dr. William Edgar Geil. Pp. xix+355+56 plates. (London: John Murray, 1926.) 24*s.* net.

As Dr. Geil's title-page indicates, he is the author of several books on China, of which "A Yankee on the Yangtze" is perhaps the best known. In explanation of his present title he says "5 is a number most remarkable to the man of the Central Kingdom." Here he deals with five sacred mountains, the peaks of East, South, Centre, West, and North—Tai Shan, Nan Yo, Sung Shan, Hua Shan, and Hêng Shan—associated with the five elements wood, fire, earth, metal, water, and the colours green, red, yellow, white and black. These mountains are all centres of pilgrimage. Of these sacred sites the importance for the student of Chinese culture lies in the fact that, like similar sites in other lands, they have been regarded as sacred from time immemorial. Like the holy wells of the British Isles, they represent a cult—and preserve survivals of it—which belongs to a stage of development infinitely more primitive than that of the official religion. So, says Dr. Geil, with the sacred mountains of China; beneath the thin rind of Buddhism, and far earlier than Confucianism, is the core with "an immemorial flavour of sanctity, the cult of the mountain spirit."

Dr. Geil, complying with the convention, ascends each mountain in five stages, but his description is not merely topographical or descriptive of the shrines and temples encountered on the way. He gives his readers a selection in each case from the legends, the history, the literature, the elements of ritual and cult associated with each peak, quoting liberally from the classics with such comment as suggests itself by the way. His book may well serve as an introduction to certain sides of the distinctive types of Chinese mentality, delicate in wit and instinct with an intellectuality peculiarly its own. The illustrations are numerous and excellently reproduced.

Die Tierwelt der Nord- und Ostsee. Herausgegeben von G. Grimpe und E. Wagler. Lieferung 2 (Teil 2. d_1, 12. h_1). Teil 2. d_1: *Noctiluca*, von A. Pratje; Teil 12. h_1: *Teleostei Physoclisti*, 10. *Heterosomata*, von W. Schnakenbeck. Pp. 12+60. 4·50 gold marks. Lieferung 3 (Teil 9. c_1, 9. c_2, 12. i_1). Teil 9. c_1: i. *Opisthobranchia*; ii. *Pteropoda*, von H. Hoffman; Teil 9. c_2: *Scaphopoda*, von Tera van Bentham Jutting; Teil 12. i_1: i. *Amphibia*; ii. *Reptilia*, von R. Mertens. Pp. 66+14+20. 7·80 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.)

EACH group of animals dealt with in this new and admirably planned series is treated along definite lines; first the characters of the animals are described, then their systematic position, in some cases the best methods of fixation, the structure, the distribution, the method and powers of movement, the mode of feeding with details of the physiology of digestion and of excretion and an account of the food, the sense organs, reproduction and development, bionomics and relation to their surroundings with especial reference to parasites. Good bibliographies are provided, while excellent line drawings and maps to show the distribution illustrate the text. As a result of this mode of treatment, we are being provided with a well-balanced account of the fauna of the North and Baltic Seas, compact and yet far removed from the old-fashioned catalogues of genera and species. Points of particular interest, such as light production in Noctiluca, the growth rings on otoliths and scales in fish and the methods of marking flatfish with metal discs, are treated in detail. Further additions to this series will be awaited with interest by all workers in marine biology.

Le tremblement de terre. Par Edmond Rothé. (Nouvelle Collection scientifique.) Pp. xxxiv + 248. (Paris: Félix Alcan, 1925.) 10 francs.

M. ROTHÉ has given us in this little book a very clear account of the latest developments of seismology, especially of the instruments that have been designed for recording distant earthquakes, the methods of locating the epicentre, the forms of seismic rays, and their bearing on the structure of the earth's interior. If it were for these chapters alone, the book would be worth possessing.

The phenomena of ordinary earthquakes are treated at less length, and there are some curious omissions, but the author has wisely chosen in illustration two recent earthquakes that are not likely to lose their interest for many years to come, namely, the Chinese earthquake of 1920 and the Japanese earthquake of 1923. The book is perhaps not altogether well balanced. One could wish, for example, to see less use made of the work of Perrey, Montessus and other French authorities—fully one-third of the references are to French writers—and more to the valuable work done in Italy and Japan. The illustrations are in some cases rough and poorly reproduced, and it is difficult to see the use in a scientific text-book of pictures of Tokyo in flames or of heaps of corpses lying about the streets of the city. The preface, it may be added, contains a brief, though interesting, outline of the history of seismology. C. D.

Migraine and other Common Neuroses: a Psychological Study. By Dr. F. G. Crookshank. (Psyche Miniatures, Medical Series, No, 1.) Pp. 101. (London: Kegan Paul and Co., Ltd., 1926.) 2*s.* 6*d.* net.

THE average general practitioner has little time and opportunity for the study of text-books on the complicated, and in these days bewildering, subject of psychotherapy. To him, therefore, will be of especial value the publication of Dr. Crookshank's two lectures on migraine and other common neuroses. The book is a small one; it can be read in an hour, and the author's style is delightfully attractive. His views—even as expressed in the title—will, of course, arouse controversy, and some of his statements can be described only as startling. His reasoning that the mind may be the deciding factor in the etiology of dementia paralytica, because mental symptoms usually precede the appearance of physical signs, is unconvincing. Yet there is nothing in these pages which the neurologist or psychologist could dogmatically deny; and if the author's efforts to demonstrate the supremacy of the psychological factor in migraine should only turn the attention of physicians to the psychical aspect of all who are sick, the book will have served its purpose.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

X-Rays—Internal Absorption and 'Spark' Lines.

In recent work by Mr. A. M. Cassie and myself (now being prepared for publication), it has been possible to study some of the details of the process of 'internal' absorption of an X-ray by the atom in which it is excited. This type of absorption has played an important part in the elucidation of β- and γ-ray spectra, and has been fully discussed, notably by Ellis and Skinner in Great Britain, and by Meitner, de Broglie, Thibaud, and others. An excellent summary of the work on the X-ray side is to be found in Bothe's article in vol. 23 of the new Geiger and Scheel "Handbuch."

In the X-ray domain the effects of internal absorption have been beautifully demonstrated by P. Auger in his Wilson tracks produced by X-rays in heavy gases. Auger's results show that in the K excitation of argon, about 90 per cent. of the fluorescent K quanta are absorbed by the atoms in which they are excited, with emission of tertiary photoelectrons: this "specially privileged" absorption becomes less marked with heavier elements (about 50 per cent. for krypton, and, according to Meitner, about 10 per cent. for elements of atomic number round 85), but is in any case amazingly high.

In our experiments, the secondary cathode rays emerging from a 'target' irradiated by X-rays are drawn out into a magnetic spectrum, and their energies are measured as in earlier work by de Broglie, Whiddington, Robinson, and others. In the present work a great deal of 'white' radiation is allowed to remain in the X-ray beam, and in consequence the fluorescent X-ray spectrum of the target is strongly excited. The corpuscular spectra show many lines which are due to the internal conversion of the fluorescent X-rays, or, alternatively, to radiationless (Rosseland) readjustments within the atom which lead to the expulsion of 'photoelectrons of the second kind.' For brevity these lines may be called 'fluorescent' lines, to distinguish them from the 'normal' lines arising from the external absorption of the constituents of the primary X-ray beam.

There are very many of these fluorescent lines, some of them very faint and difficult to resolve, and the measurements are not yet complete. It is certain, however, that most of these electrons emerge with considerably less energy than would be expected if they came from a normal atom: the deficiency is of the order 50-100 electron-volts—far too big for experimental error. There can be little doubt that they come from atoms which were already ionised, and, therefore, had abnormally high energy levels. This energy defect would be inappreciable in a fast β-ray, and scarcely detectable from the Wilson tracks.

The processes taking place are easily visualised, for example, as a possible sequence we may have in successive stages following the ejection of a K electron from the target—(1) an L_{III} electron falling into the vacant place with emission of a $K\alpha_1$ quantum of fluorescent X-radiation; (2) internal absorption of this quantum, with expulsion of a photoelectron from an L, M . . . shell, either while the vacant place in L_{III} is still untenanted, or after L_{III} has been completed (say by an M electron), but while the atom is still ionised in an outer shell. This is typical of many possible processes of the same kind (cf. Auger, *J. Phys. et le Radium*, June 1925), all leading to atoms which are multiply ionised in their X-ray shells. So far as the final result is concerned, it is immaterial whether this takes place as above, or by way of radiationless changes.

The multiply ionised atoms produced in this way ought to be competent to account for at least some of the abnormal lines observed in nearly all X-ray spectrograms (Coster's 'non-diagram' or Wentzel's 'spark' lines) as faint satellites on the high frequency sides of the series X-ray lines. Wentzel has worked out in detail the theory of these 'spark' lines, on the assumption that they are due to multiply ionised atoms. While there can be no doubt of the essential accuracy of Wentzel's work, the experimental evidence as to the manner in which the multiple ionisation is brought about is still very unsatisfactory (cf. Backlin, *Zeit. fur Physik*, 27, p. 30). Dr. Wentzel suggested to me some time ago that my corpuscular spectra might show traces of multiple ionisation produced by a single X-ray quantum, but so far I have got no evidence of this (in any case these lines would be very faint). Internal absorption obviously could not account for the production of spark lines in the K series; that is, it could not be expected to produce atoms in the K^2, KL . . . conditions required by Wentzel—but it certainly could account qualitatively for the existence of L spark lines. As shown in the above example, once the K excitation limit is reached, there will be large numbers of atoms in L^2, LM . . . conditions: this provides a very satisfactory explanation of the effect observed by Siegbahn and Larsson (*Ark. Mat., Ast. och Fysik*, 18, 1924). These experimenters, investigating the L spectrum of molybdenum with a tube operated at different voltages, found no new spark lines between 4 and 20 kilovolts. At 20 kv. a new line first appeared, and no further line appeared even at 40 kv. 20 kv. is just more than is required to excite molybdenum K, and is certainly insufficient for simultaneous K, L ionisation.

We have obtained direct and very striking evidence of the fundamental difference between internal and external absorption, by experiments in which a thin copper target was exposed under identical conditions to (1) copper $K\alpha_1$ primary rays and (2) white radiation from a molybdenum tube operated at high voltage. In case (1) we get the normal copper L lines, L_{I} and (L_{II}, L_{III})—the latter pair as an unseparated doublet—resulting from external absorption of the primary copper $K\alpha_1$. In case (2), following the ejection of a K electron, we have internal absorption of the same quantum. The corresponding L lines of the 'fluorescent' spectrum are definitely displaced 0·6 mm. (about 60 to 70 volts) on the plates in the direction of smaller energy, and there is no visible trace of the 'normal' lines. Further—and this is most significant—the intensity ratio is entirely changed: with external absorption of $K\alpha_1$, L_{I} is slightly more intense than (L_{II}, L_{III}) (cf. Robinson, *Roy. Soc. Proc.*, 1923). In case (2) the doublet (L_{II}, L_{III}) is by far the more intense.

Similar effects have been noticed in β-ray spectra, but in our experiments the phenomenon is naturally under greater control, and the interpretation more direct.

H. ROBINSON.

Physical Laboratory,
The University, Edinburgh,
July 27.

A New Type of Absorption Spectrum: Double Rotational Quantification in Formaldehyde.

The quantification of the rotational motion of an assymmetrical molecule having three different moments of inertia, J_0, K_0, L_0, is a very difficult problem and has not yet been resolved mathematically. However, if two of the moments are equal, $K_0 = L_0$, the problem lends itself to solution, as has been shown by Sommerfeld, Born, Reiche, and others. The rotational energy of a molecule having an axial symmetry is equal to

$$W_{m,q} = \frac{h^2}{8\pi^2}\left[\frac{q^2}{K_0} + m^2\left(\frac{1}{J_0} - \frac{1}{K_0}\right)\right],$$

where m and q are quantum numbers.

The absorption lines corresponding to the different possibilities of rotational transitions of a molecule of this kind form a very complicated spectrum. This may be represented by the juxtaposition of two systems of parabolic branches:

$$\text{I.}\quad \left.\begin{aligned} R(m) &= \nu_0 + (c_0 + c_1)m + c_2 m^2, \\ &\qquad \ldots\ m - \tfrac{1}{2} \rightarrow m + \tfrac{1}{2} \\ P(m) &= \nu_0 - (c_0 + c_1)m + c_2 m^2, \\ &\qquad \ldots\ m + \tfrac{1}{2} \rightarrow m - \tfrac{1}{2} \\ Q(m) &= \nu_0 + c_2 m + c_2 m^2, \\ &\qquad \ldots\ m + \tfrac{1}{2} \rightarrow m + \tfrac{1}{2} \end{aligned}\right\} q = \text{constant},$$

where

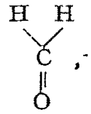
$$c_0 = \frac{h}{8\pi^2 c}\left(\frac{1}{J_0} - \frac{1}{K_0}\right),\ c_1 = \frac{h}{8\pi^2 c}\left(\frac{1}{J_1} - \frac{1}{K_0}\right),$$
$$c_2 = c_1 - c_0,\ c = 3 \times 10^{10} \text{ cm.}$$

$$\text{II.}\quad \left.\begin{aligned} R(q) &= n_0 + (\sigma_0 + \sigma_1)q + \sigma_2 q^2, \\ &\qquad \ldots\ q - \tfrac{1}{2} \rightarrow q + \tfrac{1}{2} \\ P(q) &= n_0 - (\sigma_0 + \sigma_1)q + \sigma_2 q^2, \\ &\qquad \ldots\ q + \tfrac{1}{2} \rightarrow q - \tfrac{1}{2} \\ Q(q) &= n_0 + \sigma_2 q + \sigma_2 q^2, \\ &\qquad \ldots\ q + \tfrac{1}{2} \rightarrow q + \tfrac{1}{2} \end{aligned}\right\} m = \text{constant},$$

where

$$\sigma_0 = \frac{h}{8\pi^2 c}\ \frac{1}{K_0},\ \sigma_1 = \frac{h}{8\pi^2 c} \cdot \frac{1}{K_1},\ \sigma_2 = \sigma_1 - \sigma_0.$$

Hitherto, no one has reported an absorption spectrum of this kind, and it is not known if there may exist a double quantification of the rotation of molecules

We have found that the ultra-violet absorption spectrum of formaldehyde vapour,  $\mathrm{H_2C{=}O}$, corresponds exactly to this type of rotational spectrum, with two quantifications.

The absorption spectrum consists of 32 bands situated between 3550 and 2500 Å.U. Each of these bands is formed by hundreds of fine lines. These lines are of two types: type *a* consists of the more intense lines distributed through the whole band The other type, *b*, consists of a great number of very fine, closely grouped lines forming regular series with accumulations near each line of type *a*.

The molecule of formaldehyde has, to a first approximation, an axial symmetry about the axis passing through the carbon and oxygen atoms. The moment of inertia, J_0, about this axis is expressed by $J_0 = 2 \,.\, r^2_0 \,.\, m$, where $2r_0$ is the distance between the two hydrogen atoms, and $m = 1{\cdot}66 \times 10^{-24}$ gm. The other two moments, K_0 and L_0, have very nearly the same value. This value depends upon the distance between the carbon and oxygen atoms, and upon the angle, 2α, between the bonds of the hydrogen atoms to the carbon atom, so that $K_0 \gg J_0$.

The physical interpretation of the spectrum is that the stronger lines (type *a*) are produced by rotation about the axis of symmetry, with the smaller moment J_0. The closely grouped fine lines (type *b*) correspond to the rotations about a perpendicular axis with the moment K_0.

The analysis of the distribution of the lines in the different bands has given a very satisfactory confirmation of this interpretation. We have found, for example, for the band $B(\lambda = 3418$ to $3378)$ that the stronger lines form a doublet system of three parabolic branches each, the null-lines being $\nu_0 = 29465{\cdot}1$, $\nu'_0 = 29422{\cdot}0$, $\lambda_0 = 3393{\cdot}85$, $\lambda'_0 = 3398{\cdot}82$ Å U. intern. vac., and the formulæ of the parabolas

$$\begin{aligned} R(m) &= 29465{\cdot}1 + 35m - 2m^2, \\ P(m) &= 29465{\cdot}1 - 35m - 2m^2, \\ Q(m) &= 29465{\cdot}1 - 2m - 2m^2, \\ R'(m) &= 29422{\cdot}0 + 35{\cdot}5m - 1{\cdot}5m^2, \\ P'(m) &= 29422{\cdot}0 - 35{\cdot}5m - 1{\cdot}5m^2, \\ Q'(m) &= 29422{\cdot}0 - 1{\cdot}5m - 1{\cdot}5m^2, \end{aligned}$$

where $m = 1, 2, \ldots 8$. The correspondence between the calculated and the observed values is very good ($\Delta\frac{1}{\lambda}$ calculated − observed $< 1{\cdot}0$ cm.$^{-1}$). The distribution of the intensities is also quite regular and conforms to the theoretical one.

We deduce from these formulæ the following values for the constants:

$$c_0 = 18{\cdot}5,\ c_1 = 16{\cdot}5,\ c'_1 = 17{\cdot}0,$$

and therefore

$$\frac{1}{J_0} - \frac{1}{K_0} = 0{\cdot}67 \times 10^{+40},\ \frac{1}{J_1} - \frac{1}{K_0} = 0{\cdot}60 \times 10^{+40},$$
$$\frac{1}{J'_1} - \frac{1}{K_0} = 0{\cdot}62 \times 10^{+40}.$$

A series of lines of type *b*, distributed in parabolic branches $R(q)$ and $P(q)$, correspond to each line of these six parabolic branches. The value of $\sigma_0 + \sigma_1$ is $2{\cdot}4$ cm.$^{-1}$ with a precision of $\pm 0{\cdot}4$ cm.$^{-1}$.

We have, therefore, $\frac{1}{K_0} = 0{\cdot}04 \times 10^{+40}$.

The two moments of inertia of the normal molecule of formaldehyde are $J_0 = 1{\cdot}41 \times 10^{-40}$ and $K_0 = 25 \times 10^{-40}$. Therefore, the distance between the hydrogen atoms is $2r_0 = 1{\cdot}30 \times 10^{-8}$ cm., and between the carbon and oxygen $1{\cdot}0 \pm 0{\cdot}1$ Å.U In the molecule of water the distance between the hydrogen atoms is 1·64 Å.U., and in the carbon dioxide molecule the distance between the carbon and oxygen atom 1·02 Å.U.

For the activated molecule we find two values of the moments of inertia: $J_1 = 1{\cdot}56 \times 10^{-40}$ and $J'_1 = 1{\cdot}51 \times 10^{-40}$. The branches R, P, Q correspond to the transitions from the normal energy level to the state with the moment J_1, and the branches R', P', Q' to the transitions from the same normal state to the energy level with the moment J'_1. The distance between the hydrogen atoms is increased by the activation from 1·30 to 1·37 Å.U.

This general structure of a rotational spectrum with two simultaneous quantifications has been observed by us for several other molecules belonging to the type of 'Y-molecules'; for example, phosgene and thiophosgene. Together with Prof. J. Errera, we have found the same type of absorption spectra for different para-derivatives of benzene.

Victor Henri
Svend Aage Schou.
Institute of Physical Chemistry,
University, Zurich.

Surveys of the Great Pyramid.

In an article in Nature of December 26, 1925, Sir W. M Flinders Petrie compares unfavourably the recent survey of the Great Pyramid carried out by Mr. J. H. Cole, of the Survey of Egypt, with his own survey of 1881. He points out that the closing error in the eight angles of Mr. Cole's traverse around the pyramid, which amounts to 9·6 inches, is equal to a difference of 2·7 inches "if on the whole distance." This statement would only be relevant to his argument if the traverse were an open one run, more or less, in a straight line, and if the angular error were located entirely in the initial angle. In fact, when the measured quantities (angles and lengths) are taken as observed, the closing error of the traverse amounts to 0·7 inch, and when the traverse is adjusted to self consistency, the greatest corrections applied are 0·04 inch to a measured length and 2·7 inches to an observed angle.

In Sir Flinders Petrie's book, "The Pyramids and Temples of Gizeh," he explains in Appendix II. the methods he used for determining the precision of his work and for weeding out "occasional errors." In the example he gives, on page 230, the four observations he rejects would have been retained by such authorities as Wright and Hayford or Brunt, who only reject observations the residuals of which are at least five times as great as the probable error of a single observation, unless there are physical reasons (wrong sightings, movement of instrument, etc.) for doubting the work. In the 1881 survey, out of 108 sides of triangles around the Great Pyramid, the mean observations of no less than nine were rejected This excessive number of rejected observations should never have been tolerated.

I have little doubt that the high precision claimed by Sir Flinders Petrie has only been obtained by the unwarranted rejection of observations with large residuals, which has decreased his computed probable error but at the same time has certainly diminished the precision of his results.

Mr. Cole's survey has now been tied up to points O, Q, and W of the 1881 survey. The bronze bolt U has gone but another bolt has been leaded into the same hole in the floor of the south-east corner socket and must agree within half an inch with point U. When the two surveys are fitted together by means of the points common to both, Sir Flinders Petrie's point on the casing edge on the east of the pyramid falls 2·7 inches to the east of the casing edge as surveyed in 1925. The other three points on the casing edge agree within one inch.

Accepting the accuracy of Mr. Cole's survey as deduced from the closure of the traverse, and from our knowledge of the precision of the methods employed, this large discrepancy on the east can only be attributed to an error in the 1881 survey.

In the course of this investigation several discrepancies in Sir Flinders Petrie's work have come to light. For example, the eastern side of the Great Pyramid is given as 9067·7 inches On Plate X. the N.E. socket corner is stated to be 30·2 inches north and the S.E. socket corner 35·5 inches south of the corresponding pyramid corners. The eastern socket side should therefore be 9133·4 inches and not 9130·8 inches as given.

Mr. Cole's survey was an attempt to determine the exact shape and size of the pyramid as it was built. Sir Flinders Petrie, on the other hand, reconstructed the pyramid as, in his opinion, it should have been built. He remarks "we only need to compute a square that shall pass through the points of the casing found on each side, and having also its corners lying on the diagonals of the sockets."

This being the case, there is nothing to be gained by dealing with Sir Flinders Petrie's arguments published in Nature. However, his statement that "it would be easier to achieve equality of length than of level" is, in my opinion, not true.

I therefore conclude that Sir Flinders Petrie's survey of 1881 is not nearly so accurate as he claims, that it contains errors amounting to so much as two inches, and that Mr. Cole's survey, whatever slight inaccuracies it may possess, is the most precise survey of the Great Pyramid that has yet been made.

I agree with Sir Flinders Petrie that it is highly desirable that a survey should be made joining the existing casing edge on to lines laid out close to the base, but this will have to wait until several thousands of tons of debris have been cleared away. I hope this will be done in the near future

F. S. Richards,
Director, Computation Office.

Survey of Egypt,
El-Giza (Mudiriya),
June 12.

The first point raised by Mr. Richards refers to my remark that the method of placing a single triangle of survey round a pyramid (as in the 1881 survey) was better than a line of eight lengths of traverse carried on by dead reckoning round the base, as in 1925. The effect of the error being possibly caused in the first of the eight angles, was only stated by me to illustrate the unsatisfactory principle of the method.

The exclusion of anomalous observations of five times the probable error is held up as a pattern. That would be true enough on a series of 4000 observations. On a series of 109 the limit of normal variation would be much smaller. No arbitrary rule should be followed. I excluded anomalies, one by one, until the whole series became almost normal in distribution. I still think that this is the probable road to the truth. The casual causes were due to lateral lighting and refraction of hot air. I prefer not to vitiate results by including anomalies, which are detected by the distribution of errors.

The points O, Q, W, in common on the surveys of 1881 and 1925, are stated to have been now fitted together (without quoting a difference), and the only difference is on a point plumbed up from a deep hole in 1881, which was by no means the same place as was fixed and seen on that base side in 1925. The discrepancy pointed out between the socket length and the base side which was deduced from it, on the east, is due to some misprint or slip in mere addition, and has nothing to do with the accuracy of survey. There is, therefore, no ground for claiming that there are errors amounting to two inches in the 1881 survey.

Flinders Petrie

Magnetic Susceptibilities and Dielectric Constants in the New Quantum Mechanics.

It is well known that the conventional quantum theory must be modified in accordance with the matrix dynamics developed by Born, Heisenberg, and Jordan, and by Dirac. The purpose of the present note is twofold, namely: (1) to show that in the new theory the spacial quantisation relative to the applied field has no direct effect on the magnetic susceptibility (or the dielectric constant), and (2) to give the results of the calculation of the dielectric constant of a diatomic gas by means of the new mechanics.

(1) It has been generally supposed that in a gas or liquid the orientation of atoms or molecules is random in the absence of a field, and that consequently there may be a change in the susceptibility when the field exceeds the critical value requisite for spacial quantisation. We shall show, however, that in the matrix theory the susceptibility is the same with spacial quantisation relative to the applied field as with random orientations. Let us first suppose the magnetic body is composed of atomic rather than molecular aggregates (*e.g.* monatomic ions in solution). If a magnetic field is applied along the z-axis, the paramagnetic susceptibility per atom is proportional to the average value of M_z^2/kT, where M_z is the z-component of the resultant angular momentum M. With spacial quantisation we have $M_z=mh/2\pi$, and, if j denotes Sommerfeld's inner quantum number, there are $2j+1$ possible orientations. The average value of M_z^2 is then

$$\frac{1}{2j+1}\sum_{m=-j}^{+j}\frac{m^2h^2}{4\pi^2}=\tfrac{1}{3}j(j+1)\frac{h^2}{4\pi^2}=\tfrac{1}{3}M^2,$$

which is obviously the same result as with random orientations. Although the ordinary Langevin formula is thus still applicable even with spacial quantisation, the numerical values of susceptibilities are the same as those calculated by Sommerfeld with the older quantum theory, for his correction factor for the effect of spacial quantisation is the same as the factor by which M^2 differs from $(jh/2\pi)^2$ in the new theory.

The preceding argument can be extended to show that spacial quantisation does not change the susceptibility of paramagnetic molecules, diamagnetic susceptibilities, or the dielectric constant of molecules with an electrical moment, such as HCl. This perhaps explains why Lehrer (*Zeits. f. Phys.*, 37, 155, 1926), on repeating Glaser's experiments, finds no variation of the diamagnetic susceptibility of argon or carbon dioxide with pressure, and especially why the dielectric constants of polar gases do not ordinarily vary with the pressure or field-strength despite the fact that at atmospheric pressure the intervals between collisions are small compared to the precession period.

(2) Let us suppose we have a non-gyroscopic diatomic molecule with an electrical moment μ in the direction of the axis of figure. Using the amplitude matrices for the rotating dipole given by Miss Mensing (*Zeits. f. Phys.*, 36, 814, 1926), or by Dennison (*Phys. Rev.*, August 1926) we can calculate the dielectric constant with the perturbation methods developed by Born, Heisenberg, and Jordan. The remarkable result is obtained that only molecules in the state $j=0$ of lowest rotational energy make a contribution to the polarisation. This corresponds very beautifully to the fact that in the classical theory only molecules with energies less than μF contribute to the polarisation (Alexandrow, *Phys. Zeits.*, 22, 258, 1921). The formula for the polarisation takes the simple form

$$P=\frac{8\pi^2 I\mu^2 F}{3h^2}n(T),$$

where F is the field-strength, I is the moment of inertia, and $n(T)$ is the number of molecules in the lowest rotational state. Here and elsewhere we use the term polarisation in the restricted sense of meaning only the part of the actual polarisation which is attributable to the permanent moment of the dipoles. There is, of course, in addition the 'induced' or 'electronic' polarisation, which is approximately the same for all rotational states and hence independent of the temperature. The ratio of $n(T)$ to the total number N of molecules is given by the Boltzmann formula, and from the asymptotic value of this ratio it follows that at high temperatures our formula for P reduces to the Langevin expression $N\mu^2F/3kT$. This is a much more satisfactory result than in the older version of the quantum theory, in which both the calculations of Pauli with whole quanta (*Zeits. f. Phys.*, 6, 319, 1921) and of Pauling with half quanta (*Phys. Rev.*, 27, 568, 1926) yielded results diverging from the classical Langevin theory even at high temperatures.

Similar calculations can be applied to the paramagnetism of molecules, expect that is probably necessary to suppose the molecule gyroscopic. The formula for the susceptibility is then more complicated, as it contains contributions from all the rotational states, but still reduces to the Langevin formula at high temperatues. Details of the calculations will be published elsewhere.

J. H. VAN VLECK.

University of Minnesota.

The Attractions of the Ends of Chromosomes in Trivalents and Quadrivalents.

I HAVE lately investigated the chromosome configurations at the metaphase of the first division in the pollen mother-cells of about sixty species and varieties of plants (including triploids, tetraploids, and $2n+1$ forms). The method used guaranteed perfect fixation, and the homologous chromosomes were usually clearly distinguishable at the metaphase. The following facts have been observed (omitting those few plants in which the pairs of chromosomes at the reduction metaphase were joined elsewhere than at the ends):

(1) In diploids (upper line of Fig. 1) the two homologues are nearly always joined at both ends (*a*). Those joined only at one end (*b*) are rare.

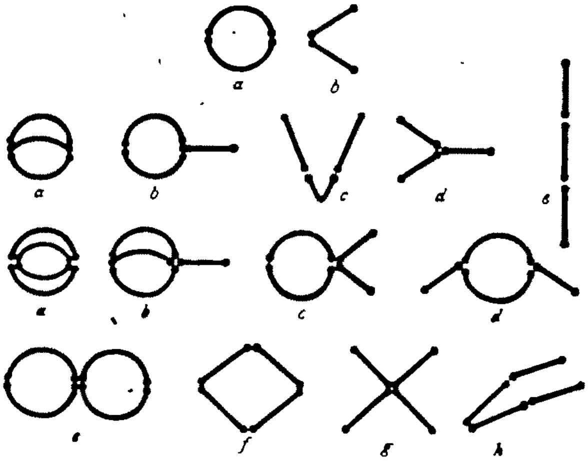


FIG. 1.—Configurations of chromosomes found in diploid, triploid, and tetraploid sets, at the first metaphase of the maturation divisions in the pollen mother-cells

(2) In triploids (second line of Fig. 1), *c* is the most common configuration, and together with *b* and *d* forms the bulk of the configurations; *a* being quite rare. This shows either that the combination of *two* chromosome ends is more stable than the combination of *three*; or that the attractions of the chromosome ends are partly neutralised by contact, so that when two ends are combined there is less attraction for a third. Thus the greater number of the junctions in the trivalents are of two chromosome ends, not of three; and in consequence free ends are common.

(3) In quadrivalents (lower two lines of Fig. 1), a is the most common form, b, c, d, and f being rare. Thus junctions of two ends are as common as those of four or three, and free ends are abundant.

(4) In agreement with these results is the fact that the frequency of separate single chromosomes at the first metaphase is least in the diploids, where they are rare. It is greater in triploids, where separate chromosomes may sometimes occur almost in every other cell. In tetraploids, however, separate chromosomes are usually so common that it often requires a search to find a cell with n quadrivalents.

John Belling.

Carnegie Institution of Washington,
Cold Spring Harbor, N.Y.

Scientific Neglect of the Mas d'Azil.

The other day in the course of an automobile tour I visited the Mas d'Azil. I would like to direct the attention of the readers of Nature, and particularly of those with money and organising power, to the very unsatisfactory state of affairs in this beautiful and incomparable treasure-house of archæological material. Practically there is no control, no protection and no organised excavation whatever at Mas d'Azil. There are masses of valuable material, but none of it is being worked at properly. Much of it, I fear, is being wasted and muddled up. There is a 'guide,' a pleasant untrained man, who pokes about in the caves, digs out bones which, as he remarks, fall to pieces, and presents the casual visitor with teeth or flint implements he has found in his own researches. He has no regular salary. He has to supplement his fees and tips by other work. Occasionally, isolated individuals obtain permission from the municipality and prod in the rocks and extract this or that and publish their 'results,' according to their lights. There is a small useless museum without labels or arrangement at the Mairie. The financial situation forbids the hope of Government direction. The essential trouble seems to be the want of funds. From Mas d'Azil came some of the most beautiful and interesting objects in the admirably arranged museum in Toulouse; the carved horse head and other carvings and the painted pebbles from this site are well known. One would not need to go outside the scientific ability available in the region if money were forthcoming to mobilise it for the proper exploitation of these priceless deposits.

H. G. Wells.

The Eggs of the Pilot-fish (*Naucrates ductor*).

In *Ann. Mag. Nat. Hist* (9) 2, p 114, 1918, Dr. Gilchrist described the egg of the Pilot-fish as having a long filament attached to the pole opposite the micropyle, and he states that it serves to attach the egg to the wall of the ovary. Further, the egg was stated to be oval, with a large perivitelline space, but without any oil globule. From the presence of the filaments on the eggs, Dr. Gilchrist presumed that the eggs were attached to floating objects and offered a plausible explanation of the well-known, but hitherto unexplained, habits of the Pilot-fish.

In November last a ripe female of the Pilot-fish was received at this Museum, and I was able to obtain a large quantity of eggs. To my astonishment these eggs differed from those described by Dr. Gilchrist in the two main characteristics mentioned: they possessed no trace of any filaments, but a distinct oil globule was present. On the other hand, they agreed in their more or less oval shape and the large perivitelline space. They floated in sea water. An examination of the ovary disclosed no "grape-like clusters" such as Dr. Gilchrist found, but only the normal structure.

In the case of such a well-known fish as the Pilot-fish, misidentification can be excluded. Another very unlikely possibility occurred to me, namely, that by a slip of the pen *Naucrates ductor* was written instead of *Echeneis naucrates*, the latter fish also being known in these waters as 'Lootsman' and found in association with sharks. To be certain, I examined the Museum material of this and allied species, the eggs of which are apparently still undescribed. Only two females with ripe ova were found and these lent no support to the suggestion of a misnomer having occurred. The ovary showed normal structure and the loose ripe eggs showed no trace of filaments.

The explanation of these diametrically opposed observations can only be found by the study of further material, and it is in the hope that ichthyological students will take the opportunity of examining fresh material and material preserved in Museums, that this letter is written.

Keppel H. Barnard.

South African Museum,
Cape Town, July 19.

Spinning Electrons.

In view of the recent correspondence in Nature concerning the spinning electron, it may be of interest to consider the effect of free electrons possessing a magnetic moment on the magnetic susceptibility of metals.

If the magnetic moment of the free electron is one Bohr magneton, and the orientation of its axis with respect to an external magnetic field is assumed to be given by the Boltzmann distribution law, then the paramagnetic contribution to the molecular susceptibility (on the basis of the Pauli-Sommerfeld averaging) will be 1378×10^{-6} P at 273° K, where P is the ratio of the number of free electrons per gram-molecule to Avogadro's number. Copper and silver have molecular susceptibilities of $-5{\cdot}7 \times 10^{-6}$ and $-20{\cdot}5 \times 10^{-6}$ respectively. The contribution to the diamagnetic susceptibility of such atoms or ions as may exist in the metal can scarcely be more than $-29{\cdot}8 \times 10^{-6}$ (the molecular susceptibility of Rb^+) in the case of copper, and -37×10^{-6} (Cs^+) in silver.

It must be remembered, in addition, that the normal atom in copper and silver has a magnetic moment of one Bohr magneton. Unless we assume that in the solid metal these elements exist in a form very different from their normal atomic state, and further, that the number of free electrons does not exceed 3 per cent. of the total number of atoms, the hypothesis of the spinning electron leads to some difficulties in understanding the diamagnetism of these metals, and of the alkalis as well.

Since the contribution to the susceptibility of the spinning free electrons would obey the Curie law, namely, that the paramagnetic susceptibility is inversely proportional to the absolute temperature, any considerable contribution to the susceptibility would therefore show itself in a temperature variation in the total diamagnetic susceptibility of a much higher order than that actually found by experiment.

I. I. Rabi.

Columbia University,
New York City,
June 22.

Biology and the Training of the Citizen.[1]

By Prof. J. GRAHAM KERR, F.R.S.

I PROPOSE in this address to depart somewhat from precedent, and to devote it neither to a general review of recent progress in our science, nor to the exposition of my own special views on problems of evolutionary morphology, but rather to a more general subject—one which I believe to be at the present time of transcendent importance to the future not merely of our nation but, indeed, of our civilisation—namely, the relation of biology to the training of the future citizen. Speaking as I do from this chair, I need scarcely say that by biology I mean more especially animal biology.

It is unnecessary to emphasise at length the enormously important part which biological science plays in the life of our modern civilised state. The provision of food for the community—crop-raising, stock-breeding, the production of dairy products, fisheries, the preservation of food by canning and freezing, and so on—is obviously an immensely complicated system of applications of biological science. So also with the maintenance of the health of the community—the prevention of disease, much of which is now known to be due to the machinations of parasitic microbes, often transported and spread by other living organisms, and the cure of disease by the modern developments of medicine and surgery—these again are applications of biological science. When we contemplate merely such simple facts known to everyone, when we see to what an extent the results of biological science are woven in and out through the whole complicated fabric of modern civilisation, when we contemplate further the gigantic expenditure in money devoted to the school training of our future citizens, it must surely strike us as an extraordinary fact that biological science enters scarcely, if at all, into the school training of our average citizen.

What I have said indeed applies, if only in lesser degree, to the subordinate position occupied by science as a whole in our school training. In the early stages of human evolution, as we see illustrated on the earth of to-day by those comparatively primitive savages who still remain in the nomadic hunting phase, what we should now call science plays an all-important part in the education of the young individual: he is taught to observe accurately the phenomena of Nature, dead and living, to draw the correct conclusions therefrom, and to regulate his actions accordingly. In our own early history, science undoubtedly played an equally important part in the training of the young. Even down into the Middle Ages it supplied an appreciable part of the curriculum of the educated man, the seven liberal arts of these days containing a large infusion of what we now call science. In later times, however, from the renaissance of classical learning onwards, science has been kept in the obscure background of our educational curriculum, and in spite of much tinkering of detail in recent years, that curriculum continues unchanged in its main features: it remains preponderatingly literary and classical. Even to-day, if we listen to contemporary discussions on education, we commonly hear arguments as to the relative merits of different constituents of the current curriculum, but the general framework of that curriculum seems to be regarded as sacred from all interference.

Yet these recent years have witnessed the most tremendous advances in the evolution of our social organisation, and, as the position now is, it seems as certain as anything can be that unless further advance is accompanied by a corresponding evolution in the training of our future citizens, a condition of instability will soon be reached such as to involve the risk of complete disaster. Probably the factor in our modern social evolution which has brought in its train the greatest danger is the development of what in general terms we may call means of intercommunication—the means by which transport is effected—on one hand of material things, on the other hand of ideas. Primitive man in the hunting phase of his evolution is a nomad, but a nomad within a restricted area: his wanderings are limited by the more or less vague boundaries between his own territory and that of neighbouring tribes. He is entirely dependent for food and raiment upon what Nature provides within these limits: he knows little of the world beyond except that it is peopled by strangers of varying degrees of hostility: his code of ethics is limited by the same boundaries—highly developed as regards intercourse with his own tribe it ceases to exist in his intercourse with those outside. His dominating idea is loyalty to his own kinsfolk and fellow tribesmen, and for this idea he is ready to make any sacrifice.

With advancing evolution, when the communal unit is no longer the clan or tribe but the nation or federation of nations, geographical and political boundaries still exist; but with the evolution of means of transport by road and rail and sea they cease to form impassable barriers—men and goods are able to pass them freely. Of even greater moment to citizenship than the transport of material things is the transmission of ideas. The great developments in this have come about in the first place with the evolution of language, the vehicle of thought, which has rendered possible the transmission of thought from individual to individual. The use of visible material symbols of a lasting kind—whether pictorial or simply conventional, as in modern writing and printing—while facilitating still further the transmission of thought from individual to individual and from place to place, has done far more, for it has enabled the achievements of each generation to be handed on to its successors with a completeness that was quite impossible by the merely spoken word.

While these advances in the methods of transmitting thought have played an all-important part in rendering secure the orderly progress of human knowledge, they have brought in their train, curiously, one of the most potent disturbing factors to the progress of communal evolution. This disturbance is brought about through interference with the workings of one of the great principles of communal evolution—that of leadership.

---

[1] From the presidential address to Section D (Zoology) of the British Association delivered at Oxford on August 6

LEADERSHIP.

Already in the primitive tribal community we find this factor at work. Tribes differ in their size and power—their men may number a mere half-dozen or several hundreds—and the main factor in this is the personality of the tribal chief. Among his own men the chief stands out by his capacity, mental and physical: a quick and accurate observer, he is also quick and accurate in drawing his deductions: he is wise, he is rich in knowledge and in its bearings; while alert and quick in decision, he is of steady nerves, has a good sense of balance, and is reliable in emergency. So it is onwards through historical evolution—the chief, the ablest man of his tribe, finds his successors in a long sequence of natural leaders of men.

It is the more modern developments concerned with the transmission of thought—printing, telegraphy, radio telephony, kinematography, and so on—that constitute the great disturbing factor, inasmuch as they have given enormously increased importance to elements of individual personality quite distinct from general strength and capacity, mental and physical. Amongst such elements there stand out conspicuously oratorical power and skill in the method of advocacy. The leader is no longer forced to the front by the sheer power of his outstanding constructive ability; the place of this is to a great extent taken over by the power of effective and persuasive writing and speaking. The most responsible posts in the leadership of the modern State have been rendered accessible to the skilled orator, even though his constructive ability in statesmanship may not be of the highest.

That this development involves serious dangers is obvious; it seems equally obvious that one of the main tasks confronting the community is the devising and setting up of the educational safeguards which alone can be efficient against these dangers. The task will, indeed, be no easy one: it will clearly, for its satisfactory accomplishment, call for the best intellects the community can provide. However great the ability of those to whom the task is entrusted, it will prove one of high complexity and much difficulty; but certain inevitable conclusions seem to be visible, one of the chief of these being the need of drastic cutting down of the number of subjects at present inflicted upon the young citizen in training during his school period. How exactly this is to be done will have to be worked out carefully; but it seems clear that at present an immense amount of time is given, during the early stages of the curriculum, to subjects which might profitably be replaced by others of greater value in mind-training during these earlier stages. If postponed to a later stage of mental development, such subjects can be mastered in a small fraction of the time required in the earlier stages—when, by the way, their prolonged and wearisome study is but too apt to kill effectively all interest on the part of the pupil in the particular subject.

While I am in complete agreement with those who desire to see the school curriculum greatly lightened as regards number of subjects and wish to see 'snippets of many subjects' replaced by more thorough training in a few, my special task now is to urge the necessity of including in the training of every citizen before the completion of his school period at least a grounding in the main principles of biological science.

It is necessary in approaching any such question to keep clear in our minds the two main functions of education: (1) the educative function in the strict sense—the training and development up to the highest attainable level of the brain-power which Nature has provided, and (2) the informative function—the providing the mind with an equipment of information which will be of use to it later on.

SCIENCE AND THE CURRICULUM.

It is again necessary to glance for a moment at the general question of science in relation to education. I am, of course, one of those who believe that the almost complete exclusion of science from the elementary education of the young which has persisted over a prolonged period has been a real tragedy. In the life of the ordinary active citizen, as opposed to that of the mere scholar and recluse, some of the most important faculties are those which training in science is specially adapted to develop. Such, above all, are the powers of accurate and rapid observation, and of the accurate and rapid drawing of conclusions from observation.

I do not, however, wish to press the claim of biology to an important place in the basic stage of school education, which should have to do with the early development of these powers. On the contrary, I harbour no doubt in my mind that the department of science to be used for this purpose is not biology but physical science. For the early training of the powers of observation there are two essentials: (1) that the phenomena observed should be capable of numerical expression to a high degree of accuracy, or, in other words, that they should be measurable; and (2) that a given observation should be capable of repetition over and over again under approximately the same set of conditions. Biological observation fails as regards both of these essentials. When we proceed to apply the method of measurement to something that is alive or that has once been alive, or to some form of vital activity, we find ourselves confronted not with a phenomenon of comparative simplicity, but with a complex of extreme and, in great part, unknown intricacy.

It is rather in the later stage of education—the informative stage—when the individual has already had his powers of observation and reasoning developed in the earlier stages, that biology should be called upon to play its rôle.

What is required is by no means the storing of the memory with a vast array of separate facts. It is rather that the budding citizen should be given a grasp of broad principles, as accepted by the competent authorities of the day. Such broad principles are generalisations from immense masses of detail. The probable soundness of the generalisation is intimately related to the broadness of its basis of fact. It is, of course, impracticable to place before the pupil the entire body of facts that constitute this base, and if it were possible it would be useless, for it is only a master who is able to perceive clearly the relations of superstructure to base. The object of the teacher is then not to attempt the vain task of demonstrating the truth of the general principle in the short period available: such facts as are introduced should serve merely to illustrate the particular principle and facilitate its appreciation.

I know that there are many who will criticise as unscientific and unsatisfactory such a simple manner of approach to general biological principles. They will say you cannot really instil such principles unless you make the pupil go through an elaborate course of laboratory training in dissection and microscopic observation such as we impose upon the specialist student of biology. I do not agree. My experience has been that an audience, whether of youths or of adults, of ordinary average composition such as we get in a public lecture in a big industrial city, appreciates the points and follows the argument perfectly satisfactorily without such elaborate preparation, provided always that the argument is clothed in plain, non-technical English.

BIOLOGY IN THE CURRICULUM.

The question may now be put: What exactly are the biological facts and principles that should be introduced into such a course of instruction?

(1) First, the great fact of evolution. We still see with tiresome frequency in magazine articles the statement that evolution is not a fact, but merely an unproved hypothesis. No doubt it may be said with perfect accuracy that in one sense absolute proof is unknown to science, except in relation to successive steps of an operation in pure mathematics. Taking, however, the word 'proved' as we use it in ordinary life, *e.g.* in relation to a matter inquired into by a Court of Law, then we are completely justified by the data of embryology and palæontology in stating that evolution is a definitely proved fact. The realisation that it is a fact admitted by all competent judges should be incorporated in the mental equipment of every citizen at an early stage of his training.

(2) Secondly, the broad fact of inheritance: the fact that the offspring repeat the characters of the parent—physical, mental, moral—but that this repetition is never so complete as to amount to identity as regards such characters. It is not always realised that, were the repetition actually exact and complete, it would constitute a fact that would shake our whole biological philosophy to its foundations!

The biologist habitually using the 'species' as his classificatory unit involuntarily becomes dominated by his mental picture of the ideal member of the species, conforming exactly to description, and an individual which obviously does not so conform impresses him as a departure from his ideal. He comes in this way to think of variation as being an active positive process by itself, instead of an inherent characteristic of life and of inheritance. It would not occur to him to decry the science of physiology because it does not know the ultimate nature of the phenomena of life with which it deals, but yet he will sometimes attempt to discredit our evolutionary philosophy because it is similarly without any clear idea as to the ultimate nature and cause of the variation which is the necessary accompaniment of life.

This instability of living things which finds its expression in the constantly fluctuating incompleteness of inheritance has to be driven well home—in the first place because it constitutes the raw material of evolutionary progress, and in the second place because its proper appreciation provides the citizen with his surest safeguard against the talk of those who make it their business to belittle, if not to deny, the ever-present differences in the capacities of their fellow-men.

(3) Thirdly and lastly, the fact of the struggle for existence in Nature and the consequent elimination of the less fit. To the biologist and, indeed, to any one who devotes thought to the matter, the struggle for existence and the consequent elimination of the unfit is an obvious truism, apart altogether from the question whether or not he accepts the Darwinian view of its potency as a factor causing evolutionary change; but yet among our fellow-citizens interested in sociological questions there is a very prevalent lack of appreciation of the widespread nature and the intensity of the struggle, induced in many cases by the perusal of charming descriptions of mutual aid in the animal kingdom, combined with ignorance of the fact that such mutual aid is restricted to the individauls of a community, and that it actually constitutes an important factor in rendering the community efficient in holding its own in the struggle with other communities.

When once the pupil has fully grasped the three great primary facts I have mentioned, he can profitably pass on to elementary notions of the biology of communal life Gateways leading to these may be found by way of the fascinating phenomena presented by communities of social insects such as bees and ants and termites Still better in some ways is the study of cell-communities, culminating in the immensely complex cell-communities that constitute the bodies of the higher animals. By whichever route, the pupil is easily led to the three great principles of communal evolution: (1) increase in the size of the community, (2) increased specialisation of its constituent individuals, (3) increased perfection of the organisation by which the constituent individuals are knit together into the communal individuality of a higher order. In some animal communities this organisation is of a material kind, the individuals being linked together by strands of living substance, in others the connexion is not material but is of the nature of social inter-relationships.

When once these basic principles are clearly apprehended an approach may profitably be made to the study of human society, where the same principles are seen clearly at work—the simple nomadic group with its individuals few in number, showing scarcely any trace of specialisation, and so loosely knit together that they separate from one another under stress of circumstances, such as attack by a hostile tribe—leading up to the complex modern civilised State with its millions of inhabitants, intensely specialised for the performance of the various communal functions, and knit together by an immensely complex social organisation.

THE INTER-COMMUNAL STRUGGLE.

The appreciation of the fact that our civilised community has come about by a long process of social evolution paves the way to an appreciation of the further fact that human societies are still in process of evolution—States becoming larger and larger, the specialisation of their citizens becoming ever more pronounced, their social organisation more complicated—and that here again a great driving force is the struggle for existence, in this case an inter-communal struggle.

It is surely one of the saddest experiences a biologist can have, to live amongst men whose communal evolution has lagged behind, and to see how, unless helped in their struggle with competitors at a higher level of social evolution by some natural protective feature such as geographical isolation or immunity to local diseases, they are doomed to disappear. Innumerable examples of this are seen in the continents of the New World, where the relatively primitive communities of red men have been displaced by whites in a higher stage of communal evolution. The same process has taken place in the past, races that lagged behind in their communal evolution giving place to others more progressive.

The realisation of the importance of this inter-communal and inter-racial competition is of use indirectly as a safeguard against falling into the common error of shutting our eyes to differences—in material interests, in racial prejudices, in religious beliefs—those troublesome factors which, in actual practice, form obstacles of the most serious kind in the way of those who would find in signed agreements between different nations a sure shield against the danger of war.

THE BIOLOGICAL OUTLOOK.

Finally, our training, if successful in inducing in our citizen's mind what we may call the 'biological outlook,' enables him to take a fresh and an enlightening view even of that distressful subject, economics. He appreciates more fully how the customary units of the economist, pounds and dollars, are merely tokens with local values dependent on their power of purchase. In a remote spot on the earth's surface, a pile of golden coins becomes merely so much workable material out of which articles useful or ornamental may be fashioned; a bundle of scrip becomes material of possible use for kindling a fire. Their actual value bears no relation whatever to their token value in other circumstances.

Our citizen from his biological view-point looks beyond this veil of make-believe and realises that the true unit of value is the capacity of the human individual. He sees in each individual a biological capitalist. His store of capital may be small or large. It may consist of the precious bullion, intellectual power, or the humbler metal, bodily strength. The store, small or great as it was to begin with, may have been simply left like talents buried in the earth, or by education it may have been increased in amount and coined into the kind of currency, such as skill in handicraft or other form of social activity, which gives it its greatest local value in the community.

TO WHAT END?

Now the question may fairly be put: What good would come of it all were the biologist given his way, and his subject, resting on a basis of elementary physical science, accorded the place in the ordinary school curriculum that he claims for it? How might it fairly be expected to work out in practice to the advantage of the community and of the individual citizen?

To attempt to state adequately the answer to this question would exhaust the time not merely of one address but of many, and I can only indicate one or two points which the answer would include. The scientific training we are arguing for would in the first place be a potent power on the side of social stability, inasmuch as it would help to develop the scientific habit of mind with its constant distrust of the ably stated 'case.' There is no more potent defence against the plausible rhetoric of the advocate than infusion of the scientific habit of bringing verbal statements up against the touchstone of actual fact.

With recognition of the principle that the welfare and happiness of the individual citizen is by no means independent of the material prosperity of the community, proper attention would be given to biological economics. It would be recognised that the training of the individual citizen must include the scrutiny of the nature and amount of his biological capital, and the taking of appropriate measures to increase his stock and to ensure its being minted into the most suitable form of currency.

Individual scrutiny would in turn drive home the necessity of confining within as narrow limits as possible the workings of the principle of mass production in education. The application of that principle plays a great part in industry, but its introduction into the sphere of education is apt to be accompanied by forgetfulness that its success in industry is entirely conditioned by one basic factor, namely, uniformity of raw material. Without such uniformity the practice of mass production is recognised as absurd. The clearer realisation how completely wanting this uniformity is in the human raw material on which education works will serve to impress upon us all the desirability of confining mass education within the narrow limits at the commencement of the educational period when it is for practical reasons unavoidable.

The fostering of the biological element in education would do something to quicken into renewed life the primitive relationship of parent and offspring which has tended to become deadened under the influence of modern civilisation and more especially of mass education. The parent would be no longer encouraged to regard his child as merely number so-and-so in a vast number of units poured into the hopper of the educational mill. He would be encouraged to keep up his natural sense of responsibility for the welfare and interests of his offspring—the slackening of which in our present system is responsible for so much that is deplorable—and incidentally he would be stimulated to take a live interest in the education of his children, in the selection of those responsible for the ordering of that education, and in the subject of education as a whole.

This greater interest would lead the parent to a better appreciation of many things connected with education. One of those of which a deeper appreciation is greatly needed has to do with the reciprocal relations of physical and mental deportment. Passing along a city street the biologist is constantly having his attention caught by little peculiarities of attitude and movement which reveal to him the existence of peculiarities of quite another kind—stability or instability of character, mental sluggishness or alertness. He realises to the full the reciprocal relations between mind and body.

The training of the individual to the highest attainable degree of biological aptitude as a citizen involves naturally his relations to other members of the community. He must be fit not merely to play his part as an isolated individual, but also to carry out smoothly and efficiently his communal activities. As communal evolution progresses, these latter relations become relatively more and more important. In the primitive savage phase the individual is still subject to the ruthless pressure of natural selection. His whole organisation—his bodily health and strength, the acuity of his senses, his mental alertness—is kept up to the highest pitch. As communal evolution goes on, however, the pressure of natural selection becomes modified. In one particular respect no doubt it becomes intensified, for the crowded community provides greatly increased liability to the attacks of pathogenic microbes, and consequently we find active evolution proceeding in the direction of increased immunity to such as are prevalent and dangerous.

While, however, in this particular respect evolution proceeds actively in the more advanced communities, it is not so in other respects. The individual no longer depends on his perfect bodily fitness, on the acuity of his senses, on the alertness of his mind, to survive and reproduce. As a result, as seems beyond question, the individual necessarily deteriorates with high civilisation in his all-round fitness both mental and physical, and this retrogression renders him correspondingly more and more dependent upon the community for his welfare. Emerging from this consideration, we have the conclusion that with higher and higher communal evolution, with more and more intimate dependence of the individual upon the community, we should have greater and greater attention paid in our educational system to these subjects which have to do with the citizen's relations to and duties towards the community—such as discipline, ethics, patriotism and loyalty to country and comrades, and the past history of the community and race.

The last of these, in fact, the history of our own people, is one of the subjects of the present school curriculum which the biologist would be particularly anxious to see retained, and even accorded increased importance. His natural sympathies go out to it, for his own philosophy—evolution—is but history of a larger growth. No doubt he would sometimes wish its teaching to be modified in detail: he would like to have less attention devoted to brawls and murders—on however great a scale—and to have a little space spared for the achievements of science. In my own city of Glasgow I often wonder how much the average child is taught regarding the two great events of the world's history which took place in that city—I mean, of course, James Watt's improvement of the steam engine and Joseph Lister's inauguration of antiseptic surgery.

In these flippant days there is a tendency to scoff at pompous lines regarding 'lives of great men,' and so on; but are we quite sure that our children are not greatly the losers by hearing so little in their school days regarding the dedicated lives of great heroes of science like Darwin or Lister?

In this address, which I must now draw to its close, I have touched upon some of the general considerations which naturally come to the mind of the biologist when he thinks of his subject in relation to this great and, as it has become, vitally important problem of the training of the future citizen. Some matters that at once suggest themselves I have deliberately avoided: eugenics—there are others who speak of that; sex—the whole air is abuzz with discussions on sex. The importance of every citizen being given a little elementary knowledge of the biological aspects of health and disease; the importance of the school paying more attention than it generally does to training the power of prolonged and concentrated effort upon dull bits of work; neither of these points requires any special emphasis.

There are, however, many other aspects of the problem which I refrain from developing, only because forbidden by the tyrant Time. Summing up the more important of these, I would say that the biologist would like to see a movement of our whole educational system away from the merely literary, doctrinaire, academic regions, in which it is apt to be out of touch with the reality of biological fact and practical affairs. He would like to see a far more general recognition of the fact that the primary object of education is to make the individual able rather than learned. A learned individual may be, and often is, a stupid one. And in any case the development and the training of general brain-power fits biologically into the earlier years of life in a way that is not the case with the acquirement of mere learning.

He would regard as another prime object in the training of the citizen the getting him back towards the primitive habit of thinking constantly. The primitive savage is kept constantly alert by ever-present danger. He is constantly thinking about the meaning of what he sees and hears. Civilised man, freed from the stress of savage life, gets into the habit of not thinking. His actions become automatic. He gulps down whatever is served up to him. If he were only to think he would promptly discriminate as to what is worthy of acceptance and what is not.

The biologist would like to see still another reawakening of ancient custom, namely, the more effective shackling of personal liberty in the bonds of duty towards the community. A biologically educated community, while according to the individual in his ordinary affairs the widest range of personal freedom, would take measures to prevent effectively its interference with the public welfare, whatever might be the form of this interference.

There is one other argument I would use for the biological factor in training the citizen. As social evolution progresses, the natural differences between men become more and more marked, as does also the material expression of these differences. One individual—say a Lister—is worth to the community many millions of pounds; another is worth little or nothing, or in some cases his value may be expressed by a negative quantity. Along with this increase of inequality there comes, unhappily, the deteriorating nervous balance which accentuates discontent and social friction. The biological outlook I believe to furnish a most potent aid towards the smoothing away of such social difficulties and the lubrication of the social mechanism, for it enables us to see with clear vision through the obscuring veil of superficiality that separates class from class, and shows us how our fellow-citizens beyond, in spite of their differences in manners and clothes and language, are after all, on the average, merely human beings like ourselves, fitted out with the same strengths and trammelled by the same weaknesses as our own.

Domestic Refrigeration.

THE origin of the discovery of refrigeration as a method of food preservation is lost in the mists of antiquity. The earliest record we have of the use of cold is that the Emperor Nero employed slaves to bring snow down from the mountains to cool his wines, so it is evident that the Romans appreciated the value of refrigeration as a means of enhancing the amenities of life in hot climates. Many centuries later the story is told by Sir Walter Scott that Saladin, leader of the Mohammedan armies, sent a frozen sherbet to Richard the Lion Hearted, much to the amazement of that doughty monarch. One hopes that such a good story is not legendary.

In the thirteenth century, Marco Polo is said to have brought back to Europe recipes for water and milk ices. It is not, however, until the sixteenth century that we obtain definite evidence of refrigeration being tried as a method for arresting the chemical processes which take place in animal tissue after death. The classic experiment of Francis Bacon is worthy of note. He stuffed snow into a chicken to see if the chicken would keep fresh. This experiment had tragic consequences for Bacon; for it is related that he caught his death of cold by alighting from his carriage one winter day to try the process.

From this simple experiment a gigantic industry has arisen, and, to illustrate the magnitude of the refrigeration industry at the present day, it may be remarked that Great Britain in 1924 imported chilled and frozen meat to the value of forty-seven million pounds sterling. In spite of this rapid commercial development, progress on the purely biological side has been slow, for very little is known as to the nature of the changes which take place in flesh chilled or frozen in the course of long periods of time.

We have evidence that flesh preserved by cold from prehistoric times is at least edible, for exploration has brought to light some remarkably well preserved specimens of the mammoth. One of these found at Beresorka, Siberia, was in such a state of preservation that the frozen meat was eaten by animals and men without any ill effects. It is supposed that the creature slipped into a crevasse in a glacier which may have been covered by vegetation as in the Malapina Glacier of Alaska. It is evident that the unfortunate creature met with a violent death. The hip bone and one foreleg were broken and there was grass between the teeth and even upon the tongue.

At the present time all we can definitely say is that refrigeration as a method of food preservation is the one which causes the minimum of alteration of the desirable food properties and consequently it is to be recommended in preference to the use of preservatives.

Whilst the commercial side of the cold storage industry is well developed, and stores of enormous capacity are available, little progress has been made in Great Britain in applying refrigeration for household purposes. In the United States the domestic refrigerating plant has been pushed vigorously during the past few years. It is stated that the production of household machines in the States has increased about 100 per cent. each year for many years, and that the total now amounts to something in the neighbourhood of 100,000.

Fascinating though the subject of the domestic refrigerating plant may be from an engineering point of view, when regarded from the purely utilitarian aspect, one must recognise that great practical difficulties are involved in the introduction of the mechanical refrigerator into the household. In the first place, as British climate is not one that calls for refrigeration for any lengthy periods in the year, the machine would need to be designed so as to be ready to operate after prolonged disuse. Furthermore, it should be proof against the attentions of the too enthusiastic owner and be unaffected by neglect whilst in the care of the cook.

The 'service' required for the maintenance of a group of plants may prove to be the most serious obstacle to the successful commercial development of the domestic machine. So, whilst there can be no doubt as to the benefit of refrigeration in the home, the means of attaining it needs careful consideration. A regular and cheap supply of ice, or a cold brine supply, from one large refrigerating plant adequate to the needs of a block of buildings, may be formidable rivals to the small mechanical plant of the future.

In the present article it is proposed to give a brief sketch of two of the many refrigerating plants now on the market. The designers of such plants have approached the problem with great originality of outlook, and consequently the resulting machines bear little resemblance to the large industrial installations.

In the choice of refrigerating fluid we also find great diversity; for example, ammonia, sulphur dioxide, ethyl chloride, methyl chloride, and a mixture of ethyl chloride and methyl bromide. The properties of ammonia are so well known as to need no description. Sulphur dioxide is greatly favoured for small plants, because the working pressures are lower than is the case with ammonia machines. It is also unique among refrigerants in so much that in the liquid state it has the properties of a lubricant. The serious drawback of sulphur dioxide is its affinity for water.

The high boiling point of ethyl chloride well adapts it for use in hot climates. A disadvantage is the necessity for using as lubricant glycerine, which is hygroscopic.

Methyl chloride is a gas condensing to liquid at −23·7° C. The admixture of methyl bromide with ethyl chloride renders the mixture non-inflammable.

The primary requirement in the case of the small plant is reliability. Certain manufacturers have produced compressor type machines which are designed so that they cannot receive any adjustment in the hands of the user beyond the turning on and off of a water tap and switch, whilst others have based their designs on the assumption that, if motive power is entirely eliminated, skilled attention becomes unnecessary. It is two of the latter type, known as absorption machines, that are described in the present article; reference may be made to the *Journal of Scientific Instruments* (August 1925) and the *Proceedings of the British Cold Storage and Ice Association*, 1925, for a description of the former class.

The absorption type of refrigerating plant is very simple in principle: ammonia gas is driven off by heat from a solution of ammonia and water; the ammonia is condensed and the liquid ammonia then allowed to boil in an evaporator, thereby producing 'cold'; the gas is absorbed in the dilute water ammonia solution, which is now cooled by water circulation. The cycle is repeated periodically.

Many attempts have been made to render the absorption machine automatic in action, and some remarkably ingenious machines have been produced. In one, known as the Keith, the boiler and evaporator are connected by steel pipes and the whole arrangement is mounted on a pivot point so as to allow it to rock. Starting from the condition when the evaporator contains a charge of ammonia and is ready to produce 'cold' by evaporation, the following is the cycle of operations:

A stud projecting from the evaporator cools and freezes water surrounding it in a small cup attached to the wall of the cool chamber. This holds the evaporator in position until all the liquid ammonia has boiled away and is absorbed by the water in the boiler now maintained cool by water circulation. When the temperature rises the ice lock is released by the melting of the boundary of the ice in the cup and, as the boiler is several pounds heavier than the evaporator, the whole unit tilts on the pivots.

This motion switches on the electric heating to the boiler and the water on to the condenser. The ammonia vapour from the boiler is condensed in this cooler and arrives as a liquid in the evaporator. After a period of about three-quarters of an hour, the charge of ammonia has been distilled over from the boiler and condensed in the evaporator. The weight of the evaporator overbalances the boiler and the machine rocks over to the position ready for a new cycle of cooling. The operation of switching over cuts off the electric supply and switches over the water so that it circulates through a coil of pipe in the boiler.

The machine has several novel features; one is a mercury seal which is so arranged that the ammonia vapour from the evaporator is passed beneath the surface of the water in the boiler during the refrigerating part of the cycle so as to produce rapid absorption.

Another feature of the machine worthy of note is the arrangement for manufacturing a supply of small blocks of ice which can be used for cooling beverages, etc. Copper studs project from the evaporator, and project at an angle of 45° into cups. When the evaporation is complete, the ice blocks thaw slightly around the sides and are freed from the cups, permitting the machine to rock. The blocks are carried up on the studs because they are at an angle and ultimately slide off into a hopper which delivers them to an ice container located on the top shelf of the refrigerator. All the cups are automatically filled with water.

Many other attempts to render the absorption machine automatic in action have been made. Recently the problem of rendering the absorption plant both automatic and continuous in operation has been studied by two Swedish inventors, Messrs. Platen and Munters. Their machine overcomes the practical difficulties encountered by Geppert, who attempted to solve the same problem in 1899, by introducing an inert gas into the system.

A diagram of the Platen-Munters machine is given in Fig. 1. The action is as follows:—When the generator (1) is heated by a heating coil projecting into the re-entrant tube (6) the ammonia dissolved in the water evaporates, rises and enters the condenser (4), where it is liquefied. Any admixture of water vapour is condensed and separated from the ammonia in a rectifier (9) and flows back into the generator. The liquefied ammonia flows down through the condenser into the upper part of the evaporator (3), where it is met by hydrogen, which is continuously transmitted from the absorber (2) through a pipe inlet (12). The liquefied ammonia thereupon flows over a number of discs (14), placed inside the evaporator, where it evaporates in, and diffuses into, the hydrogen. This evaporation and mixing goes on until the ammonia vapour has reached the partial pressure in the mixture of gases, which corresponds to the existing conditions of temperature and pressure in the evaporator. As the ammonia thus diffuses into the hydrogen, its partial pressure falls, but the total pressure in the evaporator remains the same as in all other parts of the apparatus. The gas mixture, consisting partly of hydrogen and partly of ammonia, is of a higher specific gravity than pure hydrogen, and therefore sinks down through the evaporator.

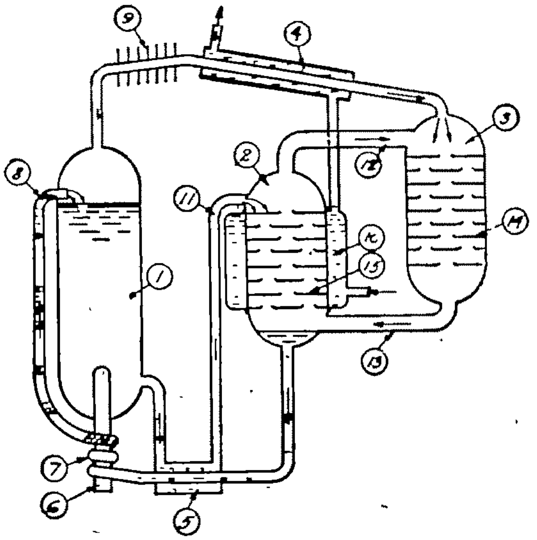


FIG. 1.—Diagram of cooling unit. 1 Generator; 2. absorber, 3. evaporator; 4. condenser; 5. heat exchanger, 6 heating medium; 7. thermo-siphon; 8 strong liquid inlet, 9 rectifier, 10 cooling jacket; 11. weak liquid inlet, 12 hydrogen inlet; 13 mixed gas outlet; 14 discs in evaporator; 15. discs in absorber. (By courtesy of Electrolux Ltd.)

During the passage through the evaporator the heat-absorbing evaporation of the ammonia takes place, and accordingly heat is taken up from the surroundings through the walls of the evaporator.

From the bottom of the evaporator the gas mixture flows through a pipe (13) into the absorber (2), where it is met by a shower of water practically free of ammonia coming through a pipe (11), and passing over the discs (15) in the absorber. This water, which, by its gravity, has flowed from the generator to the absorber through the pipe (11), readily absorbs all the ammonia in the gas mixture. The hydrogen, thus denuded of ammonia, assumes thereafter the total pressure in the upper part of the absorber. The hydrogen, thus released, naturally rises, and thereby again finds its way into the evaporator. Consequently, the hydrogen rises in the absorber and sinks in the evaporator, where it is again mixed with ammonia vapour, and in this way a continuous circulation of hydrogen between these two vessels is maintained. No hydrogen can remain in the generator while the apparatus is working, as it would be expelled by the ammonia vapour.

The return of the strong absorption liquid, from the bottom of the absorber to the generator, is provided for in a very simple way. The pipe (7-8) acts as an effective 'thermo-syphon,' by means of which the strong liquid is automatically transferred back into the upper part of the generator. The heat supplied not only lifts the liquid from the level in the absorber to the higher level in the generator, but also again releases the ammonia from the water to pursue its cycle.

It will be noticed that the weak solution when leaving the lower part of the generator is practically free from ammonia on account of the high temperature prevailing.

The pipes (5) and (11), being placed inside another, act as a heat exchanger on the counterflow principle. By means of this, the hot weak liquid, which flows from the bottom of the generator into the absorber, is pre-cooled by the comparatively cold, strong liquid that flows from the absorber to the thermo-syphon. This solution is at the same time pre-heated before entering the generator.

A test was recently made at the National Physical Laboratory on behalf of Messrs. Electrolux Ltd. (153-155 Regent Street, W.1), of a small refrigerator based on the above principle. The plant supplied was built into an insulated cabinet. The generator and heat interchanger were insulated with cork. The evaporator was surrounded by a metal tank projecting into the cabinet. In the test, the evaporator tank was insulated with a layer of granulated cork. Into the tank was inserted a propeller and an electric immersion heater and thermometer. The plant was set running and the energy required in the immersion heater to maintain the tank and its contents at −5° C. was determined by trial. Then the heat abstracted by the plant under these conditions is the sum of the energy dissipated in the immersion heater and that conducted into the tank through the cork insulation. The tests were repeated at several values of the cooling water temperature.

The correction for the heat conducted into the tank was determined as follows:—After the temperature had been maintained at −5° C. for some time, the plant was switched off, and the rate of rise of temperature of the stirred liquid in the tank was observed for a considerable period. By extrapolation back of the rate of rise at various temperatures, the value of −5° C. was deduced. The heat capacity of the tank and its contents was then determined by the electrical method, the temperature rise from an initial steady temperature, due to the generation of a known quantity of heat, being measured, when the plant was not working. This, together with the rate of rise of temperature at −5° C., gives data for the rate of leakage of heat at that temperature.

The table below summarises the results.

TANK AT −5° C

Electrical input in heating coil, 300 *watts.*

Inlet temperature of cooling water. (° C)	Air temperature (° C.)	Heat dissipated in tank around evaporator. (Kilo. cal per hr)	Heat leakage into tank. (Kilo cal. per hr)	Total refrigeration effect. (Kilo. cal. per hr)
7·35	8·6	58·1	39·6	97·7
11·95	8·75	47·5	40·9	88·4
17·4	8·8	37·1	41·4	78·5

Hence it will be observed that at a cooling water temperature of 17·4° C., a total refrigeration effect of 78·5 kilo. cal. per hour is obtained for an expenditure of 258 kilo. cal. per hour in the form of electrical energy.

An ideal heat engine working between the same temperature limits and supplied with the equivalent amount of energy would give a refrigeration effect of 3090 kilo. cal. per hour.

Whether this simple ingenious machine will solve the problem of the domestic refrigerator time alone can tell. It must be realised that it is essentially an absorption type machine and, in spite of sixty years of development, this type of machine has failed to hold its own against the compressor type in the larger sized units, except where waste steam is available. An annoying trait in the older machines was the tendency for water vapour to be carried over and accumulate as ice in the evaporator.

Science in Antiquity.[1]

By Dr. J. NEWTON FRIEND.

MAN is a curious creature, at once apprehensive and superstitious. His early observations were so closely interwoven with imagination that from his records it is oft-times difficult to sift out the wheat from the chaff.

It is to Egypt that one naturally turns for the early history of science. Learning was concentrated in the temples and in the royal courts. Magicians and necromancers were intimately associated with the ruling spirits. This is well illustrated by a story in the Westcar Papyrus, concerning Seneferu, the first king of importance in the Fourth Dynasty, *circa* 3100 B.C., and the immediate predecessor of Khufu or Cheops, the builder of the Great Pyramid. It appears that upon one occasion the king was sad, and refused to be comforted by his nobles. So the magician Tchatcha-em-ankh was sent for, who advised the king to indulge in a row on the lake with a bevy of beautiful virgins. Whilst basking in the sunshine one of the maidens accidentally dropped a turquoise ornament into the water. The king, becoming acquainted with the loss, called the magician and asked him to recover the precious thing; whereupon Tchatcha-em-ankh spoke words of power, the waters of the lake heaped themselves up on one another, and the dry bed of the lake appeared with the ornament resting in the middle. This was recovered, and Tchatcha-em-ankh again spoke words of power, the waters fell back, and all was again as before. That Moses should be credited with having performed a similar miracle by making a pathway through the sea when leading the Hebrews out of Egypt need occasion no surprise. The power of a deity was measured by that of his priests, and, in the opinion of the Hebrews, Moses was no whit inferior to the followers of Amen or of Ra.

---

[1] Substance of a lecture delivered by the author at the Royal Institution on June 10.

It is worthy of note that although commerce and religion demanded the use of balances in very early days, it was only about a hundred and fifty years ago that the value of the balance was generally recognised as a necessary adjunct to the systematic study of chemistry. In the Egyptian "Book of the Dead" the heart of the deceased is figured as being weighed in the Judgment Hall of Osiris, the counter-weight being truth, as typified by the ostrich feather. The balance bears an indicator, the movement of which, observed by Anubis, the Jackal-headed god of the Tomb or of embalmment, is recorded by Thoth, the Ibis-headed god, inventor of writing and science.

A similar idea of weighing good and evil runs through the Old Testament; as witness Belshazzar, who, we are told, was weighed in the balances and found wanting. It was regarded as grossly impious to use unjust weights and balances. In Hebrews ix. 4 we learn that the Ark contained Aaron's Rod, a Golden Pot, and two stones engraved with the Ten Commandments. Petrie very aptly suggests that these may have constituted the recognised Hebrew standards of length, volume, and weight respectively, which would naturally be kept under priestly control. In the Koran, written *circa* A.D. 600, the writer is evidently familiar with the conception of accurate weighing. Thus in Sura xxi. we read that "Just balances will be set up for the day of the resurrection, neither shall any soul be wronged in aught; though were a work but *the weight of a grain of mustard seed*, we would bring it forth to be weighed." About this time the Arabs appear to have had excellent balances, and some of their glass coin weights, dating back to the eighth century, have been tested in recent years and found to be remarkably accurate. Thus, three weights corresponded to 32·662, 32·665, and 32·667 grains respectively, a truly wonderful agreement (see NATURE, 1925, 115, 963).

In A.D. 1121 an Arab, Al-Khazini by name, discussed the balance in a work entitled the "Book of the Balance of Wisdom," and gave the density of lead as 11·33. Modern values range from 11·33 to 11·35. Further, it is interesting to note that Al Jildaki, who died about A.D. 1360, stated that "substances do not react except by definite weights." A short step further and Dalton's law would have been discovered and a bridge erected over a gulf of some four hundred and fifty years.

The ancient Druids of Cæsar's time were an intelligent set of men whose schools appear to have been famous amongst the Gauls. So great was their renown that young men came over to Britain from the continent to receive instruction at first hand from them. England was the Charlottenburg of western Europe. We have too often been led to despise the Druid, who is supposed to have burned his victims wholesale in wicker cages. Even if he did, he was but in keeping with the spirit of the times. Such a death would be less lingering than crucifixion, as practised by the Romans; and certainly no more painful than the cruel Assyrian practice of flaying alive, as illustrated on their monuments.

For many reasons we may be proud of the Druids. Amongst other things they studied astronomy. To this end clocks were necessary. In the East, sun-dials were used by day and the stars by night, to tell the time; but in a climate such as that of Britain, clocks independent of the weather were a necessity. The Egyptians had two types of water-clock, but both were based on the principle that water falling into a vessel at a constant rate will uniformly raise a float, the upward movement of which is directly proportional to the time. British water-clocks, as recently shown by R. A. Smith of the British Museum, differed entirely in principle from the above, and were probably a British invention. The clock consisted of a small bronze bowl through the bottom of which a small hole was made, as in a modern flower-pot. This vessel was then floated on water in a large bronze bowl, the water slowly entering through the hole, and eventually causing it to sink. The clock appears to have been attended constantly by a slave, who would perhaps call out or strike a gong every time the vessel sank, thereby recording the time, much in the same way as the watchmen many centuries later called out the hours of the night. Vessels of bronze, somewhat resembling frying-pans, have been found in association with the bowls, and these are believed to have served as gongs for the purpose mentioned.

Alchemy may be viewed as a link between ancient and modern science. It was regarded as a divine gift, but this is not surprising when it is remembered that knowledge was mostly vested in the monasteries, and thus intimately connected with devotion. Early recipes frequently postulate that a decoction shall be heated up or otherwise treated during the recitation of a certain number of paternosters. This, of course, was to ensure that proper time was allowed for the necessary reactions to take place, and incidentally throws an interesting light on the monkish conception of time. From this it was but a short step for the superstitious to believe, or for the quack to declare, if an experiment failed, that the cause lay in lack of devotion rather than in ordinary material experimental error.

Assisting this confusion of ideas there was also a curious mystic effect due to the contact of East with West. The Eastern mind is wildly imaginative, revelling in figures of speech and parables. The more matter-of-fact Westerner, on coming into contact with Eastern science, derived, it is true, much information that was valuable, but also accepted at its face value much that was purely mystical. It was not until the time of Boyle that he was able to shake himself free from its fetters, to study Nature from a less prejudiced point of view, and thus to enter into the realm of modern science.

The British Association at Oxford.

THE history, traditions, and amenities of Oxford mark it out as a place well suited to be the scene of the annual gathering of a body like the British Association; and it may safely be pronounced that the meeting that has just come to an end is not the least successful of those that have taken place since the Association has outgrown the questionings and misgivings that accompanied its earliest activities, and has made good its claim to efficiency and usefulness in the cause of commending the results of scientific research to the consideration of the community at large. This end has been met by the more technical and specialised communications that have formed the principal business of the sections, combined with the evening discourses delivered by men eminent in their own departments of science, with public lectures in Oxford and in neighbouring towns, and with lectures specially arranged for the benefit of older scholars from the elementary schools in the city.

The fulfilment of these various purposes has been the object of much careful deliberation and contrivance during the past year, and it is the hope of those concerned in the necessary preparations that their efforts to make the present occasion a notable one have been crowned with some measure of success. Great expectations were raised by the announcement that His Royal Highness the Prince of Wales had consented to occupy the presidential chair; and it may be said at once that those expectations were amply realised. His inaugural address provided fresh evidence, if such were needed, of the interest taken in scientific progress by the highest personages in the land, and of their sense of the important bearing of a knowledge of the facts of Nature upon the welfare of the whole body of humanity. The address, admirable alike in matter and in manner, is certain, from the interesting character of its substance and the wideness of its appeal, to be of immense service in encouraging a healthy appreciation of the aims and methods of science. Nor did the good offices of the president in the same cause end with the delivery of his address. By the readiness with which he entered into the social developments of the occasion, by his accessibility, and the gracious cordiality which he showed towards all with whom he came in contact, he has done very much to promote that kindly intercourse and encourage that fellow-feeling which should affect all those who are engaged in the common task of investigating and interpreting the phenomena of Nature.

It is the opinion of many who are well qualified to judge, that the social side of these meetings, though at first sight it may seem to bear merely the appearance of a concession to the demand for amusement, has its own peculiar value in aiding that personal interchange of views and comparison of experience for which the more formal atmosphere of a scientific sitting gives often too scanty an opportunity. It is a great point gained when one scientific worker gets to know another personally. At a reception, a garden party, or on a country excursion, it very often happens that misunderstandings are removed, that causes of irritation die down, that difficulties arising from difference of temperament are smoothed over. These surely are objects worth taking some trouble to attain; nor should it be forgotten that the coming together on terms not only of scientific but also of personal sympathy may act upon the younger worker as an inspiration, and on the elder as a quickening of his interest in the new points of view that appeal to the rising generation. These ends have been well served by the Oxford meeting.

The story of St. Frideswide may be accepted as legend with some foundation in fact; and there is no reason to doubt that the schools established in connexion with her priory, the origin of which dated from the eighth century, formed the germ of the present University. Authentic history of the city begins with the raising of the castle mound by Ethelfleda, the "Lady of the Mercians," and her surrender of Oxford to her brother Edward the Elder (A.D. 912). By the end of the twelfth century Oxford was a well-known seat of learning, and before the end of the thirteenth, the noble foundation of Walter de Merton, the model of all later collegiate establishments, had started on its way. With an academic and civic history reaching back for more than a thousand years, it is perhaps strange that Oxford should have no building capable of containing more than a very moderate-sized assembly; especially when it is remembered that among the many events of historic importance that have taken place within its walls was the session of the King's parliament of 1644; this, however, was not a numerous body. But the deficiency in question was felt as a somewhat serious inconvenience when it came to be necessary to find accommodation for all those members of the Association who wished to hear the president's inaugural address, and also for those who purposed attending at the official academic and civic receptions.

The peculiarities of an ancient University, much of the life of which is embodied in colleges—all bodies with an individual constitution, in each case largely independent of that of the University—made a certain want of concentration inevitable in the space and other facilities allotted to the purposes of the meeting. A partial remedy for this inconvenience was found in the organisation of a special system of transport, by which it was possible to reach the outlying spots in the occupation of the Association without great loss of time.

It may, on the whole, be said that these and other difficulties inherent in the situation were successfully dealt with, and that the Oxford meeting of 1926 will take its place in the records of the British Association as having contributed in a remarkable degree to the maintenance and advancement of the objects of that body. A standard has been set in this and other recent annual meetings which Leeds, the seat of the next annual gathering on August 31-September 7, 1927, may be confidently expected to follow. The meeting in 1928 will be held at Glasgow.

F. A. D.

News and Views.

AT all points where popular and professional opinion has ground for complaint against the present lunacy administration, the recently issued report of the Royal Commission on Lunacy affords clear and wise guidance to Parliament. The recommendations cover a wide field—public, private, and medical—and are fairly free from pettifogging and meaningless phrases. A certain vagueness appears over at least one of the more radical suggestions, namely, that concerning the end to which reorganisation of the Board of Control should be directed. But generally the advice offered is detailed and practical, or limited to the mere intimation that in particular directions improvement is desirable. The importance of provision for early treatment and for treatment without certification is generously recognised, the Commission advocating a recasting of the lunacy code "so that treatment of mental disorder should approximate as nearly to the treatment of physical ailments as is consistent with the special safeguards which are indispensable when the liberty of the subject is infringed." To this end detailed proposals are framed. The need for improving the status of asylum medical officers is expressed in terms equally explicit; so is the necessity for protecting medical practitioners, who at present undertake the duty of certification with increasing reluctance. The cost and responsibility of maintenance should, in the opinion of the Commission, be transferred from the Poor Law to the County authorities. No support is given to propagandist allegations of abuses in the administration of the Lunacy Act. On the question of the abolition or reorganisation of licensed houses, the Commission is divided. An Exchequer grant is proposed to meet the additional expenditure involved in a lunacy service such as the report envisages, and the hint is thrown out that an increase in recoveries following early care and the discovery, by research, of new possibilities of cure, will render such expenditure not wholly unremunerative. Further the Commission does not go, and it remains for its successor to present the problem of national fitness in its broader aspects as one of the major political problems of the modern State.

IT is a significant fact that one of the principal founders of the British Association over which the Prince of Wales is now presiding should have belonged to his own college in Oxford, and should have preceded him at that college by almost exactly one hundred years. Dr. Charles Daubeny was up at Magdalen as a Demy from 1810 until 1814, exactly a hundred years before his successor in the presidential chair this year. This is not the time to discant upon the many-sidedness of Dr. Daubeny's work within the University. In the words of his biographer: "In his whole career Dr. Daubeny was full of that practical public spirit which delights in co-operation, and feeds upon the hope of benefiting humanity by associations of men. When the British Association came into being at York in 1831, Daubeny alone stood for the universities of England, and so standing, boldly invited that body to visit Oxford in 1832. In 1856 he became president of the Association at Cheltenham, in his native county, amidst numerous friends, who caused a medal to be struck in his honour, the only occurrence of this kind in the annals of the Association." During the recent meeting a memorial wreath was placed upon the grave of the illustrious predecessor of the present president of the Association immediately within the entrance to Magdalen College, where a simple stone inscribed "C G.B D." marks the place in accordance with his own wish "that he might not be separated in death from a Society with which he had been connected for the greater part of his life."

HERR RASMUSSEN, the Danish Minister of Defence, who is shortly paying an official visit to Denmark's colony, the Faroe Islands and her sister State, the republican kingdom of Iceland, intends thereafter to proceed to the lonely, uninhabited island of Jan Mayen, lying between Greenland, Iceland and Norway. The announced object of the Minister's visit is to arrange for the erection there of a Danish seismographic station. The Danish Government owns the buildings on the island, which were given to them, it is said, by the Austrians, who once occupied Jan Mayen. It was made the station of the Austrian polar expedition of 1882–83, but has apparently remained unclaimed ever since, though Great Britain and Norway together established a 'close season' for the seal fisheries. The whale and seal fisheries off the east and north coasts are very important during the summer. Jan Mayen land, which was discovered in 1611, by the Dutch navigator of that name, is of volcanic origin, is some 35 miles long, and practically covered with immense glaciers and, in winter, frozen waterfalls. Its highest point, an extinct volcano, is 8350 feet high. Lord Dufferin refers to the island in his book, "Letters from High Altitudes," published in 1857.

THE first attempt in Great Britain to utilise the aeroplane for spraying operations in connexion with agriculture is recorded in the *Times* of August 4. Mr. George Caudwell, of Weston, near Spalding, Lincolnshire, chartered a private aeroplane piloted by Major Savage, and 40 acres of Majestic potatoes were sprayed in 25 minutes, in contrast to the two days which would have been occupied for the same operation by ordinary methods. The machine flew so low that at times it almost touched the potato tops, and the spray, in the form of a fine powder, was blown on to the leaves of the plants through two pipes on either side of the fuselage. Although this method of spraying is new to Britain, it has been applied on a large scale in the United States for the control of insect pests, extensive areas of cotton being treated in this way with considerable success. Experiments are being carried on with the view of extending the scope of application of the method to deal with a larger range of plant pests. So far as Great Britain is concerned, the report of the success of

Mr Caudwell's initial experiment will be awaited with great interest. It would seem, however, that practical difficulties may limit the application of aerial spraying in those parts of the country which are subdivided into relatively small fields with dividing hedges, but where large open areas are available much time and labour would be economised if success is attained.

AT the recent graduation ceremonial of the University of Edinburgh an interesting address to the new graduates was delivered by Prof. J. H. Ashworth. In tracing the historical development of the Edinburgh School of Zoology, Prof. Ashworth emphasised the debt it owes to three of its professors of anatomy—Monro, Monro *secundus*, and Goodsir. The first two of these were responsible for discoveries of fundamental importance to morphological science. It was Monro who demonstrated the absence of free interchange of blood between the fœtal and the maternal parts of the placenta: it was Monro *secundus* who anticipated by eighty years the discovery by Kuhne of the motor nerve-endings in muscle. The same observer, whose name is permanently registered in anatomical text-books by the 'foramen of Monro,' was also the author of the great monograph "On the structure and physiology of fishes, explained and compared with those of man and other animals." Having traced the past history of his subject, Prof. Ashworth alluded to the generous contribution of 20,000*l*. by Dr. Laurence Pullar, which, with an allocation of 18,000*l*. by the Carnegie Trust, made it at last possible to contemplate the housing of the University Department of Zoology in a building fully adequate for the special needs of zoological teaching and research. The latter part of the address was devoted to emphasising the importance of the contribution which the subject of zoology is now making to the training and outlook of the medical man on one hand, and to the general progress of mankind on the other. Zoology has established itself as an integral part in the scientific foundation of preventive medicine: it is playing a part in the advancement of civilisation and in the amelioration of the conditions of life in various parts of the world to an extent that would have been inconceivable a generation ago.

A MONUMENT to the memory of John Ericsson, the famous Swedish-American engineer, was recently unveiled at Washington, D.C., by the Crown Princess Louise of Sweden The ceremony was under the auspices of the American Society of Swedish Engineers. Erected not far from the memorial to Lincoln, the monument consists of a group symbolic of vision, adventure, and labour, standing on a massive granite pedestal, in the front of which is a statue of Ericsson, who is depicted sitting in contemplative mood. President Coolidge, responding to the speech of the Swedish Crown Prince, remarked: "Great men are the product of a great people. They are the result of many generations of effort, toil, and discipline. They are the incarnation of the spirit of the people." An unusually precocious boy, Ericsson was born in 1803 at Filipstad, Sweden, and when quite young was employed on drawings and levelling in connexion with the Göta Canal. He resided in England from 1826 until 1839, while the rest of his life was spent in the United States. His locomotive *Novelty* competed with Stephenson's *Rocket* in 1829; he was one of the chief promoters of screw propulsion, and a pioneer in the use of hot-air engines. He is best known, however, for his design and construction of the *Monitor* turret vessel.

THE annual report of the Zoological Society of Scotland for the year ending in March last is a record of the most sucessful year in the history of the Society. The large increases in the number of visitors to the Zoological Park at Edinburgh, and in the number of new fellows admitted, witness to the growing popularity and interest in its work. During the year the new Tropical Bird House and the new Reptile House were completed, and a start has been made on the Carnegie Aquarium. The latter is being built with the aid of a grant from the Carnegie Trustees, and it is hoped to have it ready for opening at the end of the year. It will add enormously to the attractions of the gardens. In spite of the rigours of the northern winter, the stock in the gardens appears to flourish and breed in quite a satisfactory manner. The number of deaths is below the average, and a good proportion of the young animals born during the year was successfully reared. One of the most notable of the deaths was that of one of the original King penguins, which proved unable to survive the strain of incubating and rearing its last chick. The financial statement reveals a healthy condition of things, and a substantial surplus from last year's activities is to be devoted to capital purposes.

A SECOND report has been issued by the Medical Research Council on the gold treatment of tuberculosis. The drug employed was sanocrysin and the report deals almost entirely with clinical experience, based on about 140 cases treated. As a result of previous experience the dangers attending the use of the drug have been greatly lessened. There is necessarily a conflict of opinion, some clinicians believing that little benefit results from the treatment. Others, however, are very emphatic in the opinion that sanocrysin did cause unusually rapid amelioration of symptoms, particularly in the lessening of sputum and disappearance of tubercle bacilli in pulmonary tuberculosis.

THE success of the Department of the Interior of Canada in its efforts to save the buffalo from extinction is shown in the fact that the great park at Wainwright, Alberta, is unable to support a further increase in the herd at present there. This park is approximately 15 miles long and 13 miles wide, and was thought by many, even a few years ago, to be ample for all time. Provision will now have to be made for the disposal of the annual increase in the herd, and the action taken by the Department will be watched with interest.

IN connexion with the recent meeting of the British Association at Oxford, the honorary degree of D.Sc. (Oxon.) was conferred upon the following distinguished visitors: Prof. Niels Bohr, professor of physics in the University of Copenhagen; The Abbé Breuil, professor of the Institute of Human Palæontology, Paris; Sir Frank W. Dyson, Astronomer Royal; Prof. A. S. Eddington, Plumian professor of astronomy in the University of Cambridge; Sir Daniel Hall, Chief Scientific Adviser to the Ministry of Agriculture; Prof. Henry Fairfield Osborn, research professor of zoology in Columbia University, Sir Edward A. Sharpey-Schafer, professor of physiology in the University of Edinburgh; Mr. F. E. Smith, Director of Scientific Research, Admiralty; Sir Josiah Stamp, Prof. Vito Volterra, professor of mathematics in the University of Rome and president of the Royal National Academy of the Lincei, Prof. Wilhelm Wien, professor of experimental physics in the University of Munich.

THE Earl of Midleton will open the new buildings of the Haslemere Educational Museum, Haslemere, Surrey, on August 27 next. A memorial tablet to Sir Jonathan Hutchinson is to be unveiled by Dr. F. A. Bather on the same occasion.

PROF. JOCELYN F. THORPE, professor of organic chemistry in the Imperial College of Science and Technology, South Kensington, has been appointed chairman of the Explosives in Mines Research Committee, in succession to Sir Frederic L. Nathan, who has resigned. Mr. F. E. Smith, Director of Scientific Research under the Admiralty, has been made an additional member of the Committee.

AN autumn meeting of the Institute of Metals is to be held at Liége on September 1-4. A number of papers on the constitution and properties of non-ferrous metals and alloys will be read and discussed, and visits to works and to places of interest in the neighbourhood have been arranged. Particulars can be obtained from the secretary of the Institute at 36 Victoria Street, London, S.W. 1.

THE trustees of the British Museum have revived the office of secretary, which since 1851 has been combined with that of principal librarian. In future the secretary will act as assistant to the director and principal librarian, with the status of a keeper. Mr. Arundell Esdaile, hitherto assistant keeper in the Department of Printed Books, has been appointed secretary.

THE Duke of York will visit the Harper Adams Agricultural College, Newport, Shropshire, on Wednesday, November 3, for the formal opening of the National Institute of Poultry Husbandry, established at the College under the joint auspices of the Ministry of Agriculture and the National Poultry Council. This signal recognition of the importance of the recent advances in the provision of adequate facilities for advanced education and experimental work in poultry husbandry will be warmly appreciated by all engaged in the industry.

AN Order of Council has been issued altering the composition of the Committee of Privy Council for Medical Research, the ministerial body under which the Medical Research Council conducts its work. The Committee originally consisted of the Lord President of the Council, the Minister of Health (England and Wales), the Secretary for Scotland, and the Chief Secretary for Ireland, but the last-named office has become obsolete as a result of the changes in the government of Ireland. In view of this vacancy, and of the increasing relation of the Medical Research Council to research work in overseas parts of the Empire and in industrial medicine, the Secretaries of State for Home Affairs, for Dominion Affairs and for the Colonies have now been added to the Committee.

DR. A. W. HILL, Director of the Royal Botanic Gardens, Kew, sailed on Saturday last for the United States, where he is attending the International Congress of Plant Sciences (the fourth International Botanical Congress) at Ithaca, N.Y., on August 16-23, as one of the official delegates of Great Britain. Dr. E. J. Butler (Imperial Bureau of Mycology), Dr. A. B. Rendle and Mr. J. Ramsbottom (British Museum (Natural History)) and Mr. Sprague (Kew) are also attending the Congress in an official capacity. After the Congress, Dr. Hill is going on to the Missouri Botanical Garden and the University of California, Berkeley, where he is to deliver three lectures, and returning via Vancouver, Toronto, Washington, D.C., and finally New York, where another lecture will be given in the Botanical Garden.

THE centenary year of Lord Lister's birth will be celebrated in Edinburgh in July 1927 during the meeting of the British Medical Association. The Committee responsible for the celebration is anxious to interest students and young graduates in the significance of Lister's work, and is offering a prize of a gold medal and 25*l.* for the best essay upon the subject, "The Influence of Lister on the Evolution of Surgery." The prize is open to registered students and graduates of not more than one year's standing of any medical school of the British Empire. Essays must be submitted by May 1, 1927, to Prof. J. Fraser, Convener of the Lister Memorial Committee, 32 Moray Place, Edinburgh. The award of the prize will be made at the Lister Celebration meeting, July 1927.

THE report of the sixth International Congress of Photography has been published by the Société Française de Photographie, 51 rue de Clichy, Paris (9e). It contains an account of the proceedings at each meeting, and the papers and reports that were presented to the Congress, but the final resolutions as to standard methods of sensitometry, and procedure in other matters in which uniformity is desirable, will be issued later. The subjects treated of at the Congress are classified under the following heads: Sensitometry, optics, photochemistry, history and documentary, and kinematography; in each case the practical applications are dealt with as well as the fundamental theories. The membership of the Congress numbered about 240, and was well representative of all the centres of scientific photographic activity.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.—A chemist and metallurgist in the Government Assay Office in Cairo—A. G. Innes, c/o Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1 (August 17). A lecturer in economics at the Imperial College of Tropical Agriculture, Trinidad—The Secretary of the College, 14 Trinity Square, E.C.3 (August 24). An assistant to the professor of surgery in the University of Bristol—The Registrar (August 28). An extra mural organiser at Armstrong College, Newcastle-upon-Tyne—The Registrar (August 31) Junior assistants at the National Physical Laboratory, preferably with some research or technical experience in either physics, engineering or electrical engineering—The Director, National Physical Laboratory, Teddington (September 4). An assistant lecturer in textile engineering at the Manchester Municipal College of Technology—The Registrar (September 20). An assistant secretary of the Oxford University Appointments Committee—The Secretary, 40 Broad Street, Oxford (October 1). A full-time assistant, or two part-time assistants, in the Department of History and Method of Science of University College, London—The Secretary, University College, Gower Street, W.C.1. Evening teachers in electrical engineering and mechanical engineering at the Croydon Polytechnic—The Principal, Central Polytechnic, Scarbrook Road, Croydon. Full-time teachers in the Physics and Chemistry Departments of the Northern Polytechnic—The Clerk to the Governors, Northern Polytechnic, Holloway, N.7.—A junior assistant under the directorate of Metallurgical Research, Research Department, Woolwich, for work mainly in connexion with technical records, reports and literature—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

FINLAY'S COMET.—This periodic comet was discovered by Mr. Finlay, Chief Assistant at the Cape Observatory, in 1886, and was observed again in 1893, 1906, 1919. S. Kanda and S. Hasunuma, of Tokyo Observatory, calculated from the 1919 observations the conditions of the present return, the perturbations by Jupiter in the interim having been considerable, producing an increase of about 6 weeks in the period. With the aid of their ephemeris, Dr. J. Stobbe succeeded in photographing the comet on August 3 at Bergedorf Observatory, near Hamburg. Its magnitude was 11·5, and its position at $0^h\ 40{\cdot}6^m$ U.T. was R.A. $4^h\ 3^m\ 48^s$, N. Decl. 17° 48′. The position indicates that perihelion occurred Aug. 7·9 U.T., which is 0·7 day later than the Tokyo prediction.

The following ephemeris is for 0^h U.T.

	R.A.	N Decl.
Aug. 15.	$4^h\ 56{\cdot}3^m$	20° 33′
19.	5 12·8	21 14
23.	5 28·6	21 47
27.	5 43·9	22 13
31.	5 58·8	22 32

The comet is a morning object passing near ζ Tauri on August 23, and entering Gemini on August 31. It is well placed for observation, but is growing slowly fainter, since the distance from both sun and earth is increasing.

A plate was exposed by Mr. F. J. Hargreaves of Kingswood, Surrey, on July 21 at $1^h\ 53{\cdot}5^m$ U.T. At first the comet was not detected upon it, but with the guidance of Dr. Stobbe's position, Mr. P. J. Melotte found a faint impression of the comet in R.A. $3^h\ 2^m\ 30{\cdot}8^s$, N. Decl. 13° 19′ 36″ (Equinox 1926·0).

THE NEW SOLAR RADIATION STATION IN SOUTH AFRICA.—A bulletin issued by the Smithsonian Institution describes Dr. C. G. Abbot's journey of 30,000 miles in search of the most suitable station in the eastern hemisphere. The desiderata were an elevated region, dry clear air, reasonable accessibility, and absence of wild tribes This last consideration caused the rejection of Khojak Peak, 70 miles north-west of Quetta, though the sky conditions were superb. Stations in the Sahara, Egypt, and Mt. Sinai were visited and rejected. His choice fell on Mt. Brukkaros in South-West Africa, 200 miles south of Windhoek, and 20 miles from the railway. It is an isolated peak 5200 feet above the sea, and 2000 feet above the surrounding plain. The sky was found to be remarkably clear, the stars being brilliant right down to the horizon. The rainfall is very small, none having fallen for ten months. There is a crater at the top with a gap to the south-east, which was found to be suitable for the excavation of a tunnel for the bolometer. The sun will be observable an hour after sunrise. A neighbouring cave will be converted into a residence for the observers, Mr. W. H. Hoover and Mr. F. A. Greeley.

Mr. A. Dryden, Public Works Inspector, S.W. Africa, has undertaken the preparation of the building, and it is hoped to commence observations in September. There are prospects of daily observations for ten months in the year, and for three-quarters of the days in the remaining two months (the so-called rainy season). The Observatory is to supplement, not to replace, the stations already existing in Chile and California.

PROPER MOTIONS OF SOUTHERN STARS.—*Memoirs of the Royal Astronomical Society*, vol. 64 (part 2), contains a catalogue of proper motions in declination of 1738 southern stars by Dr. J. E. de Vos van Steenwijk. The recent observations of the stars were made by himself at La Plata. They are compared with older observations made at the Cape, Parramatta, Santiago, Madras, and other southern observatories. The systematic corrections given by Boss have been applied. The magnitudes range from $5{\cdot}8^m$ to $8{\cdot}8^m$. The probable errors of annual motion are given; they are mainly in the neighbourhood of 0·006″.

The following seven large motions are believed to be new: No. 166, mag. 6·1, type F8, P.M. + 0·245″; No. 200, mag. 6·4, type G0, P.M. + 0·457″, No. 470, mag. 6·9, type F8, P.M. + 0·713″; No. 631, mag. 7·4, type F8, P.M. + 0·593″; No. 1529, mag 7·9, type B3, P.M. − 0·370″; No. 1774, mag. 7·0, type K0, P.M. − 0·814″; No. 2664, mag. 7·2, type B8, P.M. − 0·490″. It is unfortunate that the motions in R.A. are not given.

Research Items.

The Psychology of Amusements.—In the *Nineteenth Century* (July 1926) M. Willson Disher discusses the 'Psychology of the Show.' He points out the antiquity of the show or circus, a form of entertainment referred to in Homer, and its almost universal appeal. He finds that the various incidents resolve themselves into means whereby the visitor can experience novel sensations, or normal sensations in an intenser form, and so obtain a heightened thrill. Normal behaviour is overturned, people delight in seeing men, beasts, and things put to any but their ordinary uses, and they prefer to be deceived. The means employed vary with the advance of knowledge, but the experiences aimed at remain the same. The power moving the roundabout may change, but the general appearance has changed but little. Men on holiday bent prefer to be able to return to the attitude of childhood, and this can best be secured by similarity of outward appearance. Hence attempts to 'show up' the tricks of the show have but little effect on the show. People are seeking, not an appeal to their reason, but an appeal to their primary emotions, and are not grateful to those who would deprive the stimulus of its power. Perhaps Prof. Karl Groos' famous theory of play may be suitably recalled in this connexion. After his theory of the play of children and animals, which suggests that, biologically, in play, instincts are exercised for later use, he urges that in adult play we seek (i.) 'completion of life,' *i.e.* to experience sensations and emotions which normally in our work receive little or no gratification; (ii.) freedom from the constraint of 'must.' Fear in a limited degree, which we invoke by our own will, is very different from the fear which we experience in defiance of our will. This the show can do for us: we need not go, we can depart when we like. There is, therefore, for a short space of time, granted to us the power to feel masters of ourselves.

Craniometry of Singapore Coolies.—Dr. Gordon Harrower of Singapore has contributed to Vol. 54, Pt. 3, of the *Trans. Roy. Soc. Edinburgh* the results of an examination of the skulls of 54 male Tamils and 36 male Hokien obtained from unclaimed bodies of coolies. In cranial capacity the Hokien is on a par with the most intellectual races, and cannot be regarded as falling within the mesocephalic group in which Chinese skulls are generally classed. The Tamil, however, is on the border line of the meso- and microcephalic groups, approaching the modern negro. Yet the Hokien and Tamil skulls are approximately equal in length, the difference coming out in the breadth. In the different races compared, the Tamil is the second lowest, being only 0·9 mm. more than the Australian, while the maximum breadth of the Hokien is exceeded only by certain of the Burmese and the Ainu groups. The skull is markedly mesaticephalic. According to the view of Chinese ethnological history now generally held, the Hokien, who are natives of the Province of Fu-kien, are survivors of the aborigines who were driven into the highlands when the early invaders of northern China from eastern Turkestan had penetrated to the south of the Yangtze-kiang. The result of the present investigation strongly supports this view. The Hokien are a pure type, brachycephalic with high cranial capacity, narrow frontal region, well-marked prognathism, and distinctly sinotic megaseme orbits. The palate is primitive. In the Tamil skull the most noteworthy feature is the position of the foramen magnum, which is relatively far back. It appears to be a pure type characteristic of the Dravidian, and shows no element incompatible with the current view of the ethnological history of southern India.

Deccan Village Life in the Eighteenth Century.—Interesting side-lights are thrown on the customs of the Marâthâs by selections from the diary of the Râja of Satâra, Sivâji II. or Shâhu, who reigned 1708–1749, which are quoted by Mr. S. M. Edwardes in the *Indian Antiquary* for June. The position of *pâṭel*, or headman of the village community, is shown to entail both responsibilities and privileges of no little importance. He took precedence in various functions, such as the presentation of the ritual cake at the *Holi*, the annual procession in honour of Gaṇésa and Gauri, at the annual *Poḷa* procession, when the *Poḷa*, a bull dedicated to the gods, was marked with a trident and discus and allowed to roam at large. He held a prior claim to the decoration of his house with festoons of flowers by the Mâng and with red-ochre by the Mahâr, and to the supply of water by the village Koḷî or hereditary village servant, who was the recognised water-carrier. One of the processions in which the headman claimed precedence was the annual Śirâḷśet procession, Śirâḷśet being a legendary corn-chandler who became king for a short time, and an earthen image of whom was worshipped, carried in procession, and then thrown into a well or tank. An important rôle was filled by the headman in disputes about village boundaries. In a dispute of this nature in 1744, when other evidence failed to establish the facts, the *pâṭel* was ordered to put a cowhide over his head and shoulders and, so adorned, to walk step by step over the real boundaries of the village. He was then kept under watch for fifteen nights. As nothing untoward happened to him he was declared to have indicated the boundary truthfully. The underlying idea was that the *pâṭel*, having put the hide over his head and shoulders, became imbued with the divine influence of the sacred animal and must therefore speak the truth. In Mysore, in similar circumstances, an inferior village servant of the Holeya tribe had to carry on his head a ball of earth, scooped up in the village, with water in the middle, in which was the divine presence of the village goddess. If he went beyond the true boundary this ball of earth, it was believed, would fall to pieces, and he, having incurred the wrath of the goddess, would die in a fortnight and his house become a ruin.

A New Isopod from the Chatham Islands.—Prof. C. Chilton (*Records Canterbury Mus.*, New Zealand, vol. ii, pp. 321-326, 1925) has found among the Isopoda collected at the Chatham Islands five small specimens from a fresh-water stream, for which he establishes a new genus Paravireia in the subfamily Sphæromìnæ. The body is very convex and capable of rolling into a ball, but this genus differs from all other members of the subfamily in having five separate segments in the abdomen. A detailed description is given of a male specimen. The group (Monolistrini) to which this new genus belongs is probably an ancient one that has survived owing to the adoption of a fresh-water, and, in most cases, an underground, mode of life. The author directs attention to the interest attaching to the occurrence of this new genus in the Chatham Islands and the genus Vireia in underground waters in Europe—two very nearly related forms in localities so remote from each other.

Vitalism and Mechanism.—The editor of *Scientia* returns in the issues of his review for April and May to the consideration of vitalism and mechanism, and seeks a solution of an intermediate character. In the June issue M. Leclerc du Sablon briefly examines the principal criteria which serve to distinguish living matter, and points out that in essence they are the transformations of matter and of energy which take place in the protoplasm of living beings He believes that it is permissible to hope that the progress of chemical knowledge, which has already elucidated so many matters which appeared to our intelligence mysterious and inaccessible, may one day reveal to us the mechanism of life. He holds that it is a purely verbal solution to attribute the activity of living matter to a vital force. Every progressive step has permitted a deeper penetration into the knowledge of the phenomena which characterise life, and it is only by the slow and empirical method—as in the case of physics and chemistry—that our ideas of living matter can become more clear and more adequate. No other way can be adopted without going outside the prescribed limits of science. He concludes that the nature and origin of life may serve as a theme for the speculation of philosophers; they are not subjects of study for biologists.

THE CONTROL OF LOBSTER FISHERIES.—The interim report recently issued of the Interdepartmental Committee appointed by the Minister of Agriculture and Fisheries and the Secretary for Scotland to inquire into the crab and lobster fisheries of Great Britain (London: H.M. Stationery Office, 1926. 2*s.* 6*d.* net) gives the results of the Committee's inquiry into the lobster fishery only, the crab fishery being left until further evidence, which is to be obtained, has been considered. In accordance with the terms of reference, the Committee deals at some length with the question of further protection of the lobster of both sexes by an increase in the size below which the animal may not be taken, and of the berried female by forbidding its landing and exposure for sale during the whole or parts of the year, and the opinion is expressed that a real protection of the berried lobster would materially help to maintain an adequate lobster population. At the same time, it is held that the present position of the lobster fishery and such statistics as are available do not warrant immediate legislation in this direction. In a minority report Prof. A. Meek gives statistical evidence, accumulated since 1905 by the Northumberland Sea Fisheries Committee, which he regards as adequate grounds for the framing of an act to protect the berried lobster. An undersized lobster is of little commercial value, and, so far as the writer's experience goes, there is but little contravention of the law forbidding its landing and sale; but fishermen strongly resent, as an interference with their calling, the imposition of a penalty for the landing and sale of a berried lobster The Committee feels that the experiments which are being made in various countries in the artificial hatching of lobsters should be closely followed.

PARASITIC FUNGI IN BRITAIN.—The latest report on the occurrence of fungus, bacterial and allied diseases of crops in England and Wales, covers the three years 1922–1924 (G. H. Pethybridge, *Miscellaneous Publications* No. 52, Ministry of Agriculture and Fisheries). More diseases are listed than in the previous report, chiefly because additional host plants have now been admitted, these being mostly pasture and horticultural crops. Diseases which are new to the survey and in some cases new to Britain are indicated, and special reference is made to the downy mildew of the hop, *Pseudoperonospora Humuli* (Miy. and Tak.) Wilson, first noticed in Great Britain in 1920, which is now considered to be a probable native species which, up to the present, has been overlooked. Attention is also directed to the discovery that apple and pear scab are able to overwinter on dead fallen leaves and to produce on them their ascigerous stages which serve as centres for early spring infection. The concluding index of parasitic diseases is intended to provide as clear an idea as possible of the number and nature of the parasites associated with the crops dealt with in this survey, as a contribution towards a more complete list of British parasitic fungi than at present exists.

PENETRATION OF LIGHT INTO THE SEA.—The second number of the *Journal du Conseil International pour l'Exploration de la Mer*, published in May at Copenhagen under the editorship of Dr. E. S. Russell, continues the high standard of the first number, which was reveiwed in NATURE of May 22. In a paper by Dr. W. R. G. Atkins, researches are described dealing with the penetration of light into the sea and the increase in the coefficient of absorption on approaching land, owing to the presence of more particles in suspension. Since plant growth is dependent upon an adequate supply of light for the endothermic process of converting carbon dioxide into carbohydrates, the depth of the layer which is adequately illuminated is a major factor controlling the abundant flora of minute plants suspended in the water which the sea supports As on land, the fauna are ultimately dependent upon the flora for their food supply, so a consideration of the conditions of plant growth in the sea is of fundamental importance for any inquiry concerning the fertility of particular areas of the ocean. The author also discusses the importance of the thermal stratification of the water, which restrains the mixing of bottom water, where the necessary phosphates and nitrates are regenerated from dead organisms, with the upper illuminated layers. An interesting point which has evolved is that a white disc let down into the sea is no longer visible from above after it reaches a depth at which the intensity of light is approximately one-third of that in air at the surface.

AGES OF RADIOACTIVE MINERALS FROM AUSTRALIA.—The *American Journal of Science* for July contains a very interesting record of the analyses of Australian radioactive minerals compiled by Prof. L. A. Cotton. Unfortunately the lead-ratios are not given, and the ages are calculated from the formula $8000 . \mathrm{Pb}/(\mathrm{U}+0{\cdot}384 . \mathrm{Th})$ million years. The best modern data suggest that the factor 8000 should be about 6600. Making this correction, the pre-Cambrian mackintoshite and thorogummite from Wodgina are calculated to be about 1200 million years old. This result is probably a little high, for altered uranium minerals generally tend to lose more uranium than lead, proportionately. It agrees fairly well, nevertheless, with the ages of other minerals from the early Proterozoic era. The monazite from Normanville is also pre-Cambrian and gives a (corrected) age of 930 million years, a figure that agrees closely with the ages of permatitic minerals from Scandinavia, India, Ontario, and other localities Results are given for other minerals, but as these are recognised to be altered, their evidence is not of immediate value for either age determinations or correlative purposes

DUST IN MINES.—The Safety in Mines Research Board has issued its fourth annual report showing the researches in progress and the numerous subjects that are being dealt with, and including the report for 1925 of the Health Advisory Committee (London: H.M. Stationery Office, 1926. 1*s.* net). So far only one research appears to have been completed, and a separate pamphlet, Paper No. 23 (Mines Department: Safety in Mines Research Board. Paper No. 23: A Method of Trapping the Dust produced by Pneumatic Rock Drills. By P. S. Hay. London: H.M. Stationery Office, 1926. 6*d*. net), has been issued descriptive of it. It consists of an appliance for trapping the dust produced in rock drilling. As is well known, the fine dust produced in drilling siliceous rocks is a serious menace to the health of the men engaged in the work, being the source of the dangerous disease known as miners' phthisis. The invention consists of a cap placed over the hole which is being drilled, the cap being connected by a suitable flexible pipe to a filter bag, whilst the necessary suction is produced by the exhaust air from the rock drill. Experiments tried with the appliance in actual underground mining operations have been highly satisfactory, and seem to have demonstrated that the apparatus is practical and convenient, and that by its use the air within the working in which the drilling is being done can be kept free from dangerous dust particles, so preventing any risk to the health of the men engaged in the work.

The Growth of Surface Tension in Solutions of Common Salt.—The growth of the surface tension in newly formed surfaces of pure water has been investigated by Messrs. Hiss, Schmidt and Steyer, and Dr. E. Kleinmann in the *Annalen der Physik*, June 2, describes measurements, using the same method, on solutions of common salt. A tube with a fine and accurately measured opening at the top dips in the liquid, which can be raised and lowered on a slide. A stream of air blown horizontally across the opening causes the liquid to rise through the same, where it is blown away in spray. The air stream can be cut off electrically by means of a contact carried on a Helmholtz pendulum, which has a second movable contact producing an electric spark to illuminate the hole shortly after the air current has been shut off. The newly formed meniscus can be observed by means of a microscope, and its behaviour shows that the increase in surface tension follows an exponential law, the full value being reached in a small fraction of a second. The differences between the behaviour of water and salt solutions are studied, and some theoretical conclusions are drawn.

Aluminium Anode Film Dielectric.—It is known that various types of electrolytic cell possess unilateral conductivity, that is, they allow the electric current to pass through them much more readily when it flows in one direction than when it flows in the other. Such a device can be used to rectify alternating current into current pulsating in one direction. When we have, for example, one electrode of aluminium and one of some other conducting substance in a bichromate solution, then, when the aluminium electrode is at the higher potential, practically no current flows through the cell, provided that the potential difference is less than a certain critical value. When the potential difference is reversed a large current flows. Devices of this nature are largely used for 'lightning' arresters in electric traction. Mr. Subramanian has published in vol. 8B of the *Journal of the Indian Institute of Science* an interesting paper on the aluminium anode film dielectric. He finds that the leakage resistance of the film formed on the aluminium electrode is inversely proportional to the applied voltage for a given formation voltage and is directly proportional to the formation voltage. This resistance also is nearly independent of the frequency. The film when subjected to a voltage exceeding the critical value collapses, the breakdown being accompanied by flashes of light and crackling sounds, the pitch of which appears to be an octave higher than the frequency of the supply voltage. The electrostatic capacity of the double film in ammonium borate increases slowly with the time.

The Synthesis of Nitrous Oxide.—The first direct synthesis of nitrous oxide has been carried out by a method due to D. L. Chapman, R. A. Goodman and R. T. Shepherd, which is described in the *Journal of the Chemical Society* for June 1926. The gas is obtained when nitrogen at low pressures is submitted to an electric discharge in a quartz tube, the walls of which have been impregnated with oxygen by means of the discharge. The gas is analysed by heating a platinum wire in it, when the volume increases in the ratio of 2 to 3. When the decomposition products are exploded with hydrogen, it is found that the proportion of nitrogen to oxygen is 2 to 1, leaving no doubt that the gas is nitrous oxide.

Detonation Temperatures in Closed Vessel Explosions.—No. 1005 (E. 17) of the Reports and Memoranda of the Aeronautical Research Committee (Note on 'Detonation' Temperatures in Closed Vessel Explosions, by R. W. Fenning. I.C.E. 519. London: H.M. Stationery Office, 1926. 6*d*. net) supplements a former report on the temperature and pressure of the unburnt residue of the charge at the start of detonation in closed vessel explosions. The records of the experiments performed by R. W. Fenning make it quite clear that the chief factor in the production of explosions in mixtures of air with petrol, hexane, pentane or heptane is the temperature, the pressure having little or no effect.

The Photochemical Decomposition of Silver Iodide.—The microbalance has been used by E. J. Hartung to study the photochemical decomposition of silver iodide. Thin layers of silver, chemically deposited on vitreous silica sheets, were iodinated and the films of pure iodide exposed to sunlight in oxygen, hydrogen, and nitrogen respectively at different pressures in the presence of silver, which was used as an iodine absorbent. The results of these experiments, and those on the rate of iodination of silver and previously insolated silver iodide, are published in the *Journal of the Chemical Society* for June 1926. They show that the decomposition into silver and iodine takes place in the absence of oxygen, the maximum percentage loss of iodine being, in hydrogen 91·6 per cent., in nitrogen 88·5 per cent., and in oxygen 94 per cent.

The Slow Oxidation of Phosphorus Trioxide.—The product of the luminescent oxidation of phosphorus trioxide has hitherto been assumed to consist of phosphorus pentoxide. A paper published in the *Proceedings of the Royal Society of Edinburgh*, Vol. 46, part 2, No. 21, describes the work of C. C. Miller, which proves that under certain conditions the tetroxide is produced. Phosphorus trioxide in the presence of water vapour of 0·1 mm. pressure from 98 per cent. sulphuric acid was submitted to the action of oxygen at a pressure of 600 mm. and at a temperature of 25°. The light snow-like solid was shaken into a weighed tube and analysed by oxidising the water solution with potassium bromate, treating with hydrochloric acid and excess of potassium iodide, the liberated iodine being titrated with sodium thiosulphate. The total phosphorus was obtained by precipitation as magnesium pyrophosphate after the solution had been boiled with strong nitric acid to remove halogens. The analytical results were confirmed by microscopic investigation of the resublimed crystals.

The Gustatory Sensory Reflex.

WE have already referred to certain of the researches carried out on the special senses by F. Allen and his collaborators in describing his investigation of the tactile sensory reflex. A recent paper on the gustatory sensory reflex presents an analysis of the sense of taste, the last of the 'five' special senses to be examined by this author, using the method which has proved so successful in the case of the senses of vision, hearing and touch; the sense of smell has so far defied investigation in this manner (F. Allen and Mollie Weinberg, *Quart. Journ. Exp. Physiol.*, 15, 385, 1925). The results obtained agree with what is known at present of the sense of taste, and, moreover, can be expressed by a formula which is closely related to those derived for the other three senses investigated.

The method used in all these researches is the determination of the fusion point of interrupted stimuli applied to the end-organ concerned. Thus in vision it is the critical frequency of flicker of the colour which is determined; in sound, the critical frequency of pulsation of the tone; and in touch, the critical frequency of percussion, by means of an interrupted blast of air; so in taste, the critical frequency of an interrupted electrical stimulus applied to the tongue is observed, using varying intensities of stimulation. The authors chose electrical stimulation of the tongue, which produces a sensation of sourness, as the most satisfying method of stimulating the taste-buds, the end-organs of taste, which are found in large numbers on the circumvallate and fungiform papillæ on the dorsal surface of the organ; their method requires the application of a stimulus of definite intensity to the same point at equal intervals of time and lasting only a definite fraction of a second. It is obvious that the mechanical application of substances in solution cannot be utilised for this purpose. In taking readings the tip of the tongue was protruded into a small mouthpiece containing the stimulating electrodes, the negative being applied to the dorsum and the positive to the under surface, so that the current ran through the tissue of the tongue itself; each measurement was completed in from two to three and a half seconds.

The results obtained, using different strengths of stimulation from 0·2 to 0·7 volt, at first sight appeared very irregular, but when plotted, with duration of the stimulus at the critical frequency as ordinate and intensity as abscissa, the readings were seen to fall along four curves, convex towards the abscissa: thus there are four fusion points for each strength of the stimulus. Since only four primary taste sensations are recognised, it was extremely probable that each of these curves represented the arousal of one of these sensations. The curve for the sour sensation was taken as the one on which the greatest number of points fell, since the actual stimulus used gave rise to this sensation. The identification of the other curves required special experiments.

It is known that gymnemic acid abolishes temporarily sweet and bitter sensations; after the application of a 0·5 per cent. solution to the spot on the tongue at which the measurements were made, only two complete curves and a portion of another were obtained. None coincided with any of the normals; their position indicated depression of the receptors in the tongue. The authors considered that the incomplete curve corresponded to the bitter sensation, the receptors of which only responded to relatively strong stimulation, and that the normal curve, above which this portion lay, was the curve of bitter sensation; the remaining two curves then represented the depressed sensations of sour and salt, and assuming they were equally depressed, the normal curve for the latter could be placed; the remaining curve, unrepresented after gymnemic acid, must be that of the sweet sensation. The curves fall into the following order, commencing with the most sensitive: bitter, sour, salt, sweet; the duration of stimulation at the fusion point, using 0·2 volt as stimulus, is from 0·0015 sec. to 0·0025 sec. (bitter and sweet respectively, with sour and salt giving intermediate values). With 0·7 volt the four curves approach one another with a duration of stimulation at the critical frequency of the order of 0·005 sec. The correctness of the identification of the curves is confirmed by the fact that the receptors for the four sensations, when investigated by tasting solutions of different strengths, can be placed in the same order of relative sensitiveness.

It may be noted that the fusion point of the electrical stimuli in any given experiment cannot be predicted; in fact, it may change during its course. Since the stimulation produces a sour sensation, but at the same time affects the receptors of the other sensations, it is probable that every gustatory stimulus affects the four sets of receptors in varying degree, stimulation of one set, however, predominating.

The effects of previous stimulation of the same or opposite side of the tongue upon the position of the fusion curves were also studied. The application of a weak solution of quinine bisulphate to either side of the tongue resulted in depression of all four sensations; that is, at a given voltage, fusion of the stimuli was obtained with a longer duration of each stimulus. Acetic acid applied to the same side of the tongue depressed all sensations except sweet, but applied to the opposite side, it produced an enhancement of all sensations. A solution of 10 per cent sodium chloride depressed the sour, and bitter, and especially the salt, sensations, after homolateral application, but enhanced the sweet. Between strengths of stimulation represented by 0·4 volt and 0·6 volt this enhancement was very marked. A 20 per cent. solution applied to the opposite side of the tongue resulted in enhancement of all four sensations. Enhancement was also caused by a 20 per cent. cane sugar solution applied to the same side as the stimuli, but with 5 per cent. solution depression of the sweet, salt and sour sensations occurred.

It is thus clear that previous stimulation of a gustatory end-organ leads to a change in sensitiveness both of itself and of neighbouring end-organs, which may be in the direction of either depression or enhancement. The authors explain these results by postulating the release of efferent impulses to the end-organs following the receipt of the afferent impulses in the central nervous system; the efferent impulses are of two kinds, causing depression and enhancement of the receptors, and according as one set prevails over the other, so is the end-organ depressed or enhanced: a weak stimulus results in depression, a strong in enhancement.

The fusion curves correspond to the equation

$$\frac{1}{D} = -K \log Q + C,$$

where $1/D$ is the reciprocal of the duration of the stimulus at the critical frequency of gustation (or fusion point), Q is the quantity of electricity, and K and C are constants. This equation is closely related to those found by the same method of experimentation for vision, hearing and touch: in vision the negative log Q is replaced by the positive logarithm of the intensity of the light stimulus; in hearing and touch, the duration of the stimulus replaces its reciprocal, and in the former the logarithm of the air pressure is positive, in the latter negative; in these latter two, low intensities of stimulation produce enhancement, and the higher the reverse.

When the logarithmic curves are plotted it is found that they are straight lines with two abrupt changes of slope. In their previous communication, Allen and Hollenberg (*ibid.*, vol. 14, p. 351, 1924) described only two instead of three branches in the curves of the tactile sensations. Allen and Weinberg have reinvestigated this point (*ibid.*, vol. 15, p. 377, 1925), and find that the superficial pressure sense certainly conforms with the other senses in showing three branches in its logarithmic curve, and that the deep pressure sense shows a curve of similar nature, though the lowest branch is missing, probably because the apparatus used was incapable of delivering a sufficiently rapid series of air-puffs to reach the critical frequency at low air pressures. It appears, then, that the sense of pressure agrees in its general characteristics with the other three senses investigated. To obtain results with low air pressures the authors found it necessary to use a more sensitive surface than the palmar aspect of the forefinger, and so carried out their experiments on the lip.

The similarity of the results obtained in the case of the four senses of sight, touch, hearing and taste, together with the shapes of the logarithmic curves, suggests that the sensitivity of the receptive end-organs is under the control of the nervous system in each case. This sensitivity can be increased or diminished by stimulation of any of the receptors, the enhancement or depression affecting not only the receptors stimulated but also, by reflex action, the others which are at rest.

International Ornithological Congress at Copenhagen.

THE sixth International Ornithological Congress was held in Copenhagen on May 24-29, Dr. Ernst Hartert being the president. It should have taken place in Sarajevo in 1915, but, this being impossible, Copenhagen was chosen, where local ornithologists, Herr Lehn Schiöler, Prof. Wesenberg-Lund, and Mr. Bovien, the secretary, made excellent arrangements. The meetings took place in the splendid rooms of the Parliament Building (in the Christiansborg castle), kindly put at the disposal of the Congress by the Danish Government. More than 200 members were announced, but only 164 actually attended. Nearly all European countries were represented, as well as the United States of America, Argentina, Canada, Brazil, Cuba, India and Japan. Next to Denmark, Germany was by far the most strongly represented country, and 18 British members were present.

More than 50 papers had been announced of which 47 were read; time being too short to read all, those authors who were present were given preference. The lectures were divided between the general meetings and five sections: Section (1): Systematic ornithology, geographical distribution, palæontology, (2) anatomy, physiology, heredity and evolution; (3) biology, including ecology and bird-migration; (4) oology, nidification; (5) bird-protection and aviculture. These five sections were amalgamated into two or three, as there were no or only single papers on several of the subjects.

The president opened the first general meeting with an address (in German) on the progress and development of ornithology since 1910 (the last congress). In another meeting he spoke (in English) on "A Plea for More Scientific Collecting and Labelling" Other systematic papers were, among others: Stresemann (Berlin) on distribution and grouping of some African groups of birds; Heim de Balsac (Paris) on the supposed identity of *Cinclus cinclus* L. and *Cinclus cinclus aquaticus* Bechst; Lönnberg (Stockholm) on the origin of the North American fauna; Sushkin (Petrograd) on hybrids of shrikes and of thrushes, and on a peculiarity of adaptive evolution in the insular faunæ; Chapman (New York) on the biological significance of altitudinal life zones; Rensch (Berlin) on the justification of ornithological systematic principles in other branches of zoology; Neumann (Berlin) on the genus Alisterus (New Guinea parrot); Murphy (New York) on the adaptive variation of the Tubinares. Of other papers might be mentioned Lucanus (Berlin) on the mental life of birds; Gröbbels (Hamburg) on various anatomical subjects; Verwey (Utrecht) on the biology of the heron in the pairing season, and on a fulmar with feathered feet; Boas (Copenhagen) lectured on the neck of birds.

Great interest was manifested in bird migration, and a number of papers dealt with this subject, especially Götz (Stuttgart) on relations between moult and migration, Drost (Heligoland) on migrations in the winter months, Geyr von Schweppenburg (Munden) on the migrations of *Sylvia curruca* (Lesser Whitethroat), Schenk (Budapest) on the value and elaboration of dates of migration, Weigold (Hanover) on bird migration on Heligoland, Jägerskiöld (Gothenburg) on bird ringing by the Gothenburg Biological Society. Hörtling (Finland) dealt with ornithological explorations in Finland, and Fleming (Toronto) with the Arctic collections in the Canadian National Museum.

A somewhat prominent feature of the Congress were the numerous lantern slides and the wonderful films, which were shown in the large and beautiful 'Palace Theatre.' Unforgettable will be the motion pictures from the Bird Islands of Chile and Peru by Drs Frank M. Chapman and Murphy (New York), on the development of the young of Central European birds by Heinroth (Berlin), and, last but not least, on the last evening, Bengt Berg's films from the Upper White Nile, showing the wonderful bird life in those countries, among others the masses of migrants and the *Balæniceps rex* as well as large herds of elephants, etc. Grobbels (Hamburg) attempted to explain the physiology of the flight of birds on a film. Lectures by Meinertzhagen (London) on bird life in the Himalayas, Jespersen (Copenhagen) on the frequency of birds over the High Atlantic Ocean, Jourdain (Ditchingham) and van Oordt (Utrecht) on the bird life of Spitsbergen, Krabbe (Copenhagen) on eider-ducks and Greenland falcons, by Helms and Hortling and others, were accompanied by excellent lantern-slide projections. Lectures by Schoenichen (Berlin) and others dealt with bird protection.

Rather amusing and interesting were the imitations of birds' notes and song by Stadler and Preiss (Nürnberg), partially by mouth and partially with the help of instruments.

Much hospitality was shown to the members of the Congress. A half-day excursion took place in chars-à-bancs over a great part of Seeland, by the ancient renaissance castles Helsingör (Elsinore) and Frederiksborg to the estate of the enthusiastic bird-lover Herr Jarl, who is protecting his park and wood as a Nature reserve. Many members listened there for the first time to the powerful song of the 'Sprosser' or northern nightingale. The Minister of Foreign Affairs invited the Congress to a sumptuous tea in the rooms of the Royal Rifle Club and adjoining gardens The art-mæcenas Herr Jacobsen invited the Congress to his place at the Carlsberg Brewery. In the 'theatre' the lectures of Stadler and Preiss were delivered, a sumptuous Danish supper was served in one of the rooms of the Art Gallery, and the promenade through the extensive gardens, in the light of the full moon and lit up by numerous lanterns and torches, will long remain in the memories of those present.

Another feature of great scientific interest was the visit to the collections in Herr Schiöler's hospitable house. These collections, more or less limited to the Danish possessions, including Greenland and Iceland, are a masterpiece of completeness. All birds are represented by some beautifully mounted specimens and numerous skins, as well as very large series of skeletons, and anatomical preparations. The collection is in every way as it should be, though such completeness can at present only be reached in birds from a limited area, and is the work of a lifetime. A morning was spent in the Zoological Museum of the University, where lectures and discussions took place.

Invitations for the seventh International Ornithological Congress had come from Tunis, Finland, and Holland. A small number of the members of the International Committee voted for Tunis, others for Finland, but an overwhelming majority for Holland. The general meeting of the Congress adopted, therefore, Holland, where the next Congress is to take place in 1930, in the large and comfortable new Colonial Institute in Amsterdam

The Lister Institute of Preventive Medicine.

THE annual report which was presented by the governing body of the Lister Institute to the meeting of members held on June 9 records another year of satisfactory progress. There has been only one substantial change in staff: Dr. A. T MacConkey, who has been in charge of the serum laboratories at Elstree for twenty years, has retired, and is succeeded by Dr. G. F. Petrie. Dr. Muriel Robertson, after several years of absence through ill-health, has returned to work and will restore the protozoological laboratory to a working department. The activities of the staff are augmented by workers maintained by the Medical Research Council, the Foot-and-Mouth Disease Research Committee, the Rockefeller Foundation, the British Empire Cancer Campaign, and others who find in the Institute the facilities and atmosphere which they need.

Under Prof. Ledingham, the bacteriological department has pursued a variety of researches. Particular notice should be made of the inquiries into the invisible viruses of smallpox, vaccinia, and foot-and-mouth disease, and of those, due chiefly to Dr. J. A. Arkwright and Mr. Bruce White, into the variation and biochemical structure of the food-poisoning and other bacteria—questions which have an important bearing on the conception and differentiation of 'species.' The systematic classification, nomenclature, and identification of bacteria, upon which all good physiological and pathological work with them ultimately depends, are cared for by the National Collection of Type Cultures, maintained at the Institute by the Medical Research Council

The biochemical department in charge of Prof. Harden, who has also acted as director of the Institute during Prof. C. J. Martin's absence on sick leave, has been continuing its work on hexosephosphates and alcoholic fermentation and on the concentration and possible isolation of vitamins; Dr. Zilva is supervising the preparation of large supplies of concentrated lemon juice for the Antarctic whaling expedition. Dr. Robison is following up his important discoveries of the phosphoric esters in blood and tissues and their hydrolysis by specific enzymes.

The department of experimental pathology is energised by the director and Dr Chick, and in various directions they have extended the investigations of accessory food factors for which the laboratory is now so well known. Refinements of knowledge have led to technical difficulties, and the distinction which must now be made between vitamin A (which promotes growth) and the antirachitic vitamin D has made a good deal of previous work unsatisfactory and new experiments more and more complex. Dr. Boas has made the significant discovery that dehydration, however it is carried out, makes egg-white quite unsuitable as a sole source of protein, and indeed seems to confer on it almost poisonous properties. Long and laborious observations on the nutritional qualities of cows' milk show that diet is the important factor in determining its content in vitamin A, while the amount of sunlight the animal gets is the chief thing which influences the antirachitic value of its milk.

The finances of the Institute are superficially in good order, the past year's work leaving a balance of 14,000*l* But the position is actually far from what it should be, for of a total income of 51,000*l* no less than 36,000*l*. was derived from diagnosis fees and the sale of sera and vaccines. The demand for these products naturally varies with the vagaries of epidemics in different parts of the world, and the precarious nature of the income so obtained must hamper the governing body in extending the activities of the Institute along lines which involve long or permanent commitments. A reduplication of Lord Iveagh's splendid benefaction is much needed.

University and Educational Intelligence.

LONDON.—The following doctorates have been conferred:—*D.Sc.* (*Applied Statistics*) on Mr G. M. Morant (University College) for a thesis entitled "A Study of Egyptian Craniology from Prehistoric to Roman Times"; *D.Sc.* (*Biochemistry*) on Mr. J. H. Quastel (Imperial College—Royal College of Science) for a thesis entitled (1) "The Relationship of the Chemistry of Resting Bacteria towards Bacterial Growth," and (2) "A Theory of the Mechanism of Oxidations and Reductions *in vivo*"; *D.Sc.* (*Zoology*) on Mr. F. W. R. Brambell (University College) for a thesis entitled "Oogenesis of the Fowl (*Gallus bankiva*)"; *D.Sc* (*Engineering*) on Mr. E. Mallett (Imperial College—City and Guilds College) for a thesis entitled "Forced Oscillations, Electrical and Mechanical"; *D.Sc.* (*Geology*) on Mr. F. Raw for a thesis entitled "The Development of *Leptoplastus Salteri* and other Trilobites"; *D.Sc.* (*Physics*) on Dr. R. L. Smith-Rose for a thesis entitled "Some Recent Research in Wireless Direction Finding," and other papers; *D.Sc.* (*Zoology*) on Miss N. B. Eales for a thesis entitled "The Anatomy of the head of a Fœtal African Elephant," and other papers.

THE League of Nations' International Committee on Intellectual Co-operation held its eighth plenary session at Geneva on July 26–29 under the presidency of Prof. Lorentz. The British Empire was represented by Prof. Gilbert Murray and Sir J. C. Bose. Among the subjects discussed were: the means for securing profits for scientific workers in connexion with the industrial application of their discoveries, the organisation of an international system of scholarships for the promotion of science, the foundation of an international university for the training of statesmen, diplomats, the study of political science, etc., the co-ordination of scientific bibliography, the foundation of an international meteorological office, and the establishment of an international museum office to improve the organisation of catalogues and promote mutual assistance by loans, exchanges, distribution of photographs, etc. Sitting as governing body of the International Institute of Intellectual Co-operation, the committee received its report, adopted a programme and drew up a budget. The Institute will have at its disposal this year the French Government's subsidy of two million French francs, the Polish Government's grant of 100,000 French francs and the Czechoslovak Government's subsidy of 15,000 gold francs. The committee emphasised the necessity of setting up national university information offices in countries where they do not already exist. It was decided to study the possibility of convening in 1927 a meeting of representatives of national committees of intellectual co-operation.

UNIVERSITY tutorial class (extra-mural) teaching and its problems form the subject of a paper by Mr. R. S. Lambert, hon. secretary of the Association of Tutorial Class Tutors, published in the June number of the *Bulletin of the Association of University Teachers*. The writer points out that as the classes are largely organised by the Workers' Educational Association, nearly every tutor finds himself connected with this body, becomes a member of it, shares in its propaganda, and finds many opportunities for service as a speaker in the meetings of trade union branches, co-operative societies and guilds, working men's clubs, etc., which form the students' recruiting ground. About half the classes are, he says, taken by lecturers holding a salaried post within a university, who take a single class or two classes, in addition to their internal work, or instead of part of it, and are paid a fee per class (80*l.* as a rule). The other half are taken by tutors giving the whole or a greater part of their time. Of these, about twenty-five hold permanent salaried posts as 'staff tutors' under the various Joint (University and W.E.A.) Committees, and thirty have no guaranteed salary or status, but are dependent for their livelihood on fees paid according to the number of classes they happen to be taking. The work is both physically and mentally exacting, and four or five classes per week (each class meets twenty-four times during the year) are enough to occupy a man's entire energies. It is clear that these extra-mural classes of adult three-year students constitute vitally important areas of contact between the universities and the community, and their development, which is proceeding rapidly, needs very close attention.

COMPARATIVE statistics of German university students in 1914 and 1925 show very remarkable changes in distribution among the various faculties. Students of medicine, the humanities, mathematical and natural sciences, and evangelical theology comprised in 1914 respectively 25, 21, 11, and 7 per cent. of the total numbers; in 1925 these percentages had shrunk to 11·5, 16, 8, and 3. Students of law, of political science, and of chemistry, on the other hand, increased from 17, 4, and 1 per cent. to 28, 15·5, and 5 per cent. The total number increased during the same period from 69,644 to 81,699, this last figure being smaller by nearly eight thousand than the corresponding figure for 1924. These statistics are taken from "Academicus," a useful handbook of information about German universities and polytechnics. The 1926 issue (published by Alfred Lorentz, Leipzig, price M2.40) includes, for the first time, particulars of the German-speaking institutions of Austria and Czechoslovakia.

Contemporary Birthdays.

August 14, 1861. Sir Richard Threlfall, K.B.E., F.R.S.
August 14, 1860. Dr. Arthur Prince Chattock, F.R.S.
August 15, 1842. Sir William A. Tilden, F.R.S.
August 15, 1871. Prof. Grafton Elliot Smith, F.R.S.
August 16, 1863. Prof. Frederic Stanley Kipping, F.R.S.
August 18, 1831. Mr. Ernest Noel, F.G.S.
August 19, 1868. Prof. William Bulloch, F.R.S.

Sir RICHARD THRELFALL, who was born at Holloworth, Lancashire, was educated at Clifton and Caius College, Cambridge. He is chairman of the Fuel Research Board.

Dr. CHATTOCK was born at Solihull, Warwickshire. He is emeritus professor of experimental physics in the University of Bristol.

Sir WILLIAM TILDEN, the veteran chemist, to whom we offer our very hearty congratulations on the celebration of his eighty-fourth birthday, was born in London. Formerly a science master at Clifton College, he occupied next the chair of chemistry at Mason College, Birmingham. On leaving there he became professor of chemistry at the Royal College of Science, London, retiring in 1909. The Royal Society had awarded him in the previous year its Davy medal for his discoveries in chemistry. Sir William gave the Mendeléeff Memorial Lecture before the Chemical Society, in 1909, in all respects a masterly exposition. Incidentally, we may recall that Mendeléeff's last appearance in London was in November 1905, when he attended to receive the Copley medal of the Royal Society.

Prof. G. ELLIOT SMITH was born at Grafton, N.S.W., and educated at the Universities of Sydney and Cambridge. Formerly professor of anatomy in the University of Manchester, he now occupies a similar chair in University College (University of London). In 1912 the Royal Society awarded him a Royal medal in recognition of distinctive investigations on the comparative anatomy of the brain. Prof. Elliot Smith is the author (among many works) of "The Evolution of Man" (1924), and holds original views on the origin and diffusion of culture.

Prof. KIPPING was born at Manchester and educated there at the Grammar School, at Owens College, and at the University of Munich. For some time he was on the teaching staff of Heriot-Watt College, Edinburgh, and next became a lecturer in chemistry at the Central Technical College, London. In 1897 Prof. Kipping was appointed to the chair of chemistry in University College, Nottingham. The Royal Society awarded him its Davy medal in 1918 for his investigations in organic chemistry.

Mr. ERNEST NOEL, who is in his ninety-fifth year, is the *doyen* of the Geological Society of London. Educated at Edinburgh and Trinity College, Cambridge, he was elected into the Geological Society in 1849, and thus has been seventy-seven years on its roll.

Dr. WILLIAM BULLOCH was born at Aberdeen and educated there at the University. Formerly assistant professor of pathology in University College, London, he has been, since 1919, Goldsmiths' professor of bacteriology in the University of London. He is Hon. LL.D. Aberdeen.

Societies and Academies.

PARIS.

Academy of Sciences, July 5.—Gabriel **Bertrand** and M. **Machebœuf**: The influence of nickel and cobalt on the action exercised by insulin on the dog. The results of experiments carried out on the rabbit have been given in an earlier communication: it is now shown that the addition of cobalt and nickel to insulin causes similar effects on the dog and rabbit. There is an increase in activity in both animals; cobalt has a greater influence than nickel.—Gaston **Julia**: A series of polynomials connected with the conformal representation of simply associated areas.—Luigi **Fantappiè**: Analytical functionals which are functions of a finite number of linear functionals.—René **Lagrange**: Legendre functions of the first species and certain associated functions.—N. **Gunther**: The movement of a liquid filling a simply associated domain which is displaced.—Henri **Bénard**: The deviations of the values of the frequency of vortices alternating with respect to the law of dynamical similitude.—Th. **De Donder** and Fr. H. **van den Dungen**: The quantification deduced from Einsteinian gravific.—Léon **Brillouin**: The undulatory mechanics of Schrödinger; a general method of resolution by successive approximations.—W. H. **Keesom**: Solidified helium (*v.* NATURE, July 17, p. 81).—Jean **Lecomte**: Infra-red absorption spectra of cyclic derivatives. The infra-red absorption spectra of derivatives of benzene, cyclohexene, and cyclohexane have been compared and numerical data are given.—René **Lucas**: The rotatory power of tartaric acid. The effects of the addition of such substances as boric acid, tungstic acid, urea, etc., can be explained as being due to the appearance of one new form, strongly dextrorotatory, and in proportions varying with the reagents. It is possible that the anomalies of malic acid follow a similar mechanism.—P. **Daure**: The qualitative study of the fluorescence of bromine vapour.—R. de **Mallemann**: Magnetic rotatory dispersion and the dispersion of electric double refraction. From theoretical considerations it is concluded that the ratio of Verdet's constant to Kerr's constant should vary inversely as the wave-length, or, alternatively, the ratio of the magnetic rotatory dispersion to the dispersion of electric double refraction should be equal to the corresponding ratio of wave-lengths. This conclusion is verified experimentally for carbon disulphide and for camphor in hexane solution.—Paul Gabriel **Girault**: A possible influence of commutation on the stability of continuous current machines.—Georges **Fournier**: The absorption of β-rays by matter.—D. P. **Konovalov**: The heats of combustion of some hydrocarbons. Values are given for the heats of combustion of cyclohexene, methylenecyclohexane, and dicyclohexane and the figures compared with those calculated from a formula given by the author in an earlier paper.—A. **Boutaric** and G. **Corbet**: On the critical temperature of solution of acrolein and water and on the molecular mass of soluble acrolein resin. The soluble acrolein resin studied is a polymer of ten molecules of acrolein.— — **Surun**: The estimation of the adsorbing power of carbons.—E. **Rouyer**: The determination of some double salts in solution by the boiling point method. Experimental data for the double sulphate of ammonium and RSO_4, where R is cadmium, iron, cobalt, manganese, zinc, magnesium, copper, and nickel, and also double chlorides of the carnallite type.— — **Holweck**: The spectrometry of the *K* series of the light elements. The *K* discontinuity of fluorine. The advantages of the method of critical potentials are emphasised; it brings out the *K* discontinuity of fluorine at 684·2 volts very clearly. By combining the results of several workers, the Moseley curve from helium to sulphur is shown to be a straight line.—V. **Ipatief** and A. **Andreevsky**: The displacement of platinum by hydrogen under high pressures. The precipitation of platinum from its solutions by hydrogen is a function of the temperature, pressure, concentration, and time, and results of experiments in which each of these factors was varied are given. The presence of metals such as iron and nickel, especially in acid solution, tends to retain platinum in solution.—Daniel **Florentin**: The estimation of soluble silica in cements, mortars, and concretes.—Georges **Denigès**: The action of concentrated hydrobromic and hydriodic acids on the cobalt ion. A new reaction for nickel. A description of new colour reactions of cobalt with concentrated hydrobromic and hydriodic acids and of nickel with concentrated hydriodic acid.—André **Job** and Antoine **Cassal**: The fixation of carbon monoxide on an organic magnesium compound by means of chromic chloride. A solution of phenylmagnesium bromide is without action upon carbon monoxide, but the addition of anhydrous chromium chloride causes an immediate absorption of the gas. From the products of this reaction benzopinacone, benzophenone, benzhydrol, diphenyl, diphenyl-acetophenone, and benzaldehyde were isolated. Some chromium-carbonyl is also produced.—Marcel **Delépine**: A supposed isomer of methylene-amino-acetonitrile. Methylene-bis-iminodiacetonitrile. The substance previously described as an isomeride of methylene-aminonitrile is proved to be the methylene derivative of imino-diacetonitrile.—Emile **Votoček** and F. **Valentin**: The optical inverse of natural rhamnose. Starting with isorhodeonic acid, *d*-rhamnose has been prepared; it has all the properties of natural rhamnose except that its rotation is of opposite sign.—F. **Salmon-Legagneur**: The action of ethyl-magnesium bromide on the methyl ether of the α-mononitrile of camphoric acid. The products of the reaction are α-ethylidene-camphidone, and a secondary nitrile alcohol.—Octave **Bailly** and Jacques **Gaumé**: The synthesis and hydrolysis of glyceromonophosphoric di-ester; $\alpha\beta$-diglyceromonophosphoric acid and the constitution of orthophosphoric acid.—René **Delaplace**: The preparation of cæsium eosinate. Cæsium hydroxide is treated with the theoretical quantity of acid eosin to prepare the eosinate. Details are given of the preparation of the eosin and of the cæsium hydroxide, together with the method of recovering the cæsium.— — **Viret**: New observations relating to the rodent fauna of Saint-Gérand-le-Puy.—Mlle. G. **Bonne**: The nature of the floral section in the Chrysobalaneæ.—M. **Bridel** and C. **Béguin**: A new glucoside, hydrolysable by rhamnodiastase, extracted from the fresh flowers of *Ulex europæus*. Details of the extraction, chemical and physical properties of a new glucoside, to which is given the name ulexoside. This gives the methylpentose reaction, and can be hydrolysed by rhamnodiastase giving a sugar and ulexogenol.—A. **Sartory**, R. **Sartory**, and J. **Meyer**: The study of the action of radium on *Aspergillus fumicatus* in culture on dissociated and non-dissociated media.—M. and Mme. A. **Chauchard**: The action of curare on the electrical apparatus of the torpedo (*Torpedo marmorata*). The curarisation of the electrical apparatus of the torpedo necessitates the use of relatively large doses of curare. The poison does not act on the nerve but on the electrical organ.—G. A. **Nadson** and M. N. **Meisl**: The mechanism of the action of chloroform on living matter. Description of the action of chloroform on a yeast (*Saccharomyces Ludwigii*), the observations being so arranged that the same cell was studied throughout.—Pierre **Girard** and Edouard **Peyre**: The suppression of shock and modification of the anaphylactic sensibilisation by certain fluorescent colouring matters. The colloidal mechanism.—Charles **Pérez**: Some secondary sexual characters in Galathea.—Louis **Roule** and Léon **Bertin**: The development with complex metamorphoses (hypermetamorphosis) of *Nemichthys scolopaceus*.—Paul **Mathias**: The evolutive cycle of a trematode of the family of the Echinostomidæ (*Echinoparyphium recurvatum*).—Robert **Regnier** and Roger **Pussard**: The constitution of the reserve stores of *Microtus arvalis* (field mouse), and its importance for the multiplication of this rodent.—E. **Aubel** and L. **Genevois**: Researches on the reduction of thionine by various organic substances, in the absence of air and light.—L. **Lutz**: The soluble ferments secreted by the Hymenomycetes. Oxidising actions.—J. **Sabrazès**: Spirochætes in experimental peritonitis by intestinal perforation in the guinea-pig.

CAPE TOWN.

Royal Society of South Africa, June 16.—K. H **Barnard**: A study of the freshwater isopodan and amphipodan Crustacea of South Africa. A general account of the biology of *Phreatoicus capensis*, including a curious habit of æstivation, and certain tendencies to variation, is given. *P. capensis* is closely allied to *P. australis*; both forms are regarded as being the direct descendants of the ancestral stirps represented by the fossil species *wianamattensis*. A freshwater isopod of the family Jæridæ having affinities with the Australian genus *Heterias* is described. Several new species of 'blind' gammarids are described; the localised habitat of these 'blind' species is contrasted with the wider distribution of the single black-eyed species. *Phreatoicus capensis* is confined to old and mature valleys in the less highly tilted mountains, and is not found now outside the limits of the effective deposition of moisture from the clouds formed by the S.E. Trade winds. The finding of a fossil species of Phreatoicus shows that the tribe was both austrogenic and palaeogenic, and rules out the theory of a migration of northern Crustacea via the Andes into Australasia.—S. H. **Haughton**: The river system of S W. Gordonia: In the last few miles of its course, the Molopo River shows all the characters of rejuvenation impressed upon a mature stream—waterfalls, a winding deep gorge, and old river-gravels. This rejuvenation is due to the recession of the Aughrabies Falls past the mouth of the Molopo and the consequent cutting-back of the Molopo Falls to their present position. There is no permanent stream in the Molopo now. The tributaries of the Orange to the west of the Molopo in Gordonia have arrived at a more mature stage, although they are deeply entrenched. The cessation of erosive action in S W. Gordonia seems to have been an event of geologically recent date.—B. F. J. **Schonland** and J. **Craib**: Measurements of the electric fields of thunderstorms. An observatory for the study of electrical meteorology was established on the farm Gardiol, near Somerset East, in January 1926, and a photographic recording apparatus similar to that designed by C. T. R. Wilson has been in use.

ROME.

Pontifical Academy of Sciences (Nuovi Lincei), May 24.—**Stein**: Double stars in the astrographic catalogue of the Vatican zone.—**Colonnetti**: Experimental investigations on elastic co-actions.—**Sesini**: Elastic co-actions.—**Pugno**: Study of the compensators in use in optical experiments on elasticity.—**Luigioni**: New species of blind coleoptera (*Duvalites Franchettii*) discovered by Baron Carlo Franchetti in a grotto near Subiaco (Central Italy).—**Luigioni**: The specific validity of *Anoxia sicula*.—**Pagnini**: The hypotheses serving as foundation for the undulatory theory of light.—**Palazzo**: Geophysical observations relating to the total eclipse of the sun.—**Palazzo**: The magnetic contour of Somaliland.—**Silvestri**: Pseudonummulites in the tertiaries of Tuscany.

SYDNEY.

Linnean Society of New South Wales, May 26.—Rev. H. M. R. **Rupp**: Further notes on the genus Pterostylis Records are given of five additional species, together with corrections and additions to some of the previous notes on the genus.—E. W. **Ferguson**: Revision of Australian Syrphidæ (Pt 1). Little attempt has hitherto been made to deal systematically with the Australian species. Keys for the separation of the subfamilies, and for the identification of the species of Cerioides, Eristalis, Helophilus and Microdon are given. Twenty-three species are described as new.—P. D. F. **Murray**: An experimental study of the development of the limbs of the chick. Grafts on to the chorio-allantoic membranes of seven-day chicks, of the limb buds and fragments of limb buds of three-, four- and five-day chicks, and of limb *anlagen* at earlier stages, show the limb *anlagen* to have in a high degree the power of self-differentiation, their development being apparently independent of other regions of the chick, except for the blood supply. The limb bud is a mosaic structure. Ends of skeletal elements may develop normal joint structures in the absence of the neighbouring element upon which the joint would normally work.—R. **Greig-Smith**: The influence of certain colloids upon fermentation (Pt. 3). Fuller's earth and aeration in the alcoholic fermentation. Judging by the action of fuller's earth, the mineral colloids have an action of their own in accelerating the activity of yeast in the fermentation of dextrose. Their faculty of assisting the dispersal of dissolved carbon dioxide does not explain their action, for when the fermenting fluids were aerated, the colloid still hastened the fermentation.

VIENNA.

Academy of Sciences, June 17.—V. **Oberguggenberger**: The scintillation of the stars. A coarse diffraction grating was fixed to a telescope so that the grid was parallel to the daily motion. The telescope being fixed, the star traversed the field and showed a spectrum trace on the photographic plate. In this way the Innsbruck Observatory has examined the frequency of the scintillation.—G. **Reimann**: The formation of organs from adventitious buds in *Tolmiea Menziesii*. An attempt to trace the influence of the ratio between carbohydrates and mineral salts in forming leaves or roots.—M. **Kofler**: A simple definition of the inconstancy of a natural phenomenon.—J. **Pircher**: An apparatus for registering the squalliness of the wind connected to a Dines' anemograph.—V. **Conrad**: Fluctuations of seismic activity in various fold-regions.—A. **Wagner**: Wind registrations on the 150-metre high radio tower at Altenburg, Germany.—W. **Schmidt**: Experiments with models on the influence of the rotation of the earth on the course of rivers.

Official Publications Received.

Department of Scientific and Industrial Research. Second Report of the Gas Cylinders Research Committee (Periodical Heat Treatment). Pp. iv+29+13 plates. (London: H.M. Stationery Office.) 2s. 6d. net.

The National Physical Laboratory. Watch and Chronometer Trials, 1925. Pp. 5. (London: H.M. Stationery Office.) 6d. net.

Ceylon Administration Reports for 1925. Part 4: Education, Science and Art (F). Administration Report of the Government Marine Biologist for 1925. By Dr. Joseph Pearson. Pp. F16. (Colombo: Government Record Office.) 25 cents.

Ceylon. Sessional Paper 15, 1926: Reports on the Pearl Fishery of 1925. By Dr. Joseph Pearson. Pp. 80+11 plates. (Colombo: Government Record Office.) 2.25 rupees.

Proceedings of the Imperial Academy. Vol. 2, No. 5, May. Pp. xiii-xviii+193-240. (Ueno Park, Tokyo.)

Proceedings of the United States National Museum. Vol. 69, Art. 8: Miscellaneous new Chalcid-Flies of the Hymenopterous Family Encyrtidae. By P. H. Timberlake. (No. 2639.) Pp. 34+2 plates. (Washington, D.C.: Government Printing Office.)

Methods and Problems of Medical Education. (Fourth Series.) Pp. ix+32+48. (New York City: The Rockefeller Foundation.)

Bulletin of the American Museum of Natural History. Vol. 56, Art. 3: The Skeleton of *Moschops capensis* Broom, a Dinocephalian Reptile from the Permian of South Africa. By William K. Gregory. Pp. 179-251+21 plates. (New York City.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 1, Part 1: Theory of Generating Functions and its Application to the Theory of Probability. By Toyojiro Kaneda. Pp. 62. 1.40 yen. Vol. 1, Part 2: Studies on Binary Mixtures. By Jitsusaburo Sameshima. Pp. 63-106. 1.10 yen. Vol. 1, Part 3: Über die Maximalordnung einiger Funktionen in der Idealtheorie. Von Zyoiti Suetuna. Pp. 107-153. 1.05 yen. Vol. 1, Part 4: Thermochemical Studies. By Hajime Hirobe. Pp. 155-212. 1.80 yen. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 1, Part 1: Tertiary Mollusca from Shinano and Echigo. By Matajiro Yokoyama. Pp. 23+7 plates. 1.60 yen. Vol. 1, Part 2: Podsol in South Saghalien, by Prof. Tetsugoro Wakimizu; Physiographical Studies of the Southeastern Part of Bōsō Peninsula, by Prof. Naomasa Yamasaki; Brief Notes on Fergusonite and Allanite from Iyo, Shikoku, by Prof. Denzō Satō; Variation of Specific Gravity of Japanese Crude Oils, with Special Reference to their Geological Occurrence, by Prof. Tsunenaka Iki; The Cupriferous Pyritic Ore Deposits of the Shibuki and Seki Mines in the Province of Bungo, Japan, by Prof. Takeo Kato; The Genetical Interpretation of Extrusive Rocks, by Seitarō Tsuboi; A Tertiary Forerunner of Effusive Rocks in the Northeastern Japan, by Kōroku Tsuboya; The Post-Paleozoic and Late-Mesozoic Earth-Movements in the Inner Zone of Japan, by Yoshiaki Ozawa; Zonal Growth of Plagioclase and Sodaorthoclase in Syenitic Magma, by Tei-ichi Itō. Pp. 25-109+plates 8-13. 2.00 yen. Vol. 1, Part 3: Mollusca from the Tertiary Basin of Chichibu. By Matajiro Yokoyama. Pp. 111-126+plates 14-15. 0.80 yen. Vol. 1, Part 4: Tertiary Mollusca from Shiobara in Shimotsuké. By Matajiro Yokoyama. Pp. 127-138+plates 16-20. 1.10 yen. Vol. 1, Part 5: A Dispersion Method of Discriminating Rock-Constituents and its Use in Petrogenic Investigation. By Seitarō Tsuboi. Pp. 139-180. 1.00 yen. Vol. 1, Part 6: The Cretaceous Formation of Futaba in Iwaki and its Fossils. By Shigeyasu Tokunaga and Saburo Shimizu. Pp. 181-212+plates 21-27. 1.70 yen. Vol. 1, Part 7: Molluscan Fossils from the Tertiary of Mino, by Matajiro Yokoyama; Neogene Shells from Kōzuké and other Provinces, by Matajiro Yokoyama; Tertiary Mollusca from the Oil-Fields of Embetsu and Etaibetsu, by Matajiro Yokoyama. Pp. 213-248+plates 28-33. 1.50 yen. Section 3: Botany. Vol. 1, Part 1: Über den Reifungsvorgang des Pharbitis-Samens mit besonderer Rucksicht auf die Keimungsfähigkeit des unreifen Samens. Von Yoshiji Yoshii. Pp. 189+1 Tafel. 2.65 yen. Section 4: Zoology. Vol. 1, Part 1: Studies on some Nematode Parasites of Frogs and Toads in Japan, with Notes on their Distribution and Frequency, by Kaoru Morishita; On Two new Genera of Frog Trematodes, Cryptotrema and Microlecithus, and a new Species of Pleurogenes, by Yoshimasa Ozaki; The Anatomy and Development of a Rhizostome Medusa, *Mastigias papua* L. Agassiz, with Observations on the Phylogeny of Rhizostomae, by Tohru Uchida; Three new Species of Amphistomata from Mammals, by Tamao Fukui. Pp. 118+6 plates. 2.90 yen. Section 5: Anthropology. Vol. 1, Part 1: On the Cephalic Index and Stature of the Japanese and their Local Differences; a Contribution to the Physical Anthropology of Japan. By Akira Matsumura. Pp. 312+10 plates. 11.00 yen. (Tokyo: Maruzen Co., Ltd.)

New South Wales. Department of Mines: Geological Survey. Mineral Resources No. 34: A Contribution to the Mineralogy of New South Wales. By George Smith. Pp. 145+32 plates. (Sydney, N.S.W.: Alfred James Kent.) 3s. 6d.

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty, for the Year 1925. Pp. 10. (Cape Town.)

South Australia: Department of Mines. Mining Review for the Half-year ended December 31st, 1925. (No. 43.) Pp. 87+8 plates. (Adelaide: R. E. E. Rogers.)

The Cordwainers Technical College (Incorporated), Eagle Court, St. John's Lane, E.C.1. Prospectus of Classes in Boot and Shoe Manufacture and Making, and Leather Goods Manufacture: Day and Evening Classes, Session 1926–7. Pp. 42. (London.)

Journal of the Royal Statistical Society. New Series, Vol. 89, Part 3, May. Pp. viii+405-584. (London: Royal Statistical Society.) 7s. 6d.

Canada. Department of Mines: Mines Branch. Final Report of the Peat Committee appointed jointly by the Governments of the Dominion of Canada and the Province of Ontario: Peat, its Manufacture and Uses. By B. F. Haanel. (Mines Branch No. 641.) Pp. xviii+298+68 plates. (Ottawa: F. A. Acland.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Horticultural Section, Technical Bulletin No. 75: Influence of Nutrient Supply on Earliness of Maturity in Cabbage. By J. B. Edmond and H. P. Lewis. Pp. 16. (East Lansing, Mich.)

Proceedings of the American Academy of Arts and Sciences. Vol. 61, No. 5: Measurement of the Compressibility of the Alkali Halides. By J. C. Slater. Pp. 135-140. 50 cents. Vol. 61, No. 6: Contributions to Mineralogy from the Department of Mineralogy and Petrography, Harvard University. 12: Catalogue of the Collection of Meteorites in the Mineralogical Museum of Harvard University. By Charles Palache. Pp. 151-159. 25 cents. Vol. 61, No. 7: A Mathematical Study of Crystal Symmetry. By Austin F. Rogers. Pp. 161-203. 75 cents. (Boston, Mass.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1484: The Clover Leaf-Weevil and its Control. By W. H. Larrimer. Pp. ii+6. (Washington, D.C.: Government Printing Office.) 5 cents.

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1925. Pp. 50. (Entebbe.)

Loughborough College, Leicestershire. Calendar, Session 1926-27. Pp. xiv+228+67 plates. (Loughborough.) 2s. 6d. net.

Diary of Societies.

SATURDAY, AUGUST 14.

MINING INSTITUTE OF SCOTLAND (at Glasgow).

WEDNESDAY, AUGUST 18.

CORRELATION OF SCIENCE SOCIETY (at Royal Botanic Society of London), at 3.—Conference on Partial Impact and Whirling Coalescence.

SATURDAY, AUGUST 21.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Annual Meeting) (at Newcastle-upon-Tyne), at 2.30.

CONGRESSES.

AUGUST 27 AND 28.

IRON AND STEEL INSTITUTE (Autumn Meeting) (at Stockholm).—F. Adcock: The Effect of Nitrogen on Chromium and some Iron Chromium Alloys (Alloys of Iron Research, Part IV.).—J. H. Andrew and H. A. Dickie: A Physical Investigation into the Cause of Temper Brittleness.—Prof. C. Benedicks, H. Bäckström, and P. Sederholm: Anomalies in Heat Conduction, with some Determinations of Thermal Conductivity in Iron and Carbon Steels.—Prof. C. Benedicks and R. Sundberg: Electrochemical Potentials of Carbon and Chromium Steels.—G. F. Comstock: The Treatment of Steel with Ferro Carbon-Titanium.—G. A. Hankins, D. Hanson, and Miss G. W. Ford: The Mechanical Properties of Four Heat-Treated Spring Steels.—Prof. K. Honda: Is the Direct Change from Austenite to Troostite Possible?—A. Johansson and R. Von Seth: The Carburisation and Decarburisation of Iron and Some Investigations on the Surface Decarburisation of Steel.—A. Johansson and A. Wahlberg: The Development of the Swedish Iron and Steel Industry during the last thirty years.—E. Kinander: Notes on Jernkontoret.—A. Lundgren: The Testing of Hardened Steel.—W. Petersson: Notes on the Development of the Swedish Mining Industry during the last twenty-five years.—G. Phragmen: The Constitution of the Iron-Silicon Alloys.

AUGUST 29 TO SEPTEMBER 1.

SOCIÉTÉ HELVÉTIQUE DES SCIENCES NATURELLES (at Fribourg).—In Sections devoted to Mathematics, Physics, Geophysics, Meteorology and Astronomy, Chemistry, Geology, Mineralogy and Petrography, General Botany, Special Botany and Geographical Botany, Zoology, Entomology, Anthropology and Ethnology, Palæontology, Medical Biology, History of Medicine and Natural Science.

AUGUST 31 TO SEPTEMBER 8.

WORLD POWER CONFERENCE (at Basle), Technical Programme of Sectional Meeting:

Utilisation of Water Power, and Inland Navigation.
Exchange of Electrical Energy between Countries.
The Economic Relation between Electrical Energy Produced Hydraulically and Electrical Energy Produced Thermally: Conditions under which the two systems can work together with advantage.
Electricity in Agriculture.
Railway Electrification.

SEPTEMBER 1 TO 4.

INSTITUTE OF METALS (Autumn Meeting) (at Liége) (September 1, at 8.—Dr. W. Rosenhain: Ancient Industries and Modern Metallurgy) (Autumn Lecture).—Dr. C. J. Smithells, H. P. Rooksby, and W. R. Pitkin: The Deformation of Tungsten Crystals.—Prof. K. Honda: A Comparison of Static and Dynamic Tensile and Notched-Bar Tests.—C. H. M. Jenkins: The Constitution and the Physical Properties of the Alloys of Cadmium and Zinc.—H. J. Gough, S. J. Wright, and Dr. D. Hanson: Some Further Experiments on the Behaviour of Single Crystals of Aluminium under Reversed Torsional Stresses.—B. Otani: Silumin and its Structure.—G. B. Phillips: The Primitive Copper Industry of America. Part II.—Kathleen E. Bingham: The Constitution and Age-Hardening of Some Ternary and Quaternary Alloys of Aluminium containing Nickel.—Dr. A. G. C. Gwyer and H. W. L. Phillips: The Constitution and Structure of the Commercial Aluminium-Silicon Alloys. With an Appendix upon The Properties of the Modified Aluminium-Silicon Alloys, by Dr. D. Stockdale and I. Wilkinson.—J. D. Grogan: Some Mechanical Properties of Silicon-Aluminium Alloys.—Dr. C. S. Smith and Prof. C. R. Hayward: The Action of Hydrogen on Hot Solid Copper.—Capt. F. R. Barton: The Development of the Use of Nickel in Coinage.—A. Pinkerton and W. H. Tait: Season-Cracking in Arsenical Copper Tubes.—Prof. P. Chevenard: Thermal Anomalies of Certain Solid Solutions.—W. T. Cook and W. R. D. Jones: Preliminary Experiments on the Copper-Magnesium Alloys.—F. W. Rowe: Bronze Worm Gear Blanks produced by Centrifugal Casting.—L. Boscheron: An Account of the Non-Ferrous Metals Industry in the Liége District.

SATURDAY, AUGUST 21, 1926.

CONTENTS.

PAGE
Educational Training for Overseas Life . . . 253
Indian Witchcraft and Primitive Forms of Belief . 255
Storm and Stress. By R. G. G. 257
Root Habits and Growth. By W. E. B. . . 258
Our Bookshelf 259
Letters to the Editor:
Microstructure of Mercury.—Dr. Walter Rosenhain, F.R.S., and A. J. Murphy . . . 261
The Damping of Pendulous Jets.—Prof. Paul Kirkpatrick 261
Another Patagonian *Lusus Naturae*.—G. A. Gardner 262
Dwi-Manganese in Native Platinum.—O. Zvjaginstsev, M. Korsunski and Prof. N. Seljakow 262
Kaufmann's Experiment and the Spinning Electron.—Dr. L. C. Jackson 263
Liver Extracts in the Treatment of Malignant Disease.—John R. Howitt 263
Kammerer's Alytes.—Prof. E W. MacBride, F.R.S. 264
The Birefringence of Crystalline Carbonates, Nitrates and Sulphates.—Prof C. V. Raman, F.R.S. 264
The Reduction of Carbonic Oxide.—Prof. Henry E. Armstrong, F R S. 265
Operation of Fog-Signals from a Distance.—John J. Dowling; The Writer of the Note . . 265
Scientific Neglect of the Mas d'Azil.—The Abbé Breuil 265
Preservation of Mammalian Spermatozoa.—Arthur Walton 265
The Production of Single Crystals of Metals and some of their Properties. By Prof. H. C. H. Carpenter, F.R.S. 266
The Problem of the Origin of Species as it appeared to Darwin in 1859 and as it appears to us To-day. By Prof. Henry Fairfield Osborn, For. Mem. R.S. 270
The Geographical Distribution of Magnetic Observatories. By Dr. C. Chree, F R.S. 273
Obituary:
Sir William Ridgeway. By Dr. A. C Haddon, F R.S. 275
News and Views 276
Our Astronomical Column 280
Research Items 281
The International Geological Congress at Madrid . 284
Cancer Causation: Importance of Cell Physiology 284
Hæmoglobin 285
Contact Catalysis. By Dr. Eric K. Rideal . . 285
University and Educational Intelligence . . . 286
Contemporary Birthdays 287
Societies and Academies 287
Official Publications Received 288
Diary of Societies and Congresses 288

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Educational Training for Overseas Life.

NOT the least significant feature of the third report of the Committee appointed by the British Association to consider the Educational Training of Boys and Girls for Overseas Life, presented at the Oxford meeting, is the emphasis which is laid upon the social importance of agricultural and other practical studies. The Committee rightly states that the intellectual and cultural aspects of practical studies are too often overlooked or regarded with contempt by educational authorities who fail to appreciate the clearer vision which accompanies contact with reality and the greater interest which practical work, even if vocational in aim, arouses in the pupils themselves. As Mr. H. W. Cousins aptly remarked, in the discussion on the report, the purpose of education should be to create an interest in doing things, not in merely talking about them, a sentiment which was warmly applauded by H.R.H. the Prince of Wales, who was present.

While it is true that the work of Prof. Nunn and other educationists is gradually modifying the attitude of teachers in schools towards practical work—not merely work in a chemical or physical laboratory—it is equally true that their efforts to combat 'education by book' are hampered and discouraged by most examining bodies. The capacity of the 'bookish' pupil is easier to assess than that of the pupil whose main interest lies in acquiring understanding of, and the capacity of participating in, the activities of his particular environment. A board of examiners sitting in one of the great centres of learning, however well intentioned, must find it exceedingly difficult catering for the needs of pupils in various environments, whose education is 'practical' and suited to the special environment, but of which the examiners themselves can know very little. Their difficulties would be increased if education authorities in those of our overseas territories, which are connected for examination purposes with English universities, desired to develop a schools curriculum based on the special needs of the countries they serve.

The point might well have been made by the Committee on Overseas Training that the education of boys and girls in our Dominions, Dependencies, and Crown Colonies is more 'bookish' and less adapted to make them capable of 'deliberate adjustment to their environment'—after all, the true purpose of education—than that which is given at home. There, those who are charged with the responsibility for the evolution of a system of education have generally accepted unreservedly the system evolved to suit a very different environment. Instead of basing their system upon the needs of the many, they have subordinated it to the English examination system in order to cater for the needs of the very small number of pupils who may proceed to England to pursue their further studies. Certain education authorities in Ceylon, it is stated, send to a biological station in England for specimens of British marine and other material prescribed for study by one of our examining bodies. It would seem obviously the better course for the examining body to prescribe for study some of the specimens which abound in Ceylon.

Kenya Colony, the only East African territory where public provision is made for the education of European children, is an abject slave to the tyranny of the London Matriculation and the Oxford and Cambridge Local (so called) examinations. Most of the children educated in the State schools in Kenya will certainly never leave East Africa for a further course of study in Great Britain. The environment to which they have to adjust themselves is essentially agricultural; an environment which demands an understanding of the black races, and a sound knowledge of the elementary principles of social and personal hygiene, and human, animal, and plant diseases; in other words, an education where the bias should be agricultural and otherwise practical, where work in the field and workshop and laboratory should be the basis of the instruction in science and elementary anthropology the basis of the 'humanistic' studies. Nothing of the kind has been attempted. The syllabus of instruction is that prescribed for the 'literary' side of the English examinations; there are no workshops, there are no laboratories, there is no provision for practical work in the field. Where 'science' instruction is given at all it is 'out of the text-book.' What knowledge the children have of the native races is acquired in a school of experience which is calculated to breed contempt for them, and sow seeds of racial antagonism. Both the blacks who come within the sphere of influence of the State schools, and the Indian children, are being better educated than the children of the Europeans.

The most obvious commentary upon the type of instruction given in schools in Australia is the disproportionate size of its cities. Appeals for immigrants are made to compensate for the flight of colonial-born agriculturists from the land to the social amenities of towns, and the reluctance of Australia's urban unemployed to transfer to the land. Much the same problem faces all our self-governing dominions. This problem of education is of world-wide significance and of especial importance to the British nation, which bears a grave burden of responsibility for the development of so great a proportion of the world's natural resources and of the backward races. It is sufficiently important to command much of the attention of the statesmen of the Empire who will shortly be gathered together for another Imperial Conference. Education is not a subject remote in its bearings upon Imperial policy; it lies at the root of it. Upon the type of instruction which is given in our educational institutions at home will depend largely the character and outlook of the administrators of the scientific and technical experts in tropical possessions, and of the settlers in British dominions. Administrators could be produced whose training and educational achievements would be a guarantee that they would combine understanding of the problems inherent in the development of the natural resources of a country and the development of the soul of a people; and the scientific and technical services could be manned by those who combined knowledge of their craft with understanding of primitive crafts and a realisation of the social and political significance of the introduction of European ideas and processes among backward peoples.

If the needs of the better instructed elements among the Britons who proceed overseas are such as to demand considerable changes in the education which is given them as a preliminary training, the needs of the secondary school boys and girls destined for overseas work is greater. Whether they go to the tropics, where they must perforce have intimate contact with backward peoples, or to the self-governing dominions, there are certain obstacles which 'personality' alone cannot overcome, but 'character' based upon knowledge, capacity, and grit can. Prejudice against a newcomer wishing to introduce new methods into production is the commonest of diseases. But prejudice is not best overcome by pandering to the 'oldest inhabitants' fixed notions of what is right, but by proving the greater efficiency of the new. It is doubtless true, as Mr. Ormsby-Gore said at Oxford, that overseas farmers prefer to deal with 'raw' rather than instructed new settlers, that they prefer a man who has had no agricultural training in England to the man who has, because the methods overseas are vastly different from those at home. It does not follow, however, that the overseas man on the spot is sound in his prejudices. His methods may be thoroughly unsound. The home-trained man's methods, even applied in a new country, may be thoroughly sound in principle.

The most important aspect of the problem of land-settlement is the outlook of the settlers upon their work. Not the least significant feature of the flight from the land is the material sacrifices which those who are forsaking agriculture are prepared to make for the greater amenities of town life. The only apparent remedy lies in an education system which will bring greater contentment to the comparatively isolated land worker. It is not easy to prescribe the exact form which this remedy must take, but it is fairly clear that it must depend upon the quickening interest of the workers in their vocation. No greater harm could be done to the cause of agriculture than by ceaseless reiteration of the material benefits arising from its pursuit. There is a limit to credulity and gullibility.

What is wanted is for the Imperial Conference to take an intelligent interest in this problem. It is more vital than tariffs; without even a partial solution much of the work of the politician and financier and trader will be wasted. An Imperial Education Committee is of more importance even than an Empire Marketing Board. It will not suffice to refer the problem of education to a committee of expert educationists; the responsible leaders among the statesmen of the various dominions and Crown colonies must be prepared to consider the whole problem with the experts and to make their own contribution to the discussions. They must let the educationists know what they hope from them: they must be prepared to fight for the necessary changes in educational policy in the countries for which they are responsible. Above all, they must assist the true educationist to rid himself of the examination blight. They must encourage a spirit of experimentation in educational method and realise that a stereotyped Prussian system of instruction, towards which we have been retrogressing while even the Prussians themselves have commenced to react against it, will kill the soul of any people.

The eminent persons who spoke at Oxford, ostensibly in support of the recommendations of the Overseas Training Committee, cannot be said to have laboured the essential features of the report. They gave the impression that a social veneer was a greater attribute to a man than social qualities. It cannot be overemphasised that the latter depend upon knowledge based upon a sound education system. According to one speaker, it was more important for a man proceeding overseas to have gone to the right type of school than it was for him to have acquired the right kind of knowledge, based upon an intensive technical training. It is a pity it is not more generally recognised that this curious snobbery is responsible for more of the defects in our administration system and our comparative failures in Imperial affairs than any other factor.

One other point which emerged in the discussion is of some interest, and this is the one which was raised by Mr. Ormsby-Gore in connexion with the staffing of the education and scientific services in the Crown Colonies. He stated that the Crown Colonies are in the greatest need of expert educationists and first-class scientific advisers. At present the demand exceeds the supply and it is impossible to fill many of the vacancies which existed. This he contrasted with the ease with which the late German administration in East Africa had built up its wonderful research institutions. It can only be hoped that this was not special pleading on the part of Mr. Ormsby-Gore to justify the chronic neglect of the British administration of once world famous institutions. The fact is that it is only within the last two years that the slightest appreciation has been displayed, either by the local governments of East Africa or by the Colonial Office, of the obvious fact that upon the education and scientific services the whole future of East Africa will depend. There would be no difficulty in obtaining the personnel for either of the services if the proper inducements were offered, and if the Colonial Office and the other governments would realise that it is not merely material inducements which will make the East African services attractive; conditions of service are just as important as salary, and the Colonial Office should realise that it is sometimes possible to offer a large salary without attracting candidates, because the acceptance of the post would rob the man appointed of all title to the respect of his fellows.

Indian Witchcraft and Primitive Forms of Belief.

Religion and Folklore of Northern India. By William Crooke. Prepared for the Press by R. E. Enthoven. Pp. iv.+471. (London: Oxford University Press, 1926.) 21*s.* net.

WHEN the history of the study of 'things Indian' is written, the name of the late William Crooke will rank high. His erudition was vast, and his range of reading immense, while his sanity of outlook and grasp of matters of fact guided him among the many pitfalls which have beset the paths of theory in Indian ethnology. It was these qualities which made him a particularly safe guide to the student and accounted largely for the high repute of the pioneer work in his little book "An Introduction to the Popular Religion and Folklore of Northern India," first published in 1894. It was reissued in 1896, and is now published posthumously in a third edition, but entirely rewritten in the light of further information.

It is scarcely necessary to stress the importance of Crooke's work in the study of the primitive religions of India. His contact with the village population in the course of his duties as an official of the Civil Service led him to the study of their beliefs and ritual. These he found represented a type very different from those of the priestly class and those described in the sacred books of the Brahmans. His investigations ranged over the whole of northern India to the Nerbada River, and took in the population of the west coast and the Deccan. This area had been overrun by many waves of foreign incursions flowing over an indigenous population. Its inhabitants included primitive Mongoloids, represented by the tribes of the Assam frontier and the Kols and allied tribes, Dravidians such as the Gonds and Oraons, and in the Punjab, Indo-Aryans, Persians, Greeks, Sakas, Indo-Parthians, Huns, and Mongols.

The study of this medley of races revealed that the superficial uniformity of the widely adopted Hinduism embraced a variety of beliefs ranging from primitive animism to the worship of deities of the orthodox pantheon. In fact, Crooke's researches showed that while some conformed to Hinduism, owing to the rise in social status which followed the adoption of Brahmanism, and yet retained the cults of their tribal deities, others regularly resorted to the village, caste, or tribal godling in times of crisis, drought, famine, or pestilence. On the other hand, there went on *pari passu* a process of adoption of the godlings of the animistic peoples into the Hindu pantheon. Of such were the benign Devi, traced back to one of the manifestations of Dharti, the earth mother, Kali, a deified tigress, and on a lower scale not yet fully of orthodox rank, Hanuman the ape and Ganesa the rat. These latter are the Dvārāpalas, 'doorkeepers,' of the temple of the greater gods. The story of these local deities and of their development out of the strictly local cult into a more widely, or even generally, recognised object of worship is a pregnant chapter in the history of religion.

It is not without significance, and it is at the same time interesting to note, that among the many heroes who are objects of a cult appear the names of several Englishmen and an Englishwoman, whose tombs are treated with special reverence and to whose spirits offerings are made. The ghost of Capt. Cole, killed in 1804, is propitiated with offerings of wine and cigars; another, the spirit of a bibulous official, with beer and whisky; while the tomb of Col. W. Wallace of Sirur in Poona is worshipped on Thursdays and Sundays "in fulfilment of vows made for the cure of barrenness."

It would be difficult to single out any one topic as especially worthy of mention where so much is of interest and importance, whether in relation to the more primitive forms of belief among the Indian peoples themselves, or as affording material for comparative study. There is, however, one line of inquiry for which the religious, social, and racial conditions make northern India an especially promising field. Dr. Crooke's last chapter deals with the black art and witchcraft—a subject which offers occasion for many interesting questions. What, for example, is the relation between practitioners of white and black magic, and at what stage of development do they become differentiated? The Shaman, or medicine man, who may, and indeed often does, practise both forms of magic, develops on one hand into the orthodox magician or priest whose function is normally exercised to the advantage of his social group and its members, on the other into the witch whose action is malevolent and anti-social. The priest may still practise black magic, as do some Brahmans, with impunity. The Jackdaw of Rheims was cursed 'by book and by bell' as effectively as if he had been the victim of the blackest magic. The witch is destroyed or cast out.

The term 'witchcraft' is constantly used loosely in describing magical practices of primitive peoples, but it should imply more than the occasional use by any individual of magical practices for malevolent purposes. The witch of northern India as described by Dr. Crooke is one who performs harmful acts through the control of evil spirits. In European witchcraft, while the basis of the belief was purely magical, as can be seen even in the Bull of Innocent VIII., where the witch was said to blast crops, harm cattle, and bring disease and death to human beings—just as the Indian witch—yet the essential element in the legal and theological definition of a witch was the fact that she had entered into a compact with the devil from whom her power was derived. This no doubt goes back to the practice of the early Christian Church, which regarded backsliders into paganism as devil worshippers, and witchcraft was closely connected with heresy. But it is also significant that the Templars, who were reputed to have brought their alleged magical practices from the East, were accused of trafficking with and controlling evil spirits.

Indian witchcraft affords some curious and interesting parallels to the European belief. The witch is marked out by her appearance. Dhanwārs in the Central Provinces, for example, detect a witch by the sunken and gloomy appearance of the eye. Ovid mentions a double pupil as characterising a witch; in Wales she can be detected by the inversion of the image reflected in the eye. Unlike the European witch, almost invariably a hag, the Indian witch is beautiful. The witch acquires her art by a course of instruction. Among the Santals the novice, with a lamp in her hand and a broom tied to her waist—note the appearance of the broom—is taken to be married to one of the Bongas or spirits. The parallelism of the European methods of initiation is not exact but is sufficiently close. Again, Indian witches possess familiars, a cat or a tiger, and they themselves take on animal form. The use of a waxen image to harm an enemy, a practice which goes back to early Babylonia and Egypt, and is familiar in European witchcraft, is also noted. One of the most remarkable feats of the Indian witch in this connexion is the 'abstraction of and eating a man's liver,' of course without his knowledge until he realises that he has been bewitched and in what manner. European witches sometimes 'extracted the heart' in much the same way. Finally, in both Europe and India a witch is detected by casting her into water to see if she will sink or float.

We may conclude with a much travelled story. Lona, an Indian witch noted in legend, performed an incantation for a young man over a hair supposed to belong to the object of his affections. Unfortunately for him, he had been deceived by a slave and the hair had been taken from a sieve which burst into the room immediately the magical rite had been performed. The same story is told of John Fian, the leader of the witches who conspired against James I.; but in his case the hair was that of a heifer, which incontinently pursued him, to his great embarrassment and confusion.

Storm and Stress.

(1) *Pleasure and Pain: a Theory of the Energic Foundation of Feeling.* By Paul Bousfield. Pp. x+114. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1926.) 4*s.* 6*d.* net.

(2) *The Adolescent Girl: a Book for Parents and Teachers.* By Dr. Winifred Richmond. Pp. xv+212. (New York: The Macmillan Co., 1925.) 5*s.* net.

(3) *The Gang Age: a Study of the Preadolescent Boy and his Recreational Needs.* By Dr. Paul Hanly Furfey. Pp. xiv+189. (New York: The Macmillan Co., 1926.) 8*s.* 6*d.* net.

OF recent years, emotion as the driving and guiding principle, which shapes our lives and determines our behaviour, has occupied the attention of psychologists to a greater and greater extent. More particularly have they attempted to study from a scientific aspect that period of difficulty through which every boy and girl must pass as the simpler adjustments of the home give place to the wider emotional relationships of society. To the individual adolescent the period is still as stormy as it was to Goethe, and the adult is only groping his way to an understanding which will enable him to help. The question of what emotion is remains unsettled, and while all authorities regard the affective reactions of pleasure and pain as important constituents, they are by no means unanimous as to their exact relation to appetite, instinct, and emotion.

(1) Dr. Bousfield has approached the problem of pleasure and pain by attempting to explain the apparent paradox of the pleasure of enduring pain. First of all, he maintains that the fundamental disposition in all animals is a reaction to stimuli in such a way that tension will be reduced. Even such instincts as self-preservation and race preservation are not innately given, but the result of social influences in each generation. He demonstrates the rise and fall of tension by means of diagrams, and points out that pleasure does not exactly correspond to the fall of tension, since the maximum of pleasure depends rather on the rate than on the extent of the fall.

During life, tension is never completely relaxed, since there is always a degree of postural tone in all tissues. There may be no conscious awareness of this, but there may be an unconscious desire to retreat from this permanent tension (the death instinct of Freud).

With the advent of prospective imagination, pleasure may be induced by the prospect of relief of tension, and as a result a temporary slight diminution may ensue, although it still persists at a relatively high level. This may prolong and intensify pleasure, and with the alternations of prospective relief and actual imposition of tension the subject may even experience pleasure in painful situations.

(2) Without going into the abstruse question of the derivation of emotional reactions, Dr. Richmond, in "The Adolescent Girl," deals with the difficulty of adjustment of these reactions to the demands of society. A brief survey is undertaken of primitive cults and ceremonies in relation to the change in the girl's life, and a description is given of the physical and mental alterations incident to puberty. She points out that neurosis and delinquency easily arise out of the conflicts of this time, and that it is a matter of some wonder that the 'normal' girl does emerge from the welter of conflicting subjective impulses and objective influences. No attempt is made to discuss the root causes of troubles which arise, but sound advice is given to parents and teachers as to the upbringing of the adolescent, so that they may be alive to the possibilities of disaster and recognise the early signs of trouble, to the end that skilled assistance may be sought before it is too late.

(3) Similarly, Dr. Furfey deals with the preadolescent boy of ten to fourteen years, a period which he designates the gang age, since the child ceases to be individual and discursive in his interests, but concentrates his whole attention on the work of his activities in play. Dr. Furfey regards this phase as one of paramount importance in the normal development of the boy, and therefore one which ought to be supervised most carefully and skilfully. He quotes several case records to illustrate derivations from the normal at this time, and gives good advice as to the proper management of the child at this period of life. As he points out, the average child spends much more time in recreational

than in intellectual activities, and educationists may have neglected the former too much in favour of the latter. It may be advisable for the boy to be allowed a certain freedom to follow his individual bent in recreations, but during the gang age, when individualism is in abeyance, guidance is both wholesome and necessary.

R. G. G.

Root Habits and Growth.

Root Development of Field Crops. By Prof. John E. Weaver. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xii+291. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15*s*. net.

FROM time immemorial observations and notes have been made on the aerial growth of crop plants under varying conditions of cultivation, and an extensive literature has arisen thereon. On the other hand, the subterranean growth has received little attention, and accurate information as to the relation between shoot and root growth is remarkably meagre. During recent years a few investigations have attempted to remedy this, the most notable contributions being those of Howard in India, and Prof. Weaver and other workers in America. The mechanical difficulties of root investigations *in situ* are such that satisfactory work can only be done where the soil and subsoil are of such a nature as to permit excavation without undue expenditure of time and labour and excessive danger of breaking the roots while their course is being traced. During the last twelve years Prof. Weaver has extensively developed the technique of root excavation by means of systems of trenches, and the volume under review aims at presenting the main American results which have been set forth in detail elsewhere.

The preliminary chapters deal briefly with soil characteristics as correlated with plant growth, and an excellent epitome is given of root structure and development, an elementary aspect of matters which is seldom lucidly explained. From the general point of view, one of the most important sections is that dealing with root habits in relation to crop production. Root growth is often extremely rapid, being so much as ½ inch per day in grasses and 2-2½ inches per day in maize, the total root development being extraordinarily great as compared with the top growth, especially in the early stages. The ratio between the dry weight of shoot and root is often used as a standard of comparison between different plants, but scarcely represents the truth. The real measure of the functioning of a root lies in its absorbing surface, and a very finely branched root has a much greater surface and is far more active in working than a thick, heavy root with few branches.

Weaver opposes the idea, often stated in standard text-books, that crop plants in general are shallow-rooted and that only the top 6 or 8 inches of soil are suitable for growth. A consideration of the conditions under which root investigations have been carried out in various places, however, would lead one to suppose that the nature of the subsoil must play a most important part with regard to root penetration and the absorption of water and nutrients. In deep, easily worked soils and subsoils, such as apparently have been investigated in Nebraska, most crops are able to penetrate well, to develop an extensive root system, and so to commandeer larger stores of deep-seated water and food supplies. In other areas, where a comparatively shallow soil overlies a heavy intractable subsoil, many crops are unable to penetrate far and so gain a character for being shallow-rooted, while a few are able to go rather deeper in spite of the subsoil, and are therefore considered to be inherently deep-rooted. Further work under varying soil conditions will be needed to clear up many of the debatable points raised in the present volume. In humid regions the unproductiveness of the subsoil is recognised, whereas in arid regions this is not so. Greater root development occurs where plant food is plentiful, and this has an important relation to agricultural practice, influencing the depths of manuring, the type of fertiliser used, and the depth of ploughing, according to the crop grown. Tillage methods, as such, may not influence root habit directly, the changes in growth induced by tillering being really in response to differences brought about in the physical and chemical conditions of the soil and subsoil. Varying rooting habits may be turned to commercial advantage, for by growing mixed crops, which tap different soil layers for their water and nutrients, an increased total yield may be obtained. The reason that some weeds are more detrimental to certain crops than others may be because they absorb water and nutrients from the same level as the cultivated plants.

The root habits of native plants afford a useful indication as to soil conditions, and give some guide as to the crop plants that are most likely to succeed. This is specially the case in areas where the water content of the soil is the chief limiting factor to growth, the prevalence of scanty, short vegetation indicating conditions that are unfavourable or even hazardous for crop production. The detailed investigations on the root growth of individual crops not only bring out clearly the difference between one crop and another, but also the variation induced by different methods of cultivation, such as by spring and autumn sowing in wheat. In barley and sugar-beet, particularly, root penetration is much affected by the type of subsoil, as over a dry subsoil a mass of roots is formed in the surface soil, whereas deep penetration is achieved under other conditions.

An outstanding feature of these investigations is the care and accuracy with which the illustrations have been prepared. Photographs and ordinary sketches proved unsatisfactory in field work, and a method has been evolved whereby each root, as it is traced, is mapped into position on a vertical scale, horizontal maps also being made for certain plants, such as pumpkins, maize or cacti, in which the roots spread widely. A description is given of the method of excavation which has proved so remarkably successful on the type of soil dealt with, and a good bibliography rounds off a volume which fills a definite gap in the annals of agricultural botany and suggests many starting-points for further investigations.

W. E. B.

Our Bookshelf.

Animals of Land and Sea. By Austin H. Clark. (Library of Modern Sciences.) Pp. xxxiv+276. (New York: D. Van Nostrand Co.; London: Chapman and Hall, Ltd., 1925.) 15*s*. net.

THIS is a good book, but misses being a very good book. It is full of interesting facts, but they are not always well arranged. Mr. Clark's knowledge is extensive and often peculiar, but he has not digested it well: too many of the chapters read like the outpourings of a notebook, not free from unnecessary repetition. Finally, the numerous figures are so dispersed through the book that they can scarcely be said to illustrate the text: thus, opening at random, one finds thirty-four drawings of "biting and parasitic flies, and some maggots and pupae of flies" facing a page that deals with flying-fish. Biting flies were discussed some hundred pages earlier, but there was in the text no reference to these figures; for any further explanation of them one must hark back to the list of text-figures. Possibly the publishers are responsible for this lack of co-operation, for it is a too common fault in popular books written to order. None the less, the authors are to blame, and it is surprising to find a man of Mr. Clark's vigorous personality permitting this indignity.

Towards the end of the book the method improves. The chapter on animal flight is on the whole excellent: it works out certain ideas and subordinates the facts and observations—many of them original—to the main arguments. Yet even here some of the cargo might have been jettisoned with advantage. The chapters on "The Basis of Life in the Sea," "The Intermediate Foods of the Sea," and "The Ocean and the Land"—a contrast between their inhabitants—also puts the facts in a novel light that may reveal points of interest even to those who know them already, and may suggest fresh lines of inquiry. We are acquainted, in a sort of a way, with hundreds of facts that we do not realise; we must fit them into a scheme and see their mutual relations before our acquaintanceship matures into knowledge. It is because Mr. Clark has acted increasingly on this principle that his later chapters are more effective than his earlier. The penultimate chapter—"Life's Borderlands"—which brings together the extremes of temperature, pressure, and the like, under which life can exist, is remarkably interesting.

To write a book of this kind in such a way as to attract a large public is no easy task. The entire and not wholly inexplicable ignorance that most otherwise well-educated people display regarding their fellow-creatures, especially the inhabitants of the waters, presents an almost insuperable obstacle to the writer or speaker who wishes to interest the ordinary man in these aspects of life. We hope Mr. Clark will be found to have succeeded, for his aim, prudently kept in the background, is one with which readers of NATURE will sympathise.

Le Relief de la terre : ses origines, ses lois, son évolution ; principes nouveaux de géographie physique. Par Paul Soulier. Pp. x+432+3 planches. (Paris: Félix Alcan, 1925.) 30 francs.

THIS interesting, if not very convincing book may be described as a fugue with the hypsographic curve as its principal theme; a hypothetical structural curve derived from it as the answering subject; the geochemical cycle of water, often repeated, as the counter subject; and a final *stretto* in which these and many related episodes are worked up into an all-embracing explanation of terrestrial relief. The author supposes the effects of denudation and deposition never to have taken place, and shows that the hypsographic curve is then transformed into a simple structural curve. He deduces from this that the structural relief of the earth's surface follows the statistical laws of chance, and therefore, ignoring the implications of isostasy, he rejects Wegener's well-known deduction from the hypsographic curve. Erosion has accentuated the upper concavity of the 'original' curve, and the continental plains and shelves have developed on the middle regions of the structural surface by the accumulation of sediments.

A summary of various theories of mountain building is given and all the existing hypotheses are rejected as inadequate. The author then suggests that water passes down through the surface rocks to an underlying "active orogenic zone," where it promotes aquo-igneous fusion and a general expansion of the materials there present by a process of hydration. The activities of the orogenic zone are made responsible for all the puzzling phenomena of vulcanism, compression, and tension, and for the surface relief of the moon and of Mars as well as of that of the earth. The gradual lowering of the surface of the oceans, due partly to the intensification of relief and partly to the internal absorption of water, leads to the conception of islands developing into continents by coalescence and the uplifting of peripheral mountain systems.

M. Soulier's theory of the earth is not likely to win acceptance, for it runs counter to the modern trend of geophysics. In particular it ignores the effects of radioactivity, and introduces instead a hydrothermal process that seems quite incompetent to produce the results ascribed to it. Nevertheless, the book is original in method and stimulating in thought, and it certainly deserves to be read by those interested in the evolution of the earth's surface features.

Geographie der Moose. Von Prof. Dr. Th. Herzog. Pp. xi+439+8 Tafeln. (Jena: Gustav Fischer, 1926.) 27 gold marks.

WHILE many writers have published works on the anatomy and taxonomy of mosses, Prof. Th. Herzog has struck out on a new line in his recently published volume and given an account of their geographical distribution together with that of the Hepaticæ. He has done for the mosses what Dr. H. Christ did for the ferns in his "Geographie der Farne." Unlike the older writers on plant distribution, he does not give his results in statistical tables but follows the examples of Prof. E. Warming in his "Oecology of Plants," and in the first 74 pages gives an interesting account of the factors, both internal and external, which influence the choice of a habitat, and distinguishes between distribution by spores and by asexual vegetative means. By this method it becomes easy to realise why some species have a wide range while others are confined to a restricted area.

The section dealing with the substratum upon which mosses grow is of special interest and contains lists of species which are confined to either acid, neutral or basic rocks, or to two of them, or (like *Brachythecium rutabulum*) will thrive equally well on any of the three. The epiphytic species are also dealt with in this section. This is followed by 136 pages, in which the distribution of the various families is discussed in detail.

The third section deals in a similar way with the geographical regions and gives numerous examples of the species characteristic of them. A few maps are inserted; that on p. 214 shows clearly the parallelism in distribution in widely separated areas of Gigaspermum and the genus Callitris belonging to the Cupressineæ, namely, north-west Africa, South Africa, and Australia. This Herzog terms "Disjunktionen." The book, which concludes with a classified bibliography and two indexes, one geographical, the other of genera and species, is illustrated with 151 text figures and 8 plates, Fig. 70 showing the various forms of thallus which occur in Aneura. The work should form a stimulating contribution to the literature of bryology.

C. H. W.

The Relation of Nature to Man in Aboriginal America. By Prof. Clark Wissler. Pp. xx+248. (New York and London: Oxford University Press, 1926.) 16s. net.

IN the text of this volume Dr. Clark Wissler follows closely a course of lectures at the Wagner Free Institute of Science, Philadelphia, which he delivered under the Richard Westbrook Free Lectureship Foundation. It is an admirably lucid exposition of the method of attacking anthropological problems by the study of distribution, and as such it is deserving of careful attention apart from the application of that method to the specific problems of aboriginal America to which the earlier chapters lead. The subjects reviewed are samples of the material culture, segregated distribution, social traits and somatic traits, and finally distribution form and its meaning.

The method is one of special importance in the study of American culture, where indeed there is a peculiarly favourable field for its employment. Its application to the somatic problem is especially instructive in view of the conclusion generally held by American anthropologists as to the homogeneity of the aboriginal population, notwithstanding differences such as that found in head-form. On the ecological side of the inquiry, Dr. Wissler's conclusion is that there is good ground for suspecting that the principle of concentric distribution is an ecological phenomenon universal to the more specialised form of plant and animal life, including man. Dr. Wissler's book is a most valuable and stimulating contribution to the method of anthropological study, but why will he, in common with many other scientific writers, especially in the United States, treat the words *fauna* and *flora* as if they were feminine singular nouns and endow them with an entirely superfluous plural in *æ*?

The Pedigree of the Human Race. By Prof. Harris Hawthorne Wilder. Pp. xiv+368. (New York: Henry Holt and Co., 1926.) 3.25 dollars.

IN spite of its title, Prof. Wilder's book refers to the races of mankind only in the last chapter. It is a compilation of a great deal of interesting information relating to the comparative anatomy of the Primates. But it scarcely fulfils the expectation the title suggests, for there is relatively little serious discussion of the pedigree. In a work dealing with man's ancestry, it is rather surprising to find no mention of Propliopithecus, perhaps the most interesting link in the chain, and an absence of reference to the leading works on the subject of the book.

The classification of the Primates is peculiar. The Tarsiidæ are included in the sub-order Anthropoidea. Though much might be urged in excuse of such a course, it can only create unnecessary confusion; and the student who critically studies the differential tables on pp. 25 and 26 will certainly be at a loss to discover why Tarsius is put under the heading Anthropoidea and not under Lemuroidea, seeing that it is cited as exceptional in respect of every feature enumerated and in most of these agrees with the Lemuroidea. Then again, alongside this ultra-modern treatment of Tarsius the antiquated idea with regard to Chiromys is retained. This specialised member of the Indrisinæ is removed from its own family and a special sub-order is made for its reception.

The book contains a large series of useful illustrations.

The Annual Register: a Review of Public Events at Home and Abroad for the Year 1925. Edited by Dr. M. Epstein Pp. xiv+330+180. (London: Longmans, Green and Co., Ltd., 1926.) 30s. net.

THIS invaluable work of reference again gives a complete survey of the world's history during the past year in a small compass and a readable form. The customary arrangement is followed, of considerable sections devoted to Great Britain and the Empire, with smaller sections on other States. There are also surveys of the literature, science, art, drama and finance of the year, and a record of events. Appendices give the full text of the Locarno Treaties, the Irish Boundary Agreement, the Irish Bill 1925, and the Russo-Japanese Treaty. The work has now reached its 167th annual issue.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Microstructure of Mercury.

IN the course of investigations on dental alloys and amalgams, which we have carried out at the National Physical Laboratory on behalf of the Dental Investigation Committee, Department of Scientific and Industrial Research, we have thought it necessary, for the full study of the constitution of the amalgams, to undertake their microscopic examination. As mercury, and the amalgams rich in mercury, must be completely solidified for this purpose, it has been necessary to devise means for the preparation, etching, and photo-micrography of specimens at very low temperatures. Most of the work has been done by means of a paste of carbon dioxide snow and acetone.

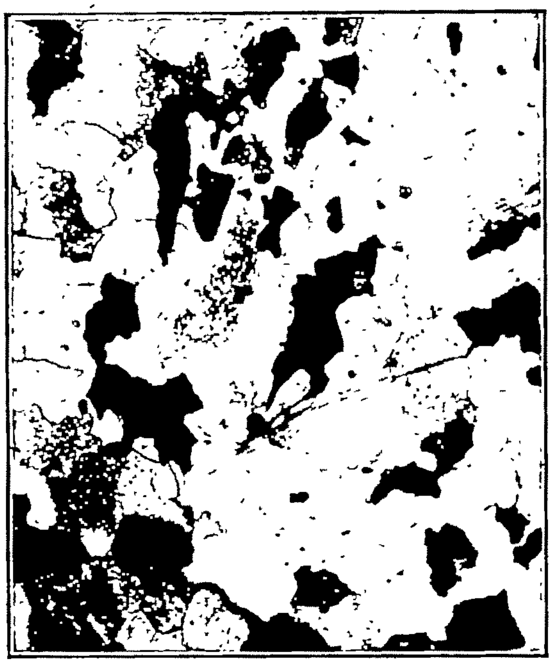


FIG. 1.—Microstructure of pure mercury. Magnification: ×100.

Surfaces suitable for microscopic study have been prepared by allowing the metal to solidify in contact with glass; and such surfaces have been successfully etched by electrolysis in hydrochloric acid (sp. gr. 1·12 at 15° C.). It has also proved possible to polish the frozen specimens, but so far it has *not* been found possible to etch surfaces prepared in that way.

Special devices have been used for keeping the lenses of the microscope, etc., free from deposits of frost during examination and photography. Fig. 1 is a reproduction of a photograph showing the typical microstructure of solid mercury under a magnification of 100 diameters; we believe that this is the first time that such a structure has been recorded.

WALTER ROSENHAIN.
A. J. MURPHY.

The National Physical Laboratory,
Teddington, Middlesex,
July 30.

The Damping of Pendulous Jets.

IN a previous letter to NATURE (April 11, 1925, p. 530) the behaviour of liquid jets from a moving source was discussed theoretically, and supporting experimental data were presented. Dr. Julius Hartmann reviewed the subject in the issue of NATURE of June 6, 1925, p. 872, and arrived at confirmatory conclusions, though adopting a different mode of attack and manner of statement. Both of these communications treated the particles constituting the jet as though in free flight. The possibility of their being subject to viscous constraints while in flight was alluded to in the former paper, but Dr. Hartmann detected no such damping effects under his conditions of observation. Lately, Mr. Walter Thompson and I have examined the damping effect, and as the conclusions admit of concise statement they are presented herewith.

To recall the experimental conditions it may be stated that we have under consideration a jet of liquid issuing vertically downward, and that the container is subject to a linear, horizontal, oscillatory motion, and, in a particular case, a simple harmonic motion. The problem is the description of the horizontal motion of the jet at lower levels. It may be very simply shown that if the particles of the jet are acted upon during their fall by no force except gravity, and if the time of fall to the level considered is T, then the displacement of the jet from an arbitrary initial position will be $X = s + T\,ds/dt$. In this equation s represents the displacement of the container from its initial position at the instant of release of the particle observed. If damping forces, such as might be supplied by viscosity, are present, the particle, and hence the jet, will fall short of the displacement X defined above.

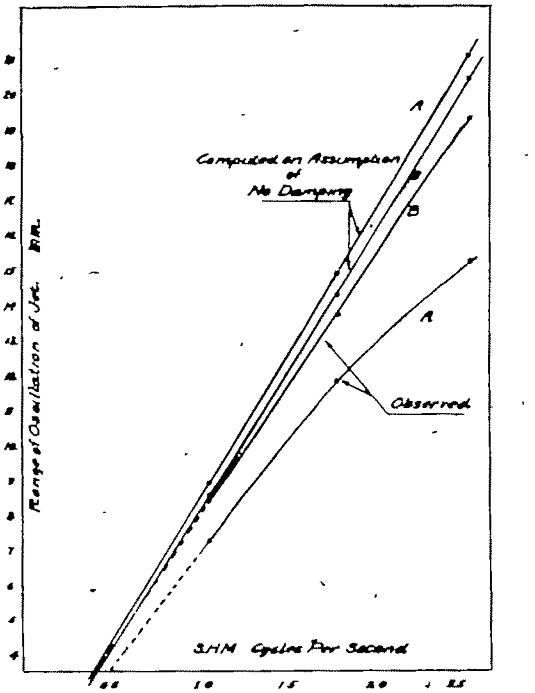


FIG. 1.—Effects of frequency and viscosity in diminishing the range of oscillation of jets. *B* curves are for a viscosity of 0·75 poises, *A* for 6·4 poises. Times of fall, about 0·75 seconds.

We experimented with six different oil mixtures, varying in viscosity from 0·75 to 6·45 poises, but otherwise physically similar. The specimen studied was delivered from a cylindrical glass nozzle in the bottom of a container which executed horizontal simple harmonic motion of adjustable amplitude and period. Following the reasoning of the free-fall equation given above, one may readily compute the jet amplitudes to be expected, in the absence of damping, for any particular applied simple harmonic motion. Measuring jet amplitudes by a variety of methods, including photographic, we have compared actual with predicted values in several hundred cases.

It is learned that with low frequencies (one cycle per second or less) all of these liquids show amplitudes agreeing with the simple no-damping predictions, but that all of them, even the least viscous, show diminished amplitudes when the frequency is greater than two cycles per second. The more viscous the liquid the lower is the frequency at which this damping first appears. After its first appearance, damping always increases with increasing frequency, but at a slower rate with less viscous liquids. The variation of the damping threshold with viscosity is such as to indicate that only a liquid of zero viscosity would be entirely free from damping at high frequencies. Damping is very nearly independent of amplitude, though a slight increase with increasing amplitude may be observed.

The accompanying diagram (Fig. 1) illustrates the effects of both viscosity and frequency on the jet amplitudes.

These findings are of interest in connexion with the suggested use of recorded jet motions for the absolute measurement of seismic or other accelerations. The proposals are discussed in the communications to NATURE referred to above. It now appears impracticable to arrange a jet of any liquid which shall be sensibly undamped at frequencies so high as four cycles per second, and yet be viscous enough to fall unbroken for so long as half a second. A succession of falling solid spheres would seem to offer better opportunities for the development of the suggested method.

PAUL KIRKPATRICK.

Department of Physics,
University of Hawaii,
Honolulu, T.H.

Another Patagonian *Lusus Naturæ*.

RECENTLY I was interested to hear, from a friend, of the discovery in Patagonia of a representation of a human head sculptured in stone, and, at his request, the finder kindly allowed me to have it for examination.

I expected that it would be more or less of the same type as the rudely fashioned head[1] found by Prof. Franz Kuhn at Punta Arenas in the south of Chile, and now in the Natural History Museum of Buenos Aires; but when the object arrived it was at once evident that, although it bears a remarkable resemblance to a human head with definite features, it owes nothing of its form to human agency, and is, in fact, a strange freak of Nature.

It was found, lying on the surface of the ground, in Tierra del Fuego, exactly where I do not know, and consists of a nodular piece of rock, weighing 1750 grams, and measuring 155 mm., 115 mm., and 75 mm. in its greatest length, breadth, and thickness respectively (Fig. 1). The surface is covered with a greyish patina, except where rubbed off on the projecting parts, which are of a dark, metallic grey colour. In appearance the stone resembles basalt, and is very probably an altered rhyolitic rock, but its nature cannot be accurately determined without submitting a section to examination under the petrological microscope. At one end there is an ancient fracture, and when the stone is set up on this as a base, it has the appearance of a bearded head, as may be seen from the photograph (Fig. 2). The fact of the fracture occurring at what seems to be the neck serves to strengthen the illusion, giving the impression that it is a head which has been broken from a statue

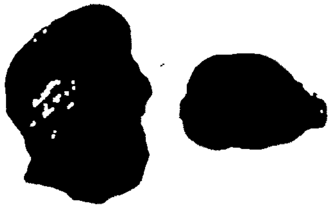


FIG. 1.—Vertical and horizontal profiles of the stone: scale ¼.

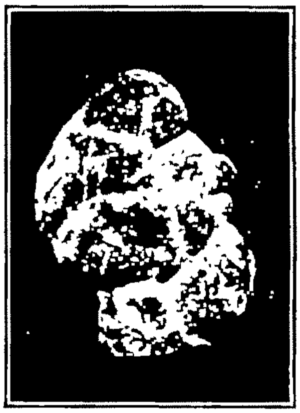


FIG. 2.—One side of the stone, from an untouched photograph: scale nearly ¼.

South America has gained an unenviable notoriety as the source of periodical announcements of sensational palæontological and archæological discoveries, which, when investigated, generally prove to have no foundation in fact. The affair of Paso Ibáñez, in which a lump of sandstone was put forward as a fossil human skull of Tertiary age,[2] will yet be fresh in the memories of many, and the purpose of this note is to prevent any misconceptions as to the true nature of the object described, should it ever figure in the daily Press either as yet another 'proof' of the existence of Tertiary man in South America, or as a remarkable example of stone carving by the prehistoric inhabitants of Patagonia.

G. A. GARDNER.

194 Calle Callao, Buenos Aires.

Dwi-Manganese in Native Platinum.

CHEMICAL EXAMINATION.—Native platinum was long ago the subject of investigation and the search for elements not yet discovered. Kern, in the year 1877 (*Chem. News*, 36, 1877, and 37, 1878), A. Guyar

---

[1] This is figured by R. Hauthal, "Zwei bemerkenswerte Funde im südlichen Patagonien" (Congrès International des Américanistes. *Compte rendu* de la XXIe Session, deuxième partie, tenue à Goteborg en 1924, Fig 6a, p 518), Goteborg, 1925

[2] The story of this extraordinary 'discovery' has been told by J. Imbelloni, "Nota sobre los supuestos descubrimientos del doctor J. G. Wolff en Patagonia" (*Revista de la Universidad de Buenos Aires*, vol. 51, pp. 39-51), Buenos Aires, 1923, and "L' uomo terziario fossile della Patagonia e la sua veridica istoria" (*Rivista mensile del Touring Club Italiano, Le Vie d' Italia e dell' America Latina*), Milan, 1924.

(*Chem. News*, 40, 59, 1879), Kurtz (*Trans. Amer. Inst. Min. Eng*, 33, 347, 1903), A. French (*Chem News*, 104, 283, 1911) and many others claimed to have found new elements in native platinum. These 'discoveries,' however, have not been confirmed. In 1925 W. Noddak, I. Tacke and O. Berg (*Die Naturwissenschaften*, No. 26, pp. 167-174, 1925) published a paper stating that they found in native platinum from the Gorablogodatski region, Ural, an element of atomic number 75. The quantity of the discovered substance was, however, so small (about 1 mgm) that it was not possible to carry out conclusive experiments

We have tested the native platinum systematically for the presence in it of dwi-manganese (No. 75) The platinum (mixed) was treated chemically, and the final products were investigated Röntgenographically. Dwi-manganese would have been easily detected if it were present in the native platinum in quantities pointed out by Dr. Noddak, or even 10 or 100 times less than that. As a matter of fact, the Röntgenographs obtained prove with certainty the absence of dwi-manganese in native platinum in a quantity exceeding 0.0003 per cent.

Our investigation thus settles the question about the presence of manganese analogues in native platinum in the negative sense. It is also very likely that eka-manganese, a closer analogue of manganese and a rarer element in the earth's crust, is not present in native platinum. Druce (*Chem. News*, 131, 273, 1925) and Heyrovský (NATURE, November 28, 1925, p. 782) seem to have chosen a more trustworthy way, assuming that dwi-manganese is associated with manganese and not with platinum.

O. ZVJAGINSTSEV.

The Platinum Institute,
Academy of Sciences of U.S.S.R.,
May 1.

RÖNTGENOGRAPHICAL EXAMINATION.—The investigation of the spectra was carried out either with Siegbahn's vacuum spectograph or with Muller's spectrograph with Hadding's tube In both cases the Rontgenographs were obtained with calcite crystal by the method of a fixed crystal. For the determination of the wave-lengths of unknown lines, the lines $K\alpha_1$Cu, $K\beta_1$Cu and $L\alpha_1$W were chosen for reference lines (the substance under investigation mixed with about 5 per cent. tungsten was deposited on the anticathode of copper). The wave-lengths of the unknown lines were calculated from the following formula:

$$\mathrm{Ctg}\,(\theta_3-\theta_x) = \frac{a_{1x}}{a_{2x}}\cdot\frac{a_{23}}{a_{13}}\;\frac{\sin(\theta_1-\theta_2)}{\sin(\theta_2-\theta_3)\sin(\theta_1-\theta_3)} - \mathrm{Ctg}\,(\theta_1-\theta_3),$$

where θ_1, θ_2 and θ_3 denote the angles of deflexion for three given lines and a_{1x}, a_{2x}, a_{13} and a_{23} denote the mutual distances between the lines, measured with a comparator.

On Röntgenographs obtained with Müller's spectrograph, the doublet $K\alpha$Cu was well resolved (the width of the lines was 0.06 mm. with equal breadth of the slit)

The accuracy of measurements of wave-lengths was 0.4 X.U., but no lines were found in the region where the K lines of the element 75 would be expected.

M. KORSUNSKI.
N. SELJAKOW.

Physico-Technical Röntgenological Institute,
Leningrad, May 1.

Kaufmann's Experiment and the Spinning Electron.

IN a paper in a recent number of the *Zeitschr. fur Physik*, Wentzel has published a calculation of the X-ray screening constants on the basis of the spinning electron. He obtains values of the screening constants which are much larger than those experimentally determined, so raising a difficulty in the way of the acceptance of the spinning electron. Wentzel introduces into the calculations a force $1/c(\mu[vX])$ (μ = magnetic moment of spinning electron, v = velocity, X = electric field) the exact analogy of the force $e[vH]$ on a moving electric charge in a magnetic field.

It can readily be shown that, if this force is accepted as having a real existence, Kaufmann's experiment is conclusive against the spinning electron. In this experiment the moving electrons are subjected to the action of parallel electric and magnetic fields. The deflexions of the electrons due to the actions of the fields are thus perpendicular to one another, and in the case of the spinning electron there will be an additional deflexion due to the force $1/c(\mu[vX])$. This deflexion will be in the same plane as that due to the magnetic field. Then, taking the simple theory of the experiment (as given, for example, in Richardson's "Electron Theory of Matter"), we have for the deflexion in the plane parallel to the condenser plates

$$x^1 = \frac{(He \pm X\mu/c)x'(x'-x_1)}{2mv},$$

the $\pm$ sign being required because of the spatial quantisation of the spinning electron in the magnetic field.

Since now $X = ncH$, in which n is a factor of the order 1/2 in Kaufmann's experiment, and $\mu = 2eh/4\pi m$ or two Bohr magnetons, it can be seen on inserting the values of the constants concerned that the quantity in the first bracket in the expression for the deflexion is approximately equal to $He(1 \pm \frac{1}{4})$ It will thus be seen that, instead of the trace on the photographic plate being a single arc of a parabola, this, for the case of the spinning electron, will consist of arcs of two parabolæ, the x co-ordinates of which are respectively approximately $\frac{5}{4}$ and $\frac{3}{4}$ of those of the arc obtained with the non-spinning electron. Kaufmann's published photographs do not appear to show any sign of this double trace. Hence, provided that the force $1/c(\mu[vX])$ has a real existence, Kaufmann's experiment shows definitely that the free electron cannot possess any spin comparable with that required by Goudsmit and Uhlenbeck's theory. This, of course, applies only to free electrons, and does not preclude the possibility that the electron may possess such a spin when it is a constituent part of an atom.

L. C JACKSON

Liver Extracts in the Treatment of Malignant Disease.

THE liver is proportionately very large during early fœtal life when rapid growth is the most prominent factor in the life of the organism: Since the formation of bile has not commenced at this stage of existence, the relatively large size of this organ may be attributed to the probability that it exercises some influence on the growth of the body. This effect would be brought about presumably through the medium of an internal secretion As malignant disease in its various forms is primarily a manifestation of abnormal cellular growth, I attempted to determine the presence of such an active principle and to isolate it in a form suitable for therapeutic use.

The work was initiated in the laboratories of the Hamilton General Hospital with the co-operation of Dr. W. J. Deadman. Extracts of fœtal pig livers were used during the earlier stages of the work on animals. Later extracts of both fœtal and adult pig livers were employed in the clinical work. The preparations were first administered to mice in which Marsh tumour tissue had been transplanted, an equal number of transplanted animals being untreated and used as controls. It was noted that as compared with the controls the extension of the transplanted tissue was arrested in the mice under treatment, and with repeated injections distant from the site of the tumour, a total necrosis of the transplants occurred. The degeneration of the tumour tissue did not take place in the centre of the mass as normally occurs, but commenced at the periphery of the growth.

The work was afterwards transferred to the McGregor-Mowbray clinic of Hamilton, which has borne the entire expense of the earlier chemical investigation, and under the supervision of which all the clinical research has been carried out. The preparations which were originally employed contained relatively small quantities of the active principle. Recently the co-operation of Profs. A. Bruce Macallum and A. A. James, of the Department of Biochemistry of the University of Western Ontario, London, has been enlisted, and they have developed a preparation from beef livers which contains the active principle in a highly concentrated form and can be rapidly and economically prepared. These preparations effect no changes in the blood pressure.

The clinical results to date in those patients who have received the treatment may be summarised as follows: in one patient there was complete disappearance of the tumour mass; in others still under treatment a reduction in the size of the growth has been noted. In every case the progress of the disease has been arrested and the life of the patient prolonged beyond that of the prognosis given before treatment commenced. So far only inoperable and otherwise hopeless cases have been treated. No radical claims are advanced for this treatment, but the results obtained clinically have warranted a more extensive investigation which is now being carried out at the University of Western Ontario, London, and the McGregor-Mowbray Clinic, Hamilton.

This preliminary communication is made for the purpose of scientific record.

JOHN R. HOWITT.

Department of Biochemistry Medical School,
University of Western Ont.,
London, Ont.,
July 8.

Kammerer's Alytes.

As I was intimately connected with Dr. Kammerer's visit to England in 1923, and as his specimens were unpacked in my laboratory and examined there before being taken to Cambridge, perhaps I may be allowed to make some comments on Dr. Noble's communication to NATURE of August 7. As to the present condition of the Alytes, about which there has been so much controversy, I know nothing. Dr. Przibram's view that the specimen after its return to Vienna was allowed to fade and macerate and that then a clumsy attempt at 'faked' restoration was made, appears to me probable. But this specimen was demonstrated to a continuous stream of critical observers for a whole afternoon in the Zoological Laboratory at Cambridge by Dr. Kammerer, who removed it from its case and invited examination under a lens. We all saw the spines; it was these and not the colour which convinced us. Dr. Noble may set his mind quite at rest as to the former existence of nuptial asperities.

I possess a print of the photograph which shows them—it is not a question, as Dr. Noble imagines, of two or three spines but of a whole series of minute spines regularly spaced which can be clearly seen in profile along the edge of one of the fingers.

In the attack which he made on Dr. Kammerer at the meeting of the British Association last year, Dr. Noble laid great stress on the peculiar glands characteristic, as he said, of the nuptial pads, indeed, as he then stated, diagnostic of them, whilst the asperities were irrelevant. By his reference to Champy's paper in his present letter it is clear that he has since discovered his mistake. The glands found in these pads are merely the ordinary skin glands hypertrophied under the influence of the sexual hormone as the breeding period approaches. I have compared photographs of the sections through the normal skin of Alytes and through the 'pad.' The skin glands in the latter section are double the size of those in the former.

In conclusion, I may say that when Dr. Kammerer came to my laboratory in 1923 he brought other specimens about the existence of which I was sceptical until I saw them and which struck me as much more wonderful than Alytes. I refer to the large-eyed specimens of Proteus.

I suggest that Dr. Noble and his colleagues, instead of making aspersions on the good faith of a fellow-worker and the credulity of English scientists, would be better employed in endeavouring, as I have done, to repeat Kammerer's experiments, and when they have produced anything half as wonderful as the Proteus their comments will be listened to with more patience.

E. W. MACBRIDE.

The Birefringence of Crystalline Carbonates, Nitrates and Sulphates.

IN two very interesting papers (*Proc. Roy. Soc.*, vol. 105, p. 370, and vol. 106, p. 346, 1924) Prof. W. L. Bragg put forward an explanation of the strong birefringence exhibited by the crystalline carbonates and nitrates. Expressed very briefly, his theory is that in the carbonate and nitrate ions the oxygen atoms are situated in one plane around the central carbon or nitrogen atom, as the case may be, and that, as the result of this arrangement and of the mutual influence of the electric doublets induced in the atoms by the field of the light-waves, the refractivity of the group depends to a marked extent on the direction of the light-vector. The refractive indices of the crystal were successfully computed on this basis. The crystalline sulphates are known, on the other hand, to have a very weak birefringence, and the suggestion was made that very probably the oxygen atoms are arranged tetrahedrally round the sulphur atom in the sulphate ion group, thus making it optically isotropic.

Very interesting evidence regarding the birefringence of the nitrate and sulphate ions is furnished by some recent observations on the scattering of light by concentrated acids and their aqueous solutions made in the present writer's laboratory by Mr. S. Venkateswaran. The light scattered by dust-free nitric acid is found to be nearly unpolarised, indicating an extremely large anisotropy for the nitric acid molecule and for the nitrate ion. Concentrated sulphuric acid and its aqueous solutions, on the other hand, polarise the scattered light nearly completely, indicating that the sulphate ion is nearly isotropic optically. We have thus a striking confirmation of Prof. Bragg's views.

Observations on the scattering of light by concentrated solutions of salts and by organic vapours containing the groups in question have been undertaken. One may venture confidently to predict the results to be expected.
C. V. RAMAN.

210 Bowbazaar Street,
Calcutta, India,
June 10.

The Reduction of Carbonic Oxide.

EVEN politicians are attracted to this problem and see in it not red but the oils of to-morrow. If peers speculate in futures, why not we plebeian sciencers, who give our lives to such matters, not a princely two days or so? The victim of a pernicious complaint contracted in the service of the British Association in the granitic environment of Aberdeen, pursuing the vicious line of thought which has afflicted me since 1885, I have recently been led to make logical use of my singular views on the course of chemical change and apply them fully to this most remarkable, perhaps *the* most remarkable, of molecules—carbonic oxide. No other molecule has 'taken us in' so long. All my life I have been seeking to fathom its mysterious depths: even now I don't feel in safe soundings.

I have argued, before the Royal Society and at the recent Solvay Conference, that it is not directly oxidisable by oxygen: the potential of the circuit would be too low. Prof. Bone and I are duelling over this issue at the moment: the foils are to be without buttons.

If my line of thought regarding its oxidation be sound—I seem to see signs that the force of facts is beginning to tell in its favour, at the same time that trousers are no longer all built turned up, those who dabble in science being as unable as are ordinary mortals to follow one fashion for ever—the reverse operation, the direct reduction of the gas by hydrogen, should be equally impossible, catalyst or no catalyst. Some adjuvant action must intervene to effect reduction if the carbonic oxide-hydrogen potential be below the oxygen-hydrogen potential. F. Fischer's suggestion that the process is an indirect one is, therefore, of special interest The modifications of the fundamental equation given by Messrs. Elvin and Nash (NATURE, July 31, p. 154) are no more likely than that equation is as an expression of the character of the chemical change. Metallic carbonyls are perhaps concerned in the transformations.
HENRY E. ARMSTRONG.

55 Granville Park,
Lewisham, S.E. 13.

Operation of Fog-Signals from a Distance.

IN the issue of NATURE for July 10, p. 58, reference is made to an installation for the operation of fog-signals from a distance. I wish to direct attention to two misstatements. The apparatus is not automatic in the strict sense of the term, as it requires to be started and stopped by human agency. The statement "These guns are the only automatic signals at present in use" may apply to the Clyde, but there are two lighthouses in the port of Dublin which are equipped with automatic fog-signalling apparatus, and these have been in operation there for almost two years. The system in Dublin depends on the interruption of a beam of light by fog. The light beam traverses the channel in an oblique direction over a distance of about half a mile, and the apparatus upon which the light acts is so arranged as to respond when the visibility falls to a dangerous degree. These lighthouses in Dublin were undoubtedly the first completely automatic lighthouses to be in operation.
JOHN J. DOWLING.

University College,
Dublin, July 13.

I REGRET to have to confess ignorance about the two lighthouses in Dublin Bay. It would be of interest to know whether smoke from a passing steamer affecting the beam of light causes the 'guns' to act. I am well aware that engineers have often discussed the proper use of the word 'automatic.' Automatic telephony, for example, is not automatic in the strict sense of the term. It would take too long to discuss this fully, but personally I object to 'semi-automatic.'
THE WRITER OF THE NOTE.

Scientific Neglect of the Mas d'Azil.

L'ÉTAT d'abandon que l'illustre écrivain M. Wells signale pour la caverne du Mas d'Azil est réel et fort regrettable, bien que les conséquences en soient probablement moins graves qu'il ne pense. Elle appartient à l'état, mais la commune en a l'usage de temps immémorial. Le cantonnier chargé de l'entretien de la route départementale qui la traverse en est le gardien officiel; c'est lui qui fait visiter les galeries obscures, plus intéressantes par le pittoresque que pour la science préhistorique, bien que de rares dessins pariétaux s'y rencontrent, et, deci-delà, quelques menus vestiges de fréquentation humaine. Sur la rive droite, le point important était la salle du Foyer et sa galerie inférieur. La salle du Foyer a été fouillée depuis longtemps dans sa totalité par Piette, Ladavèze, Maury, etc., et en dernier lieu (1901–1902) par moi-même. Je doute qu'elle contienne actuellement autre chose que les déblais de ces fouilles, sauf son couloir inférieur, où existent quelques peintures étudiées par le Comte Bégouen et moi. Les couches archéologiques peu épaisses qui y subsistent vers le fond sont sans doute l'objet des grattages dont M. Wells nous entretient. Plus grave est le bouleversement réalisé l'année dernière dans cette région de la grotte par la municipalité pour y installer un théâtre. Mais je ne crois pas que les lieux de la caverne contenant encore du gisement, placés sur l'autre rive, aient été touchés récemment: une épaisse couche de pierrailles et de terre poudreuse les défend bien.
H. BREUIL.

Preservation of Mammalian Spermatozoa.

IT may be of interest that experiments on the preservation 'in vitro' of mammalian spermatozoa show some prospect of successful application to the transport of semen to a distance; a problem of considerable importance in animal husbandry. Spermatozoa from a rabbit were sent by post from Cambridge to the Animal Breeding Research Department, University of Edinburgh. From 5 does inseminated, 46-49 hours after despatch, 3 produced litters of 8, 11, and 2 respectively. One doe died without diagnosis of pregnancy and one proved infertile.

Although the technique excludes the practical application of this particular method to the domesticated animals, further experiments are in progress, and it is hoped that these difficulties will be overcome.
ARTHUR WALTON.

Institute of Animal Nutrition,
Cambridge, July 29.

The Production of Single Crystals of Metals and some of their Properties.[1]

By Prof. H. C. H. CARPENTER, F.R.S.

THE problem of preparing a piece of metal in the form of a single crystal may be approached in one of two ways. As ordinarily prepared, metals and alloys consist of a large number of small crystals the size of which varies in the great majority of cases from about 100,000 to several million in a cubic inch. These result from the fact that when the metal or alloy freezes, crystallisation takes place at a large number of centres and the crystals grow until they meet one another. The boundaries, therefore, are produced by the meeting of these crystals and vary very much in shape. The net result is rather similar to that of a jig-saw puzzle, for the crystals are oriented quite at haphazard. The shapes and sizes of these crystals may be altered by working and heat-treatment, and the precise rearrangement may go so far as to result in the birth of new crystals, but the net result is always an aggregate of comparatively small crystals.

The properties of metals and alloys are the properties of these small crystals, and are due to two factors—(*a*) the crystal itself, and (*b*) the crystal boundary. In the crystal itself the atoms are arranged in a particular pattern corresponding to the symmetry of the metal. At the boundary, on the other hand, this condition does not obtain. For example, where two crystals are in contact atoms meet in two different directions, while at the place where three crystals touch, atoms meet in three different directions, and so on. It has been known for some time that the crystal boundary is stronger than the metal crystal, in the sense that normally when a metal is fractured it breaks through the crystal and not along the boundary, and the fracture of a metal test-piece is the summation of a large number of fractures running through small crystals. Hitherto it has been impossible, except in a very few isolated cases, to determine the properties of a metal crystal apart from those of the crystal boundary. The great and indeed fundamental interest of the problem of preparing a piece of metal in the form of a single crystal, therefore, is that its solution would enable the properties of the metal crystal to be determined.

SINGLE CRYSTALS FORMED DIRECT FROM THE LIQUID.

Evidence has been in existence for some time that, provided that the right conditions obtain, very large crystals can be grown from the liquid. The famous Tschernoff crystal dates back to about 1880. It was a large iron crystal, which he noticed in the 'riser' (head) of an ingot at the Vickers' works in Sheffield, and was upwards of 6 in. in length. Its shape was peculiar, and was what is called a 'crystal skeleton'—*i.e.* it had grown along the crystallographic axes to a greater extent than the filling-in process had occurred, and the net result was something which looked very like the branch of a pine-tree. Other instances of the accidental occurrence of large crystals have been noticed by Osmond and Cartaud, Moellendorff and Czochralski.

So far as I have been able to discover, the problem of preparing a single crystal direct from the liquid was first solved by Czochralski in 1918. He prepared long thin threads of crystals by drawing out a rod at a particular rate from the molten metal. As the rod was withdrawn the metal solidified and the resulting wire (0·5 mm. diameter) was found to consist of one crystal. Success was thus achieved with tin, lead, and antimony. Later Gomperz improved the technique of Czochralski's method. He used a silica rod on which to deposit the crystal growing from the melt and surrounded this with a neutral gas.

Quite recently (1923 and 1925) P. W. Bridgman has prepared much larger single crystals by melting the metal in a tube tapered at one end to a point and lowered through the furnace at a given rate. He found that if the lowering is at a speed less than the velocity of crystallisation and slow enough for the heat of solidification to be dissipated by conduction, then the metal will usually crystallise as one grain, provided that only one nucleus started at the bottom of the tube. In this way he prepared crystals of antimony, bismuth, cadmium, tellurium, tin, and zinc. It is particularly interesting to notice that this method also holds for metals having a polymorphic transition point (tin and antimony).

The melting was carried out *in vacuo*, and great stress is laid on the importance of freedom from dirt as an essential condition of success. At some little distance from the bottom the tube was constricted to a capillary, 0·1 mm. in diameter. It was found that one orientation of the crystals is usually more favourable for growth than others, so that even if crystallisation starts from more than one centre at the bottom, that crystal will eventually win through the capillary which is most favourably situated. Bridgman found that the most favourable orientation is, in almost all cases, when the plane of easiest cleavage or slip is parallel to the axis of the casting. In this way single crystal rods up to a diameter of 2·2 cm. were prepared. The same device was adopted by Obreimow and Schubnikow.

Valuable work on the single crystal wires produced by Czochralski's method and their distortion by mechanical stress has been carried out by Polanyi, Schmid, and Schouborn, while Bridgman has determined a number of physical properties of his single crystals of metals, which were purposely chosen because they did not possess the highest symmetry and therefore might be expected to give different values in different directions. This expectation was fulfilled.

SINGLE CRYSTAL TEST-PIECES FROM PRE-EXISTING CRYSTALS.

Here, again, a study of the literature showed it to contain a number of observations which indicated that, provided that the right conditions were obtained, success might be achieved in this direction, although the chances did not appear so good as that of preparing a single crystal from the melt. Sauveur was, I think, the first investigator to show that, by carefully straining and afterwards heating metals, crystals of a much larger size than the normal could be produced, and stated that there was a critical stress which produced the largest crystals. Afterwards Ruder, Chappell, Jeffries, and Hanson showed that if a metal is locally deformed and then heated, exceptionally large crystals form at some distance from the point at which stress is the severest. If a tapered test-piece was used a 'strain gradient' was obtained, and it was found that the largest crystals always formed within the strained region, but farther from the area of greatest strain the higher the temperature. Seligman and Williams, working in my laboratory, stretched aluminium sheet, which had been previously heated, to various degrees, and found on heating that, up to a certain point, a small deformation had no effect. Beyond this, however, large crystals were formed, and as the deformation was further increased the crystal size was diminished. The crystals produced by these methods were very large compared with those in the original metal, some of them being 0·5 in. long.

---

[1] From the sixteenth May Lecture to the Institute of Metals, delivered on May 19.

In recent years wires have been produced, originally by accident, both of tungsten and molybdenum, in which crystals occupy the entire cross-section of the wire. This is done by drawing the metal through dies at a certain rate and temperature. Sykes, experimenting on molybdenum wire, obtained crystals 0·5 in. long, with an average diameter of 0·013 in.

Experiments on the production of single aluminium crystals were begun several years ago by Miss C. F. Elam, my research assistant, and myself. For many months we studied the structural changes produced in a crystal aggregate by deformation followed by heat, which may be summarised as follows: The first effects of strain are revealed by the presence of slip-bands, and in some cases of twin crystals. The former are completely, and the latter to some extent, removed by heating. No change is observed in the shape of the crystals. Somewhat greater deformation, however, followed by heat, produced actual crystal growth, and at this stage the boundaries of the crystals became active. This activity is shown in the capacity of the growing crystal to push forward its boundaries in certain directions, thus invading other crystals, upon which it imposes its orientation. A still greater deformation produces a change which appears to take place exclusively in the boundaries of the deformed crystals. It is here that new crystals are born, possessing a different orientation and a much smaller size. Accordingly, in this third stage there is a refining of the crystal structure. From the point of view, therefore, of producing large crystals from an aggregate of small ones, the intermediate degree of strain, just referred to, is the important one.

The increase in crystal size could be clearly followed in our experiments with an alloy of tin containing a little antimony, where the actual movement of the crystal boundary was observed and photographed. Our experiments further showed that in the absence of a change of phase neither crystal growth nor recrystallisation will take place in a metal unless it has been plastically deformed and afterwards heated to a certain minimum temperature for a certain minimum time. They also showed that there is no gradual increase in size from the original crystals up to the largest, but that the latter appear to form directly from them. It is clear therefore that, in the production of large metal crystals, the adjustment between mechanical strain and the temperature of heating is extremely important.

This point can be clearly illustrated in the case of the metal aluminium. Test-pieces, after preliminary heat-treatment to remove work hardness and render the crystals so far as possible equiaxed, were subjected to varying degrees of strain. After this they were all heated to 550° C. for 6 hours. Finally, they were etched in a 10 per cent. solution of caustic soda. Below the minimum strain required for growth, the crystal size remains unaltered. At the critical strain large crystals suddenly appear. Above this the size diminishes in proportion as the strain increases.

PRODUCTION OF SINGLE CRYSTALS IN SHEETS.

By this time we were ready to approach the problem itself, and our first experiments aimed at converting the crystals in the parallel portion of a test-piece 4·0 in. × 1·0 in. × 0·125 in. of aluminium into a single crystal. Calculation showed that the total number of crystals contained in the parallel portion of the test-piece was about 1,687,000.

After many months of work success was achieved in the following way: The test-piece must, in the first place, be accurately machined along the parallel portion. In order to convert this into a single crystal three treatments are necessary: the first thermal, the second mechanical, the third thermal. The first treatment is necessary to soften the metal completely and produce new equiaxed crystals of so far as possible uniform size, the average diameter being $\frac{1}{100}$ in. The second consists in straining these crystals to the required amount, and the third in heating the strained crystals to the requisite temperature, so that the potentiality of growth conferred by strain could be brought fully into operation.

The most suitable temperature of the first heating was found to be 550° C., and the time 6 hours. The precise degree of strain for the aluminium used was an elongation of 1·6 per cent. on 3 in. produced by a stress of 2·4 tons per sq. in. The final heat-treatment was begun at 450° C., and the temperature raised at about 25° C. per day up to 550° C. It was then brought finally up to 600° C. for one hour, in order to complete the absorption of small crystals on the surface, which persistently remained at lower temperatures. On an average, one test-piece in four is converted into a single crystal in this way. The boundary at each end extends in the form of an irregular line into the wide head of the test-piece. The time required for the single crystal to grow in this way is therefore about 100 hours.

The conditions laid down by us for the production of a single crystal were that every crystal in the complex should be strained a certain small amount, and that one of them should be strained rather more than all the rest. We were originally disposed to think that the crystal which grew and absorbed all the others was the one most highly energised by strain. Later investigations with X-ray analysis, however, have shown that single crystals produced in this way are free from strain, and we have accordingly modified our view and consider that the most highly strained crystal deposits a nucleus free from strain upon which all the other crystals ultimately align themselves, thus producing an unstrained single crystal.

PRODUCTION OF SINGLE CRYSTALS IN BARS.

We next proceeded to apply these methods to the production of single crystals in round bars. We found that, provided that the same conditions as to accuracy of machining, correct crystal size, degree of straining, and final heat-treatment were maintained, single crystals could also be produced in round-bar test-pieces, both in diameters of 0·564 in. and 0·798 in. Single crystal test-pieces 9 in. long and 0·564 in. in diameter have been prepared in this way.

Deformation of these test-pieces under tensile stress is very remarkable. On one hand, the 'normal' bar, consisting of small crystals, drew down with a roughening of the surface, a cup and cone fracture, and the maintenance of a circular cross-section throughout. On the other hand, when a single crystal was pulled in this way it produced an ellipse. As the test proceeded the ellipse became narrower and narrower in one diameter, while the other diameter remained nearly constant. Presently a point was reached when a characteristic lens-shaped figure was formed. As the bar pulled apart this became smaller and smaller. Eventually fracture took place at each side and ultimately in the middle.

The final result was that the fractured surface of each half of the test-piece was a very acute ellipse or wedge, the metal being grooved in each case. Characteristic flow lines also made their appearance on the test-pieces, corresponding to the slipping of the metal in this remarkable and quite novel way. They may be called 'glide-ellipses.' Here, again, the properties varied considerably in different specimens, the tenacities ranging from 3·0 to 4·0 tons per sq. in. and the elongation from 57 to 85 per cent. In some of these experiments the volume of the single crystal exceeded 2 cu. in., which means that about 7,000,000 crystals had coalesced in their formation.

It has not been found possible to produce single crystal test-pieces of square bars. Owing to the shape, these fail to strain uniformly, and, on heating, crystals grow from the four corners and meet in a line in the middle of the four sides. Some of the crystals were from 2 in. to 3 in. long and were visible on two adjacent sides. Remarkable effects were obtained on breaking them. In some places the corners became rounded, while in others they were narrowed to a ridge of almost knife-edge thickness. The whole bar became very much twisted and distorted.

ANALYSIS OF THE DISTORTION OF SINGLE CRYSTAL BARS.

The distortions of the single crystal test-pieces produced both in sheet and bar forms were very remarkable, and clearly suggested that the crystal axes were not oriented in the same direction in each specimen. In discussing this matter with Mr. (now Prof.) G. I. Taylor, he thought that it would be a straightforward, though possibly laborious, task to determine the relationship between the orientation of the axes and the distortion produced in a tensile test, and that by examining a number of specimens some general results might be obtained about the forces necessary to produce distortions of this type. He kindly agreed to join us in the work of testing these matters. Before the test contemplated could be carried out, however, it was necessary to obtain the help of an expert in crystal analysis by X-rays. Dr. A Müller accepted our invitation, and succeeded in devising a satisfactory method of determining the orientation of the crystal axes in single crystal bars by means of X-rays.

For the purpose in hand it was necessary to work with a square bar. As already mentioned, single crystals cannot be grown in square bar form. We had, therefore, to produce a round single crystal test-bar and then to machine it down until its section was square. The method of investigation adopted was as follows: Each face was marked by a scratch parallel to the length of axis of the specimen and by cross scratches at 0·5 in. intervals. The faces were numbered 1, 2, 3, and 4, so that when the specimen was placed upright in the testing machine the faces appeared in this order when the observer moved round the machine in an anti-clockwise direction. At each successive stage of the test the extension between each pair of cross marks was measured on each face. At the same time the angles between the cross scratches and the longitudinal scratch were measured in each case. In addition, the thickness of the specimens between pairs of opposite faces and the angle between neighbouring faces were also measured. These suffice to determine the nature of the distortion.

Measurements showed that near the ends of the specimen, where it was held in the grips of the testing machine, the measurements were not quite the same as those near the middle, but that the central portion was nearly uniformly strained. There is a high degree of uniformity among the measurements of extension in the three middle compartments of each face, especially in the earlier stages of the test.

Measurements were made at extensions of 5, 10, 15, 20, 30, 40, 60, and 78 per cent., when the crystal broke. As the test proceeded the square section of the bar gradually disappeared, and the final result was a parallelepiped of remarkable form. The cross scratches, although remaining rectilinear, shifted by a definite angle which became markedly acute. When the specimen finally broke, it contained two very acute and two very obtuse angles.

Prof. Taylor and Miss Elam followed up this work with a paper published in 1925. In this they have described similar experiments made with several more specimens in order to find out whether the conclusions previously reached are general in their application and to settle several points which the previous experiments left in doubt. The chief result of their earlier work was to show that of the twelve crystallographically similar possible modes of shearing, the one for which the component of sheer-stress in the direction of shear was greatest was the one which actually occurred. The first object of the later work was to determine the orientation of the crystal axes of several specimens.

Assuming that the relationship outlined above holds in general, it is possible to predict the orientation of the plane on which slipping should occur. Three more single crystal test-pieces were stretched and their distortions analysed by the method already described. It was found that in each case the distortion was such as would be produced by shearing parallel to a single plane, and that this plane of slip was the one predicted. It was also found that the changes in orientation of the crystal axes relative to the axis of the specimen during the test were in good agreement with the prediction.

In the previous work it was not possible to make a detailed analysis of the deformation during the last stages of the stretching, but it was shown that the deformation ceased to be due to slipping on one crystal plane. Reasons were given for supposing that the deformation might be due to slipping on two crystal planes simultaneously, and it was shown that the crystal axis which formed the intersection of these two planes remained unstretched during the test, as it should if the distortion were in fact due to this cause. There are, however, a number of other types of distortion which might also leave this particular axis unstretched. In their later paper Taylor and Elam showed that for a small distortion the 'unstretched' cone passes through or very close to three other crystal axes, which, in fact, determine all the possible kinds of unstretched cone which can be produced by double slipping of the type contemplated. This completes the proof that the slipping in the last stages of the test is of this type.

When the crystal begins to slip on a second plane it seems likely that the rate of slip on each plane would be the same. In this way they would remain inclined at equal angles to the axis of the specimen, but it was impossible to verify this suggestion from the previous experiments. The second paper contains the test of this, and it is found that, although double slip does begin when two planes get to the position in which they make equal angles with the axes, the rate of slipping on the original slip plane is sometimes greater than it is on the new one. The two planes do not, therefore, necessarily remain at equal angles with the axis, but the process cannot be followed very far because the specimen usually breaks when only a comparatively small amount of double slipping has occurred.

A most interesting test described in this paper was that in which the authors distorted a single crystal test-piece, in which they predicted that from the original position of the crystal axes double slipping should begin at once. A specimen was found the axes of which corresponded very closely to this position, and it was found that double slipping did occur during nearly the whole extension. In this case it was found that the amount of slipping on the two planes was practically equal, and that the axis of the specimen remained very close to the (112) axis during the whole test.

A point of which Taylor and Elam made special mention was the extraordinary uniformity of the stretched specimens. They showed a photograph of specimen No. 68 which had been stretched to an extension of 70 per cent. To the eye it appears absolutely uniform. They gave numerical data as to the variations in extension of different parts of the specimen, and found that the average variation of ϵ was 0·0028 during the first 5 per cent. Up to 20 per cent. extension the variation did not exceed this figure; it then began to increase, until at the breaking point it rose to 4 parts in 100.

The chief conclusions drawn by the authors from the theory of fracture contained in their paper are—(1) that with a stress-strain curve of the type found by them, fracture of aluminium single crystals cannot occur by slipping on a single crystal plane, and (2) that the geometrical conditions alone imply that fracture takes place more easily when double slipping occurs than when all the slipping is confined to one plane.

Miss Elam and I have recently investigated the distortion of single crystal test-pieces of aluminium followed by subsequent heating. We have found that the crystals can be deformed so much as 7 per cent. without being destroyed on heating. Beyond this amount the metal recrystallises and breaks up into a number of smaller crystals the size of which depends on the amount of distortion. Near the fracture the crystals are smallest and they increase in size towards the shoulders of the test-piece. The recrystallised metal shows exceptionally straight crystal boundaries, and the crystals are frequently twinned.

We then made a detailed examination of the behaviour of two round single crystal test-pieces after successive increments of strain followed by heating. The orientation of the bar was first determined by means of X-rays, and the metal then extended 5 per cent. The position of the crystal axes was then determined, and it was found that the reflections on the photographic plate were not so well defined and were spread over a large reflecting angle. The crystal was then heated to 400°, 500°, and 600° C. and examined after various periods at these temperatures. No change appeared after this treatment. The nature of the X-ray reflections was unaltered, and there was no change in the position of the reflecting planes. After a second extension of 5 per cent. the positions of the reflecting planes were redetermined and the bar heated to 350° and 450° C. No change was observed. After heating at 550° C. the reflections that had been found previously had disappeared, but new ones were obtained in other positions.

A comparison of the reflecting planes from different parts of the bar, including opposite sides of the same reference plane, showed that it was still a single crystal, but that it possessed an entirely different orientation from that of the original. Moreover, the X-ray reflections now obtained were sharp and well defined as in the original crystal. Etching in caustic soda revealed a homogeneous structure. Further extension of 5 per cent. produced results similar to the first extension, and heating up to 600° C. produced no change. On heating after the fourth extension, however, the orientation was found to have changed once more, but the bar still remained a single crystal. The process was again repeated, and after the sixth extension a partial recrystallisation took place. Another single crystal test-piece was subjected to this treatment with exactly similar results. Here again the crystal moved successively into two new positions.

The Problem of the Origin of Species as it appeared to Darwin in 1859 and as it appears to us To-day.[1]

By Prof. HENRY FAIRFIELD OSBORN, For. Mem. R.S.

The first of these objects, that is, the establishment of a belief in descent with modification, was always held by my father to be the more important of the two; for I once heard him say, if a recollection of about fifty years' standing may be trusted, that "after all, evolution is the great thing, not natural selection."—LEONARD DARWIN, "Organic Evolution," pp. 1, 2.

NEARLY one hundred years ago Charles Darwin began to collect facts for "The Origin of Species," his immortal work, which was cautiously withheld from publication until 1859. There still prevailed the zoology of Linnæus and Buffon and the palæontology of Cuvier. In Lesson's "Mammalogie" (1827) the number of mammalian species is exactly 1124, as compared with the 13,450 species and subspecies of mammals known at the end of the year 1925. Birds increased from 3600 to 23,939; reptiles and amphibians from 543 to 9000; fishes from 3500 to 20,000. Darwin's species stood apart like isolated mountain peaks, whereas to-day living species and subspecies are often comparable to mountain chains composed of lesser peaks completely connected by ridges known as intergradations. It is not the number of species and subspecies which is significant, but the facts as to habit and habitat which are recorded with them. Similarly, it is not the number of fossil species now known as compared with those of Darwin's time, but the *linkage* of families, genera, species, subspecies, and even of 'ascending' and 'descending mutations' reaching back over hundreds of thousands, if not millions, of years.

This twenty- to one hundred-fold disparity in our knowledge simply intensifies our admiration for the courage of Darwin in boldly substituting a natural for a supernatural conception of the origin of species. It is true that Darwin's most influential authority was not the current zoology and palæontology of his day but Nature itself, whereby even in 1859 he absolutely established the Law of Evolution, as well as the directing and standardising principle of Natural Selection. It is, however, not this broader aspect of evolution, but the more concrete problem of the *modes* and *causes* of the origin of species which we are considering to-day.

Let us re-examine these causes in the light thrown by naturalists and observers on the invertebrates and vertebrates as distributed over the great continents of Europe and Asia, of North and South America, of Australia, considered not alone with their present boundaries but also with their former land connexions secured by elevation to the hundred fathom line. In this connexion I present a new zoogeographic and palæogeographic map of the world, prepared with the aid of Bartholomew of Edinburgh. We shall see that the results of zoological and palæontological research are entirely harmonious and concordant, but that zoology, while clearly teaching certain principles of the origin of species, leaves blank many gaps which are completely filled by palæontology.

Thus these two branches of biology are complementary in demonstrating that, through observations after the very naturalistic manner of Darwin in the voyage of the *Beagle* and through the very Lyell-Darwin methods by which the natural origin of species was originally discovered, *the problem of the origin of species has entirely changed in the last hundred years*. In fact, were the great naturalist living to-day, he would be foremost in modifying his own opinions, speculations and theories.

Greatly enhancing the value of the recent work of our field naturalists is the fact that the results reached in fishes, amphibians, reptiles, birds and mammals were recorded entirely independently of each other. Where the conclusions reached are harmonious or concordant they have the convincing value of entirely independent testimony. Also, these results are doubly valuable because they are for the most part assembled without biological purpose or intent, not to prove or to disprove any particular theory, but recorded simply as actual observations.

This is generally true of all field naturalists, who are more concerned about Nature than about the interpretation of Nature. The interpretations upon which our field naturalists do venture, such as the 'direct action of environment,' and 'Lamarckian inheritance,' are often lacking in real biological analysis. For such analysis, therefore, we must allude to five biological principles which have developed from laboratory experiments, and the generalisations growing out of them, beginning chiefly in the year 1880. These are as follows:

(1) Weismann's sharp distinction of the germ-plasm from the body plasm, from which follows the equally sharp distinction between truly germinal specific characters and bodily modifications by environment or habit; (2) the experimental failure of the inheritance effects of adaptive habit, known as Lamarckism; (3) the apparent failure of the environment to modify immediately the germ-plasm in creating adaptive specific characters; (4) the sharp limitations of the originative powers of Natural Selection as conceived by Darwin; (5) the sharp distinction between the continuous and discontinuous (or mutational) origin of specific characters.

In fact, the outstanding speculations of Darwin's and Herbert Spencer's time as to the causation of the origin of species have been pared down by laboratory analysis to a mere vestige of their former selves, and the overweening confidence of one school of causation after another has been displaced by diffidence, doubt, or even agnosticism, as expressed in the final address of William Bateson, whose recent death we lament at this meeting. To sum up, intensive laboratory and experimental research has added vastly to our knowledge of the functions of animals and of the heredity mechanism but has greatly increased the difficulties inherent in the problem of the origin of species. It is the *modes* and the *causes* of the onward progressive movement of the germ-plasm resulting in the consecutive origin of new adaptive specific forms which are rendered still more mysterious by the negative results of laboratory research.

---

[1] Read before Section D (Zoology) of the British Association, at the Oxford meeting, August 5, 1926. This is the fourth of a series of papers on the origin of species, the first having appeared in NATURE, June 13 and 20, 1925, under the title, "The Origin of Species as Revealed by Palæontology."

DISTINCTION BETWEEN SPECIATION AND MUTATION.

So far as the *modes* of the origin of species are concerned, these negative results of the laboratory are more than offset by the positive results obtained by our field naturalists and explorers who are independently discovering a considerable number of species-in-the-making at the present time. In other words, we now understand the contemporary origin of species after modes and under conditions wholly unknown to Darwin in 1859. Geographic *isolation*, to which Darwin's attention was first directed by Wagner, with all the incidental influences of physical or chemical change, of enforced change of habit, of competition with a new life environment, perhaps of stimulus to the germinal energies themselves, seems to constitute the chief complex of causes in the origin of new species; this complex is summed up in the principles which Osborn terms *tetraplasy* and *tetrakinesis*. An extreme phase of isolation is *insulation*, where species are scattered among a number of islands. A like isolating mode among fishes is seen in the complete separation of rivers and streams formerly connected. In this complex of four coefficient causes, all involving energy, the specific germinal substance itself undergoes change, extremely slow but continuous, so that a new stage is very gradually reached, formerly known as a 'geographic variation' but now known as a 'subspecies.' Between subspecies living in islands and separated rivers there are naturally no *intergrades* or intermediate stages, but in a number of independent examples among fishes, amphibians, reptiles, birds and mammals, true intergradation has been observed linking one subspecific form with another in a continuous germinal life-chain. Such survival of intergrades may be instanced as proof of *complete continuity* between subspecies and, consequently, between species.

This appears to be the normal and natural mode of origin of the greater number of specific forms as observed in zoology; such mode has been termed 'speciation' by recent British and American authors. In exactly the same field of observation and by the same observers, apparently as an abnormal mode due to some irregular influence on the specific germ-plasm, is seen the discontinuous or sudden origin of new characters, ranked by some observers as specific, after the manner termed 'chance variation' by Darwin and 'mutation' by De Vries. *Mutation* thus appears to be a real phenomenon, but a relatively rare one; such mutational origins need to be protected by geographic or climatic isolation from interbreeding with normal species.

Thus *speciation* through continuity stands in contrast with *mutation* through discontinuity. There is no question as to germinal change in mutations, but may the same be said of subspecies? In answer to this doubt it has recently been shown by experiment (Sumner 1924) that many, if not all subspecific characters are *stable under changed conditions of environment*. Consequently, while under suspicion as to reality, often vexatious and unconvincing, and always annoying to the systematist, *well-authenticated subspecies are of priceless value to the biologist who seeks to ascertain the conditions under which new species arise.* It proves that many 'geographic variations' and 'subspecies' are really germinal transitions, intermediates and intergradations from 'species' to 'species' of the higher kind known to Darwin.

The above is a summary of principles gathered from a very large number of independent observers whose names will be fully recorded with the titles of their papers in the complete series of notes on which the present paper is based. Outstanding names are those of Adams in the gastropods, Jordan, Berg and Regan in the fishes, G. A. Boulenger in the amphibians, E. G. Boulenger in the reptiles, Chapman and Griscom in the birds, Osgood and Sumner in the mammals. The whole list of observers in the vertebrates alone comprises more than a hundred names. For the annotation of this extensive literature I am indebted to members of the corps of zoologists of the American and British Museums and of the Zoological Society of London.[1]

EXAMPLES OF GEOGRAPHIC ISOLATION AND SPECIATION.

It appears that speciation arises only where one or all of the energy coefficients of Osborn is changed. In amphibia especially, geographic isolation does not invariably result in the origin of new species, because all the conditions of the new habitat may be identical with those of the old. A most striking example of complete intergradation between 'species' is that of the molluscan genus Io of the Tennessee River, which now presents all the living intergrades between the smooth and the spinose forms as we pass downstream. In fishes, skeletal intergrades are observed as we pass from northern to southern waters (Berg) or from a colder to warmer marine habitats; these intergrades consist in the number of vertebræ, of fin rays and of scales, and in body form and colour, and Berg concludes that all the individuals of certain geographic areas simultaneously produce similar new specific characters.

Among amphibians the entire region around the Mediterranean affords G. A. Boulenger a series of subspecies of the edible frog, *Rana esculenta*, more or less connected by intergrading forms. Among reptiles E. G. Boulenger observes the speciation of the skink, *Chalcides ocellatus*, a species which, like the edible frog, surrounds the Mediterranean, in which the difference between two isolated subspecific forms is so great that *were it not for the wonderfully complete manner in which they are connected they could not be denied full specific rank*. As among fishes, intergradations are observed in all the skeletal characters, as well as in the colouring and the scales. Completely supporting these observations are those of many of the recent herpetologists who conservatively use the word 'variety' where other authors use the word 'subspecies,' who imply that intergradations occur wherever a sufficiently large number of specimens are examined. Chapman, with extensive collections of South American birds at his command, records exactly similar results:

---

[1] These data will be published in full in a sequel to the present paper, in the *American Naturalist*, No. 5, in the series on the origin of species.

> The ornithologist finds large forms occupying colder areas, dark ones humid areas, and pale ones arid areas, and as the [environmental] conditions which obviously produce these variations in size and colour merge one with the other, so do the [specific and subspecific] forms themselves intergrade. That these variations are inherent [*i.e.* germinal, constitutional, hereditary] and not merely the temporary impress of physical environment on the individual, is apparently shown by the fact that they are often as well marked in the nestling as in the adult.

Chapman also observes a distinct case of 'mutation' within the genus Buarremon in the presence of a black pectoral feather-band, which is established as a specific character by isolation or geographic discontinuity. Like the single case with black dorsal band observed within the genus Troglodytes, the mutation does not intergrade and is thus recognised as of discontinuous or mutational origin. Stresemann finds partial melanism as well as albinism arising as not infrequent mutational characters, but fails to show that these are adaptive. Chapman and Griscom in their North and South American field work distinguish clearly between intergrading and non-intergrading kinds of birds. In a collection of 1500 specimens of the house wren, Troglodytes, these observers have noted a considerable number of cases of *complete* intergradation between subspecies, and those familiar with the marked physiography of South America, with (*a*) its cold and arid Pacific coastal belt, (*b*) its Andean Mountain chain subdivided by Chapman into numerous vertical life-zones each clearly demarcated until we reach the boreal summits, (*c*) its vast Amazonian forest plain, (*d*) its pampas and plains of the south-east, and (*e*) humid forests bordering the Straits, may anticipate wide speciation in other forms of animal life in this continent. It is noteworthy that these observers have discovered in Troglodytes only one example of mutation in the sense of De Vries. It cannot be questioned that isolation is the most important factor in the speciation of birds, especially in its extreme form of insulation. As an example of wide isolation without speciation, the house wren of Florida, *T. ædon ædon*, exhibits the same characters as those of Tierra del Fuego, but in the intermediate regions another species, *T. musculus*, exhibits a large amount of subspeciation and several complete intergradations.

Among mammals the great transverse geographic range from Scotland across Eurasia and North America to New Brunswick, Canada, of three species of the deer family, affords a striking example of geographic speciation; the stag (Cervus) yields twenty-three species and subspecies; the moose (Alces) yields eight subspecies; the reindeer (Rangifer) yields twenty-one subspecies. This is in wide contrast to the knowledge of Darwin (1837–1859), to whom were known only two species of stag, one species of moose, and one species of reindeer. Far more significant, however, are the observations of Osgood and Sumner on the deer-mice of the genus Peromyscus, which range through the temperate region of North America to the Pacific coast. From a collection of 30,000 specimens Osgood finds that a subspecies is characteristic of every distinct climatic region and sub-region. These subspecies listed by Merriam and Osgood have been accepted with great reluctance, especially by naturalists unfamiliar with the excessively sharp geographic and climatic barriers of the western United States. Our hesitation to accept these subspecies as of real germinal or genetic value has been entirely removed by the persistent observations and experiments of the biologist Sumner, largely in the identical collecting grounds of Osgood, and we must welcome these combined observations and experiments as the most convincing demonstration of the principle of *speciation continuity* thus far afforded. Between at least six of these subspecies complete intergradations occur. Classification becomes like dividing the lines of the spectrum. After eight years of transfer from an arid to a humid environment, or vice versa, these subspecies retain their original characters. Even profound change of environment does not yield a new subspecific form, nor are changes of habit inherited in eight years of experiment.

> (1) The summary of eight years' experiment proves the comparative stability of subspecies of the Deer-mice (Peromyscus) under very marked new environmental physical conditions. (2) Merriam-Osgood subspecies are proved to be stable under changed conditions of environment, by transplantation experiments; *i.e.* a desert subspecies, *P. m. sonoriensis*, reared for eight years in a humid environment, is entirely unmodified in the direction of the humid subspecies *P. m. gambeli*. (3) This doubly proves (*a*) that characters of the desert *P. m. sonoriensis* are germinal, not environmental; (*b*) that humid environment makes no modification whatever toward increased depth of colour in eight years and in seven to twelve generations. (4) Similar results from transplantation of *P. m. rubidus* and *P. m. sonoriensis* are obtained: reared in an entirely new environment, they do not converge toward each other but toward local humid species *P. m. gambeli*.

SPECIATION A SECULAR PHENOMENON.

Whereas an inheritable mutation may be produced by a single experiment, 40,000 years, the lapse of time since the last glaciation, is a moderate estimate of the time required to produce a subspecies. In the case of all the genera cited above—Cervus, Alces, Rangifer, Rana, Chalcides, Troglodytes, Peromyscus—we are observing subspecies arising in a region which was profoundly affected by the fourth glaciation with its pluvial climate, a region in which new subspecies have arisen *pari passu* with the modern demarcations of habitat and of habit. That speciation is an incredibly slow process is attested by the case of the newly discovered Pliohippus of Leidy, which early in Pliocene time assumed all the characters of the modern Equus. The entire speciation process of plants and animals has been going on perhaps for a thousand million years, as estimated on purely physical grounds, and in a recent conversation with Sir Ernest Rutherford it was agreed that another thousand years of research may be required for an understanding of the highly complex physico-chemical basis of life.

CONCORDANT OBSERVATIONS IN ZOOLOGY AND PALÆONTOLOGY.

As distinguished from the speciation observed in zoology, in palæontology we deal with secular speciation, in which, quoting from the first of Osborn's series of papers on the origin of species, we observe the adaptive action and reaction of the heredity germ over long periods of time. We also observe the secular action of natural selection (Darwin's selection factor), the secular direct reaction to environment (Buffon's factor), the secular adaptive action of habit (Lamarck's factor), the secular adaptive reaction to the living environment (Darwin's factor). We sharply separate Darwin's factor of selection, which has no energy content, from the above four energetic forces of evolution, namely, heredity, physical environment, living environment, and individual development or ontogeny. This is the principle of tetraplasy and tetrakinesis.

This momentary lapse into speculative as distinguished from purely observational consideration of the problem of the origin of species may clarify the transition from zoology to palæontology.

In palæontology an entirely new series of principles is discovered in speciation which are quite beyond the eye of the zoologist. Chief among these new principles is that dimly perceived by Darwin in the words 'analogous variation'; it is that of germinal or evolutionary trend in a definite direction, the 'mutations richtung' of Neumayr. Out of this springs Osborn's principle of *rectigradation* observed in the rise of adaptive characters from the germ-plasm, that is, new specific characters which pass continuously from the most rudimentary and inefficient into the most efficient and highly developed stages. It may be a matter of interest to members of the British Association to recall that this principle was presented to the Association in 1889 by the present speaker. Through unbroken observation during the intervening thirty-seven years this rectigradation principle has been confirmed in four great orders of hoofed mammals, namely, the horses, the rhinoceroses, the titanotheres, and the proboscideans. Research on the two latter groups fills two great monographs aggregating nearly a million words and covering, in the case of the Proboscidea, the analysis of the mode of origin of more than 350 species and, in the case of the titanotheres, the chief stages of specific development extending from Lower Eocene through Lower Oligocene time, when these animals suddenly disappear.

An epitome of these observations is presented in three diagrams in which the three outstanding principles discovered in palæontology are observed: First, the unbroken continuity of speciation, which becomes absolute as the gaps are filled by discovery. Second, the constitutional predisposition to speciate in certain predetermined directions which must be inherent in the germ-plasm of ancestral forms. Third, that these constitutional predispositions are not released except through adaptive reaction to new conditions of life; they are not, therefore, of the nature of inherent perfecting tendency, but, rather, of the nature of a *potentiality* to appear when the need for them arises. For example, the rhinoceroses have the potentiality of developing two horns, an anterior horn on the nasal bone and a posterior horn on the frontal bone. But in the fourteen branches into which this great subfamily subdivides in its migrations to all parts of the earth, this double potentiality is seldom availed of, sometimes not availed of at all.

Conclusions.

We seem to have reached an entirely new era in research on the problem of the origin of species, marked by the decline and death of speculations and theories advanced upon the very limited knowledge of the first half of the nineteenth century. Through zoology and palæontology we have reached a solution of the least difficult half of the problem with which Charles Darwin was confronted: we know the *modes* by which subspecies and species originate; in fact, there is little more on this point to be known. But this very knowledge renders the problem of *causes* infinitely more difficult than it appeared to Darwin. The causes of 'variation,' to use the term he employed for the evolutionary process, lie in the way before us. They may be resolved or they may prove to be beyond human solution. We must resolutely face these alternatives, and in the meantime continue our synthesis over every field of biologic research.

The Geographical Distribution of Magnetic Observatories.

By Dr. C. Chree, F.R.S.

The provision for observational work in terrestrial magnetism is different in kind in different countries, and in some countries—Great Britain, for example—the provision made is of more than one kind. The object in view may be purely utilitarian, or purely scientific, or partly both. Originally the provision of information necessary for the use of the compass was the one utilitarian object generally recognised. To secure this object to the best advantage, the natural course is to make a single department responsible for the running of magnetic observatories, the taking of field observations and the preparation of charts. Thus, in the United States the Coast and Geodetic Survey controls the whole of official terrestrial magnetism. The number and position of the observatories—Sitka, Cheltenham, Tucson, Vieques (Porto Rico), and Honolulu—is determined primarily by survey considerations. The same idea prevailed to a certain extent in India, but the oldest magnetic observatory, Alibag—regarded as the continuation of Colaba, Bombay—represents a more usual form of development.

In most countries terrestrial magnetism has not been an independent plant, but from the point of view of astronomers and meteorologists has been a parasitical growth on astronomy or meteorology. Greenwich may perhaps be regarded as an example of this. At present most magnetic observatories are under the meteorological service of the country, and one of the two international associations concerned with the subject is the Magnetic Commission of the International Meteorological Committee. It is under its auspices that a selection of international quiet and disturbed days is made at De Bilt, Netherlands. The other international association, the Section of Terrestrial Magnetism and Electricity of the International

Union of Geodesy and Geophysics, represents the more distinctly scientific aspects of the subject. Its existence distinct from the Section of Meteorology is largely due to the independent position assigned to terrestrial magnetism in the United States and some other countries.

In France—as is still the case in Germany, Denmark, Holland, Belgium, and Portugal—terrestrial magnetism used to be in the main a branch of meteorology, but it now comes under the Institute of Geophysics, presided over by Prof. Maurain, of Paris. In Italy there was once an observatory at Rome under the Meteorological Office. But Rome—like Kew of later years—suffered from artificial disturbance and had to be given up, and Italy remained for many years without a continuously recording magnetic observatory. It succeeded after the War to the observatory maintained at Pola by the Austrian Admiralty, which is now controlled by the Italian Hydrographic Office.

Of the observatories independent of State control, the most important are those of the Jesuit Order and of the Carnegie Institution of Washington. The former group includes Stonyhurst—one of the oldest magnetic observatories now existing—Ebro (Tortosa) and Lukiapang (successor to Zi-ka-wei) in China. The Carnegie observatories at Watheroo (Western Australia) and Huancayo (Peru) are of recent creation.

In Bulletin, No. 5, 1924, of the International Section of Terrestrial Magnetism and Electricity, 66 magnetic observatories are included in the list on pp. 146-148, but some of these had not been active for some years, and a few, for example Kew, are now extinct. The number may seem large, but it means only one observatory per three million square miles of the earth's surface, while the diversity in the phenomena to be recorded is very great. Further, the distribution is very irregular. Of the 66 observatories mentioned above some 30 were in Europe, and only 13 were in the southern hemisphere. Only three were north of 60° N., and only two were south of 40° S. The regions of the globe in which observatories are particularly scarce call for our special consideration.

Until a few years ago Pavlovsk (59° 41′ N.) was the most northerly regular station provided with magnetographs. No publications from it or other Russian observatories for years after the commencement of the War were available until comparatively recently. But it would seem that unbroken records were obtained at Pavlovsk and Kasan in Russia, and at Ekaterinburg in Siberia. Records were also obtained at Irkutsk, or at Zuya in its neighbourhood, down to 1920. The Russians have also established a new station at Matochkin Shar (73° 15′ N.), in Nova Zembla, a neighbourhood where Prof. Birkeland had a temporary station in 1902–3. This is the most northerly station on the international list. From information recently supplied we learn that it is equipped with Eschenhagen magnetographs recording D, H, and V (declination, horizontal force and vertical force), the sensitiveness of these instruments being respectively 1′·0, 22·6γ and 5·7γ per mm. More suitable values for a station where H is very low and disturbance large, would be 2′ or 3′ per mm. for D, and 10γ for H and V. The magnetograph room itself seems to be of wood, but the instruments stand on a concrete and brick foundation. This foundation should be satisfactory if it is non-magnetic, a property, however, which is rather unusual in brick. Further, Russian observatories seem also in contemplation at Taschkent and in Eastern Siberia, a part of the world unrepresented at present.

Of the two other observatories on the international list north of 60° N., one, Sodankylä (67° 22′ N.), is run by the Finnish Government, which of late years has also been active in survey work. The third of the new high latitude stations, Lerwick (60° 9′ N.), in the Shetland Islands, was instituted by the Meteorological Office, and magnetographs were in operation in 1923. Another high latitude station of comparatively recent origin calling for notice is Meanook (54° 37′ N.) in Canada. This was only partially equipped in 1924, and one of the resolutions passed by the Section of Terrestrial Magnetism and Electricity at its meeting in that year at Madrid emphasised the importance of full equipment. Meanook is one of the nearest stations to the north magnetic pole. Yet another high latitude observatory is being instituted by the Danish Government at Godhavn (69° 15′ N., 53° 14′ W.) in western Greenland. Pavilions for absolute observations and for magnetographs connected by a corridor form a single building. An important feature is that the equipment includes two complete sets of magnetographs, one of low sensitiveness, so as to make provision for large disturbances.

Observatories in high magnetic latitudes (that is, latitudes where dip is high) have special difficulties to contend with. Magnetic disturbance is large, and H being small, changes in D are enormous, rendering ordinary D magnetographs unsuitable. On the other hand, small changes of dip represent such large changes of V that ordinary dip instruments are unequal to the satisfactory determination of base line values for V curves. It is thus a matter of general interest that the National Physical Laboratory has under construction an instrument for measuring V directly. The desirability of such an instrument was also the subject of a resolution at Madrid. High latitude stations are of special importance, not merely because they record magnetic disturbances in the regions where these are most developed, but also on account of the light they may throw on the relation between magnetic and auroral phenomena. The importance of this relation has been increased by the development of radio, and the evidence that has recently been obtained as to the influence on radio of a 'conducting layer' at about the height which Prof. Störmer has found for the lower level of aurora. So far at least as latitude is concerned, Lerwick should be favourably situated for combined observations on terrestrial magnetism and aurora. But the full utilisation of the opportunities presented by such a station calls not merely for special knowledge and equipment, but also for an ample and vigorous staff, as a lot of night work is involved under probably severe climatic conditions.

Another region where magnetic observatories have hitherto been sparse includes the geographical equator. The international list contains no station between Buitenzorg (Batavia, 6° 11′ S.) and Kodaikanal (10° 14′ N.), and a footnote supplies the regrettable information that Kodaikanal stopped recording in

1923. This will leave more than 20° of latitude unrepresented between Batavia and Antipolo (14° 36′ N.). Kodaikanal was one of the stations supported by the Indian Survey, which has also closed down observatories at Barrackpore (22° 46′ N.) and Toungoo (18° 56′ N.), thus leaving only two magnetic observatories, Alibag and Dehra Dun, in the whole Indian empire. The fact that, as compared with pre-War times, magnetic observatories have fared worse in India than in Russia seems to afford food for reflection. If Kodaikanal is an unsuitable site, as is rather suggested by remarks in some of the Indian Survey publications, the resuscitation of Trivandrum, memorable for the work of J. A. Broun, would provide a station nearer to the equator than any existing observatory in the northern hemisphere.

Other areas within the British Empire where magnetism is somewhat poorly represented are South Africa and Australia. There was once a magnetic observatory at Cape Town, and a new observatory somewhere else in South Africa has been talked about, but at present the Royal Alfred Observatory in Mauritius seems to be the only one in that part of the world. Melbourne was once the site of a magnetic observatory, but has long been unsuitable for that purpose. Recently an observatory has been set agoing at Toolangi in Victoria, but that seems the only observatory in Australia, with the exception of Watheroo, which belongs to the Carnegie Institution of Washington.

New Zealand has a magnetic observatory at Christchurch, and with assistance from the Admiralty and the Carnegie Institution is also maintaining what was originally a German observatory at Apia, Samoa. It is scarcely necessary to say, in view of the scarcity of magnetic observatories in or near the Pacific Ocean, that the stoppage of Apia observatory would have been a great misfortune.

The latest observatory of the Carnegie Institution, Huancayo (12° 3′ S.), is in a way unique from its proximity to the magnetic equator. Dip there at present is less than 1°, and its measurement must present unusual features. Huancayo is situated, moreover, in a continent, South America, where additional magnetic observatories are badly wanted.

Obituary.

Sir William Ridgeway.

William Ridgeway, a son of the Rev. J. H. Ridgeway, of Ballydermot, King's County, was born in 1853; he had a brilliant career in Trinity College, Dublin, and later at Gonville and Caius College, Cambridge, graduating as fifth Classic in 1880, and was elected a fellow of his College. In 1883 he was appointed to the chair of Greek in Queen's College, Cork, and while holding that appointment he resided for five months each year in Cambridge. In 1892 he was elected to the Disney professorship of archæology in Cambridge, and shortly afterwards resigned his chair at Cork. He was re-elected a fellow of his College, and had also been Brereton reader in classics since 1907. He was Gifford lecturer in natural religion, University of Aberdeen, in 1909–11; Stokes lecturer in Irish archæology, Dublin, 1909; and Hermione lecturer in art, Dublin, 1911. He was president of the Royal Anthropological Institute, 1908–10; of the Anthropological Section of the British Association, 1908; and had been president of the Cambridge Philological, Antiquarian, Classical and Anthropological Societies. He was elected a fellow of the British Academy in 1904, and was a foreign member of various learned societies in Europe. His learning was recognised by other universities, and he had conferred on him Hon. D.Litt. Dublin, 1902; Hon. D.Litt. Manchester, 1906; Hon. LL.D. Aberdeen, 1908; and gained the Sc.D. of Cambridge for his work on the horse. He was knighted in 1919. He wrote numerous contributions to classical, philological, anthropological, zoological and other journals, and the following books: "Origin of Metallic Currency and Weight Standards," 1892; "The Early Age of Greece," 1901; "The Origin and Influence of the Thoroughbred Horse," 1905; "The Origin of Tragedy," 1910.

This bare enumeration of the academic distinctions and of the writings of Sir William Ridgeway will serve to show the wide extent of his erudition and the great range of his interests. These were constantly exhibited when he joined in discussions at classical and scientific societies, in which he usually gave a free rein to his sense of humour, and also to caustic criticism. His strong personality and the definite views he expressed vividly in speech and writing, combined with his love of controversy, sometimes strained the forbearance of many friends, even occasionally to the breaking point. He was a man of pronounced likes and dislikes, and it was often a moot point whether he was not as dangerous to the causes he espoused and to his friends as to his enemies, for he was liable through friendly enthusiasm to overstate the case at issue. He entered wholeheartedly into a fray, whether it was Irish education, the Irish and English Anglican Church, or University politics, as those can testify who remember the discussions on the degrees for women and on compulsory Greek in the University of Cambridge.

Sir William was emphatically a driving force in the University, and spared no pains in furthering the well-being of the institutions to which he belonged, to take but two examples: the Cambridge Antiquarian Society and the Museum of Archæology and Ethnology. It was due to his energy that a lectureship in ethnology was instituted, and again largely to him that nine years later it was converted into a readership; in this and other ways he was instrumental in founding the Cambridge School of Anthropology. He very early recognised the value of ethnology in elucidating obscure points in classics and archæology; in some respects he was a pioneer in these comparative studies, and he delighted to recall how his heterodox views later gained acceptance from more conservative scholars.

Sir William stimulated very many students, naturally mainly in classical archæology, of whom a considerable proportion have gained great eminence, and he was careful to keep in frequent correspondence with them; but he also had a large number of correspondents throughout the world on an amazing variety of subjects, from Asiatic ritual dances to currency and zebras.

Those who were privileged to see Sir William's family life gained another view of this very remarkable man. His love for his wife was as apparent as it was deserved, for Lady Ridgeway devoted her life to her brilliant husband, and no one will ever know what he owed to her. She was his prop for very many years as his eyesight increasingly failed, and she dispensed gracious hospitality to his friends in their charming home at Fen Ditton. Her sudden death at the end of May was a terrible blow, and though he gallantly tried to overcome his desolation and to take up the threads of his old life, he was a broken man until death mercifully took him in his sleep during the night of August 11: a peaceful ending for a strenuous and militant life.

A. C. HADDON.

WE regret to announce the following deaths:

Mr. William Fawcett, lately Director of Public Gardens and Plantations, Jamaica, on August 14, aged seventy-five years.

Prof. Robert Gnehm, professor of technical chemistry, and afterwards director of the Technical High School, Zurich, who was known for his investigations on dyeing processes and dyestuffs, aged seventy-four years.

Dr. J. F. Hall-Edwards, president of the British Electro-Therapeutic Society, and a pioneer in the field of medical radiology, on August 15, aged sixty-seven years

News and Views.

THE meeting of the British Association at Oxford which ended on August 11 has been memorable in many ways; and not least for the specially interesting character of the proceedings at the concluding gathering held at the Examination Schools. The message received from the Prince of Wales as president summed up in felicitous language the aims and prospects of the cause of science, the advancement of which it is the object of the Association to promote. The message also conveyed, in graceful terms, the president's appreciation of, and thanks for, the efforts made by all concerned to render the Oxford meeting of 1926 one of the most successful in the records of the Association. The reply read by Sir Oliver Lodge as chairman gave due expression to the gratitude felt by the members assembled at Oxford for the keen personal interest and sympathy shown by the Prince in the work of the Association, notably in his inaugural address.

THE speech delivered by Sir Oliver Lodge bore eloquent testimony to the world-wide charm exercised by Oxford over all who can be touched by the long history of western civilisation and culture. The well-known eulogy by Matthew Arnold, marked by graceful fancy and poetic feeling, and not without a light suggestion of penetrating humour, came with especial force and acceptance from one so capable of giving it its full effect as Sir Oliver Lodge. The significance of the presence of guests from overseas and from foreign countries had been emphasised by the Prince in his message, and was driven further home by the chairman of the meeting. The speeches of Prof. M'Murrich and Prof. Osborn, the latter of which concluded the meeting, showed that they too, as visitors and guests from overseas and abroad, fully appreciated the claim of science for international co-operation and fellowship. The final meeting at the schools was especially well attended, and formed an excellent conclusion to a very successful gathering.

AMONG several interesting papers presented to the Chemistry Section of the British Association at Oxford was a contribution by Mr. J. J. Manley on "The Union of Mercury and Helium." Judging by a lengthy report of Mr. Manley's paper in the *Times* for August 11, the author does not appear to have carried his investigations beyond the stage described in his letter to NATURE of April 24 last, except that he now believes that only one helide—HgHe—is formed, whereas in the letter he stated that he had obtained experimental evidence of the existence of two—$HgHe_{10}$ and HgHe. The evidence for union appears to be based upon the disappearance of free helium when it is submitted to the action of the electric glow discharge in contact with purified mercury, and upon a slight increase in refractive index as the action proceeds. The presumed compound is apparently decomposed by heat, so that its composition could be deduced from the difference in weight of 'uncombined' mercury before and after the experiment. As this difference is exceedingly small—of the order of 236 millionths of a gram—it is clear that Mr. Manley is encountering very great experimental difficulties; and bearing in mind the somewhat similar work of Miethe and Stammreich on the alleged transmutation of mercury into gold (NATURE, May 29, 1926), it is obvious that further investigation is required to dissipate or confirm the doubts that are held concerning the author's conclusions. Should those doubts be dissipated, Mr. Manley's work will constitute a discovery of very great importance.

IN the issue of the *Times* referred to, a leader-writer refers to Mr. Manley's contribution as a "startling announcement," as if it were novel, but actually the claim was first announced by Mr. Manley in these columns more than twenty months ago (NATURE, December 13, 1924). It is perhaps asking too much to expect a leader-writer, even in the *Times*, to be conversant with all that appears in our correspondence columns, but the incident directs attention once more to the need of adequate scientific representation on the staffs of our leading newspapers, and it also testifies to the value of the work done by the British Association in affording opportunity for lay writers to proclaim from the house-tops matters of scientific importance that otherwise may be lost in the pages of scientific periodicals. The opinion is frequently heard that announcements of great discoveries at meetings of the British Association are less frequent than of yore, and although there is little more valid evidence for this opinion than for that concerning the diminished severity of our winters compared with those of, say, fifty years ago, the belief is probably to some extent responsible for the unbridled romance with which the popular writer is apt to invest his accounts of scientific achievements. The first duty of the newspaper man is to make a 'story,' and to this end he gives free rein to his unscientific imagination by supplying or suggesting sensation where it is not called for, or by elaborating relatively unimportant details at the expense of the main issue; he is also peculiarly susceptible to the temptation of treating the new as of necessity true, and occasionally, as in the present instance, of treating the true as necessarily new.

A strong earthquake was felt in the midland and western counties of England and in Wales at 3.58 A.M. (G.M.T.) on Sunday, August 15. From the accounts so far received it appears that the shock was felt over a nearly circular area 225 miles in diameter, and containing, therefore, about 40,000 square miles. The centre of this area lies a few miles to the south-east of Hereford, and it is worthy of notice that the shock was strongest in this city and Ludlow and in some of the villages between. A few chimneys fell at some of these places, but damage so slight would not entitle the earthquake to a higher degree of intensity than 7 of the Rossi-Forel scale. During the last forty years British earthquakes of the same intensity have disturbed areas ranging from 25,000 to 63,000 square miles. The position of the roughly determined centre suggests that the recent earthquake may be connected with the twin-centres in a northwest-southeast line near Hereford and Ross, which gave rise to the strong earthquakes of 1863, 1868, and 1896. These disturbed areas of about 85,000, 41,000, and 98,000 square miles respectively. As regards intensity and disturbed area, the recent earthquake closely resembles that of 1868, and it is not impossible that, as in that year, the Ross focus was mainly responsible for the disturbance. The much slighter shock of January 26, 1924, was not directly connected with the others, for the axis of its disturbed area runs in a northeast-southwest direction through or near the Hereford focus.

After a busy professional life of forty-three years, Prof. T. Turner is retiring on September 30 from the Feeney chair of metallurgy in the University of Birmingham. Taking the Associateship of the Royal School of Mines with the De la Beche medal in 1883, Prof. Turner was appointed demonstrator in chemistry at Mason College. A few years later he became lecturer in metallurgy, and when the chair of metallurgy was instituted in the University, he was appointed professor and has held the position for nearly a quarter of a century. Prof. Turner's own research work has dealt with silicon in cast iron, the production of wrought iron and steel, the hardness of metals; volatility, density and other properties of metals and alloys. He is a past president of the Institute of Metals, having also served as treasurer. He is a member of council and Bessemer Gold Medallist of the Iron and Steel Institute. He is an honorary member of various metallurgical societies in the Dominions, the United States, and on the continent. In his own University, a gold medal has been instituted to commemorate his services to metallurgy. His best known book is the "Metallurgy of Iron," which has passed through several editions.

The School of Research in Metallurgy at the University of Birmingham, under the able guidance of Prof. Turner, has done much original work, and has contributed in no small degree to the amazing progress in metallurgical science which has taken place during the present century. The past and present students and friends of the metallurgical department of the University and of its retiring professor, have decided to make a presentation to him in the immediate future. The subscription list is open to all who feel inclined to associate themselves with the movement; members of the local section of the Institute of Metals and of the Birmingham Metallurgical Society are supporting the scheme. Several local firms have also intimated their desire to subscribe. Further information and subscription forms may be obtained on application to Dr. T. B. Crow, hon. sec. to the testimonial committee, at the University, Edgbaston, Birmingham. Prof. Turner is proposing to reside at Leatherhead, Surrey, in order to keep in close touch with his interests in London, and in extending to him and Mrs. Turner our best wishes for further years of health and happiness, we will be voicing the sentiments of his very large circle of friends.

All true lovers of plant-life will be interested to hear of the exceptionally well thought-out scheme propounded by Dr. L. Cockayne, the doyen of New Zealand botanists, for the setting apart of the Wilton's Bush Reserve, about three miles from the capital city of Wellington, N.Z., as an "open-air museum for plants native to New Zealand." The New Zealand flora is unique, not only in the beauty of its forests, its ferns and its alpine associations, but also in certain aspects of the lines of evolution which it has undergone, such as, for example, the replacement of a xerophytic type of foliage in the young plants of a number of species by a mesophytic type when well grown, this being exactly the opposite to what happens in the well-known case of the Australian phyllodineous wattles. Dr. Cockayne propounds a scheme with four main points in it, as follows:—(1) A well-grown collection of all possible species from the flora of New Zealand, the Kermadecs, Stewart Island, Chatham Islands and the subantarctic islands, so far as the limitations of the soil and climate of the proposed site will allow. (2) Representations of the leading plant-associations found in the Dominion, just as they existed in primeval New Zealand. Many of these associations are now either almost extinct or very inaccessible for study, and this scheme would bring them within reach of students in the capital city. (3) Illustrations of the horticultural use that can be made of New Zealand plants, by the planting out of small gardens, alpine rockeries, etc. (4) Restoration of the present forest area of Wilton's Bush to its primeval condition. The area is already much modified and invaded by exotic weeds, but could speedily be brought back to its original state by scientific treatment.

DR. COCKAYNE suggests that the plan should be put into operation gradually over a number of years, and that a start could be made at once by procuring from all parts of the Dominion the plants required to build up the complete collection of the flora, and in particular by concentrating on the formation of an alpine garden along the sides of the mountain stream which flows through the bush. He also suggests the transformation of one of the fine cliffs in the gully into a representation of the typical cliff flora of Eastern Marlborough, which is one of the most striking plant associations known in New Zealand. After that the planting of a small kauri forest could be taken in hand, and so, from year to year, one new effect after another could be added until the scheme was completed. The scheme as outlined (*vide* the *Dominion*, Wellington, June 15) appears to us to be a very fine one, and will certainly meet with the cordial support and approval of botanists throughout the world. We hope that the Wellington City Council will take a wide view of the problem and not allow considerations of finance to stunt a plan which, if carried out in a broad and generous spirit, will add greatly to the fame of a capital which at present is perhaps too much renowned for its windiness and too little known for its wonderful beauty.

A PUBLIC demonstration of the potato trials carried out by the National Institute of Agricultural Botany at its Potato-Testing Station at Ormskirk took place on August 11. Research into the resistance of potatoes to wart disease (*Synchitrium endobioticum*), undertaken by the Institute on behalf of the Ministry of Agriculture, forms a large part of the work. Wart disease is fortunately not spreading, but there is an urgent demand from infected districts for improved immune varieties. New productions of breeders are grown by the Institute at Ormskirk in highly infected soil to determine their reaction to the disease. A variety is only certified as immune if it has been grown for at least two years at Ormskirk without showing any trace of disease. Dry seasons do not afford a good test, and therefore occasionally three or even four seasons are required This year 97 stocks are being tested for the first time, 45 for the second, and 9 for the third. There are also 626 stocks of from two to ten tubers each, which are grown both to inform breeders at the earliest possible date which of their seedlings are susceptible, and to assist genetical studies on the inheritance of immunity. It is of interest to note that it is theoretically possible to find an immune variety as a parent which will produce 100 per cent. immune seedlings, no matter what the other parent is. Research is also made on the methods of transmission of virus diseases, such as leaf-roll and mosaic, which are a serious menace to English potato crops. There appears to be some correlation between the health of the crop from which the seed-tubers are taken and the incidence of these diseases in the following year. On the other hand, the diseases apparently cannot be transmitted through the soil or by mere contact of foliage Trials are also being made both of the chief main crop varieties and of the best new immunes to determine their yielding capacity and the time taken to mature. The improvement of the methods of testing these characters is also under investigation. Finally, all stocks sent to Ormskirk as new are examined by the Institute's Potato Synonym Committee; 1533 stocks were reviewed between 1920 and 1925. In 1920 72 per cent. proved to be 'synonymous,' but by 1925 this unsatisfactory proportion had been reduced to 16 per cent. of the entries, the remaining 84 per cent. being distinct varieties.

A FOURTH edition of the handbook entitled "Particulars of Meteorological Reports issued by Wireless Telegraphy in Great Britain and the Countries of Europe and North Africa" (M O. 252) has been issued by the Meteorological Office, Air Ministry (London. H.M. Stationery Office, price 4*s*. net). It contains full particulars of the meteorological bulletins issued by the various countries. These bulletins are normally issued at least three times a day, and include ordinary ground observations of weather, wind, temperature, humidity, and height of the barometer for a number of places. They also include information about conditions in the upper air, reports from and to ships at sea, and weather forecasts. Full particulars are given of the various codes in use for summarising this information. The area dealt with extends westwards to America, eastwards to Siberia, northwards to Spitsbergen, and southwards to northern Africa. Greenland is also now included. Changes constantly occur in the weather reports issued by radio from different countries, and in order to keep those interested informed of such changes, supplements to this handbook are issued from time to time This revised fourth edition embodies all supplements issued since the previous edition. The area covered by the weather charts prepared from these messages is shown in a frontispiece. Most of the issues can be received in the British Isles by the use of quite modest receiving apparatus. Purchasers of this work will be informed when amending notices are issued and when a new edition is ready if they notify the Director of the Meteorological Office of their desire to receive this information.

No one can work in the vast field of economic and political science or be engaged in business or trade, without continually feeling the need of some work which will supply in a handy form statistical and other information on any of the numerous topics that go to make up the complexity of modern life.

It is well known that such works—encyclopædias, year-books, professional and trade directories, commercial returns, biographies, and so on—are published in large numbers in all parts of the world and relating to diverse subjects, but it is not always so easy to obtain definite information of their exact nature or to make the most suitable selection to meet any particular want Dr Paul Heile has now set out to provide a guide to this wealth of material in his "Nachschlagebuch der Nachschlagewerke fur die Wirtschaftspraxis" (Hamburg: Verlag Wirtschaftsdienst G.m.b.H., 5 marks), which he has compiled, using as a basis the collection of the Welt-Wirtschafts-Archiv at Hamburg after a special attempt had been made to make this as representative as possible. The work is comprehensive and is divided into the following sections: general, geographical, commercial substances, directories (again subdivided geographically and by subject), dictionaries, and biography. German works predominate, as is natural, but the other countries are well represented, as a glance at the geographical section shows, and the value of the work is enhanced by annotations where the title is not self-explanatory and by analysis of those entries which cover more than one subject It is a drawback to its use as a reference book that such details as place of publication and publisher's names have not been given, but it will nevertheless be a valuable guide for business firms in Great Britain and for our growing commercial libraries. The volume contains also a classified list of the 1000 or so current trade and commercial periodicals taken by the library at Hamburg, together with a history of the Institute. The receipt of the work makes us hope that the promised catalogue of the Library of the London School of Economics will not long be delayed.

THE Annual Report of the Mines Branch (Canadian Department of Mines), for 1924 contains a section on investigation of fuels and fuel testing, which throws light on the fuel problem as it occurs in Canada. Experiments are recorded on the production of coke from the coal of the Maritime Provinces. The coke is intended to make Canada independent of imported anthracite. Tests of friability of coke have been worked out. Reports are made of lubricating oils and gasoline marketed in Canada. The distillation of lignite and sub-bituminous coal and oil shale is considered, evidently an anticipation of the time when supplies of liquid fuel will have to be produced at home.

A BIBLIOGRAPHY of meteorological literature prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office (No. 9, January-June 1925) has recently been issued by the Royal Meteorological Society. Since October 1920 the bibliography which previously had been given in the Society's *Quarterly Journal* has been issued as a separate publication in six-monthly parts (price to non-fellows, 2*s*. 6*d*.) A symbol is attached to the title of the work to show in which library the publication has been received. The divisions of the bibliography deal with general meteorology and with various branches of the work, such as temperature, rainfall, and terrestrial magnetism. The publication is helpful to meteorologists in different parts of the world.

THE annual report of the Physical Department of the Ministry of Public Works, Egypt, for 1923–24, has been issued. Dr. H. E. Hurst, the controller, reports continued progress in all departments. In the hydrological service observations are now obtained from 286 rainfall stations, an increase of five on the previous year, and from 82 gauging stations extending from Egypt to Uganda, Kenya and Abyssinia. The daily weather report continues to be published, based on the data from 28 stations in Egypt and the Sudan, five in Europe and two in Palestine. A daily broadcast message is sent out from Abu Zabal at 09·55 G.M.T. Upper-air investigations by pilot balloons from Helwan Observatory continue. Arrears of meteorological publications which accumulated during the War are being fast overtaken, the annual reports up to 1921 being nearly ready. The report contains a full list of the publications of the department.

VOLUME 17 of contributions from the Jefferson and the Cruft Laboratories of Harvard University consists of reprints of thirty-nine papers on physical subjects which have been published in scientific periodicals during the years 1924–5. Nine of these emanate from the X-ray laboratory of Prof. Duane, six from that of Prof. Bridgman, four deal with radio circuits and their properties, and twelve with spectroscopy. In the last group is a paper by Messrs. H. N. Russell and F. A. Saunders directing attention to certain new regularities in the spectra of calcium, strontium, and barium. Almost the whole of the lines of the first two are now identified by the help of new spectroscopic terms comparable in importance with the older terms, but some of them negative. The authors characterise the present notation of spectroscopy as chaotic, and as the result of discussion with other workers suggest that in future the *series* be denoted by Roman capitals, the *system* by an index at the upper left hand giving the multiplicity, and the *component* of a multiple term by a subscript on the right giving the inner quantum number.

READERS interested in early printing should obtain from Messrs. Bowes and Bowes, 1 Trinity Street, Cambridge, a copy of their Catalogue (No. 435) of books printed from 1477 to 1600. The list comprises some 548 titles, to which are added many helpful notes.

THE British Science Guild will publish shortly a Supplement to its Catalogue of British Scientific and Technical Books. The Supplement has been compiled by Miss Daphne Shaw from the monthly lists published in NATURE, and it will contain 2258 titles of books issued in 1925, classified alphabetically from agriculture to zoology, as well as an author index.

MESSRS Chapman and Hall, Ltd., ask us to state that they have had in active preparation "The Theory and Practice of Radiology," by Dr. B. Leggett, but that in consequence of a fire at their printers the whole work, almost completed, was destroyed, and it is therefore necessary to recommence production and there will be a delay of some months in the publication of the volume.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A junior inspector of mines in the Mines Inspectorate of the Government of India—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (August 30). Assistant masters for, respectively, physics and mathematics and chemistry, and physiology and biology at the Lawrence College, Ghora Gali (Murrer Hills), India—The Principal, St. Luke's College, Exeter (August 31) An adviser in dairy bacteriology at Armstrong College, Newcastle-upon-Tyne—The Registrar (September 2). An assistant bacteriologist in the Department of Pathology and Bacteriology of the University of Sheffield—The Registrar (September 11). A lecturer in plant physiology in the University of Aberdeen—The Secretary (September 14). A senior metallurgist under the British Cast Iron Research Association—The Director, 75 New Street, Birmingham (September 15). A professor of philosophy in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (September 15). A professor of psychiatry in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (September 15). A research bio-chemist at the Walter and Eliza Hall Institute of Research, Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (September 30). An adviser in agricultural chemistry at Armstrong College, Newcastle-upon-Tyne—The Registrar (October 1). A lecturer in mathematics and physics in the Government College for Indian Women, Lahore—Miss G. Harrison, The Poplars, Buckingham.

Our Astronomical Column.

THE AUGUST PERSEIDS OF 1926.—Mr. W. F. Denning writes that "a series of very clear nights during the first eleven days of August enabled these meteors to be well traced as they gradually increased to a maximum on the morning of August 12. On August 7 the shower was strikingly evident by some fine, flashing meteors. The hourly number observed was about twenty-five from all radiants, of which the proportion from Perseus was sixteen. On August 10, after rain and clouds had prevailed in the early part of the night, the sky became very clear and 60 meteors were seen by an assistant during a watch maintained for 2¼ hours. The great majority of these were Perseids and were fairly bright with the normal features of swiftness and afterglows, the latter being strongly marked in several cases where the heads were unusually lustrous. On August 11 clouds and rain again affected the conditions, but soon after 22^h G.M.T. the sky became clear and the ensuing morning presented an ideal aspect for astronomical purposes. A look-out was maintained for 4¼ hours and 180 meteors were counted. About 145 of these were Perseids and included a fair proportion of conspicuous objects with long paths and a rapidity of movement which called for celerity on the part of the observer in accurately recording their flights. The maximum of the shower occurred between 2^h and 3^h G.M.T., August 12, when 60 meteors appeared On the whole, however, the display may be regarded as only of moderate intensity and not nearly so rich in number as those of 1871, 1874, 1877, 1921 or some other years."

SOLAR RADIATION.—Special attention is directed by the Scientific News Service of the Smithsonian Institution to a recent issue of the *Monthly Weather Review* of the U.S. Weather Bureau, which is said to contain a further corroboration by Dr. Abbot of the reality of the variability of the sun's radiation. From a series of observations made at Mt. Wilson by himself and Mr. L. B. Aldrich during the years 1910–1920, a selection has been made of the days on which the atmospheric conditions were as nearly identical as possible, these being divided into comparable groups. Observations made throughout 1912 and 1913 were discarded on account of the Mt. Katmai eruption. When the mean values of the solar radiation readings for these selected days, grouped for a month at a time (the mean value for July of each year from 1910–1920 is given as an example), are plotted, together with the solar constant values already published by the Smithsonian Institution and the sunspot numbers for the same epochs, a close degree of parallelism is shown between the three sets of observations. It is also claimed that short interval changes within the individual months are verified. It is not stated, however, whether the data for other months or periods of the year give as close agreement as that shown for July. The full details of Dr Abbot's communication will be awaited with interest.

THE SYSTEM OF CASTOR.—This beautiful system became still more interesting when Adams and Joy found in 1920 that the distant companion *C* (about 1 distant from the bright pair) was itself a spectroscopic binary. The period was at first given as 4 days corrected later to 0·815 days. *C* is of magnitude 9·03; as the two spectra are of equal intensity each component is of mag. 9·78; taking the parallax as 0·0747″, this corresponds to absolute mag 9·15

Mr. H. van Gent, of Leyden Observatory, examined *C* for variability and found that it is an eclipsing binary. He has determined the light curve from photographs taken with the Leyden 33 cm. refractor He discusses the observations in *Bull. Astr. Inst Netherlands*, vol. 3, No. 97. The radius of each component is 406,000 km.; the mass of each i 0·518 sun and density 2·60 sun; the distance apar 2,581,000 km. and inclination 86°.

The surface brightness of each component is 3·3 mag. fainter than that of the sun. The effectiv temperature is deduced as 3500°, agreeing well wit the spectral type *M*. These exact details concernin a red dwarf star are of great interest.

It is noted that Castor *C* has the greatest paralla and proper motion so far known among eclipsin variable stars, and that the components of 61 Cygn have similar absolute magnitude and colour.

Research Items.

THE HUNGARIAN BRONZE AGE.—In *Man* for August, Dr. Lajos Zoltai describes two bronze hoards from Hajdusámson, near Debreczen. The finest examples of the Hungarian bronze industry come from the region known as the Nyirség in the north-east bend of the Tisza, which would appear to have been densely populated and a centre of culture in the Bronze Age. The hoards here described are now in the City Museum of Debreczen. The first consists of a sword and twelve axes found in an orderly grouping which suggests a votive deposit. The leaf-shaped sword is only 53·2 cm. long and has a pommel of which the button consists of closely fitting superimposed rhombs, diminishing in area from the base, the smallest being pointed. Such a pommel is unique in Hungary but is met in Scandinavian swords. Analogous forms of sword are figured by Montelius from north Germany and north Italy. The scroll decoration of the blade is peculiar to Hungary. Three of the axes are similarly decorated. Hajdusámson lies near the centre of the region in which axes ornamented with this scroll pattern are found. It may be described as the centre of the area of fabrication. The second hoard consisted of a number of bronze vessels of which the peculiarity lay in the double handles and their mode of attachment. Mr. Gordon Childe, in an appended note discussing the chronology of the finds, points out that they illustrate two periods of the Hungarian Bronze Age. The leaf-shaped sword belongs to the earliest variety and, being stamped clearly with marks of local manufacture, supplies a link missing in Peake's argument for the Hungarian origin of the type.

PHYSICAL CHARACTERS OF THE FRANKS.—A detailed study of skeletal remains from a Franco-Merovingian cemetery at Baye (Marne) by M. H. V. Vallois in Fasc. 4-5-6, Vol. 6, VIIe Série of the *Bull. Soc. d'Anthropologie de Paris*, concludes with a comparative study of such material relating to these invaders of France as is available. The typical Franks would appear to be comparable to the tall dolichocephals of the *Reihengräber*. The type is found with some frequency in Flanders, but in France it rapidly merges into the rest of the population. Thus the Frankish cemeteries of the centre and east of France show a fairly homogenous population in which the skeletal characters agree, generally, with those of the Franks of Belgium, in being dolicho- or sub-dolichocephalic, mesoseme, mesorrhine, or leptorrhine, to some extent prognathous and with a marked protuberance of the occiput. But in the south of Belgium and the more central parts of France these characters rapidly undergo progressive modification, dolichocephaly becomes sub-dolichocephaly, leptorrhiny, mesorrhiny, and the effect of crossing with the Gallo-Roman populations is more and more marked as the distance from the Frankish centre of origin increases. The decrease in stature is considerable, and the measurements given here, 1·64-1·67 m. (males), 1·53-1·58 m. (females), while higher than those of the neolithic peoples, do not exceed those of the Gauls or medieval or modern Parisians. It is noted that while the early crania are predominantly dolichocephalic, and brachycephals are rare, the face being long and narrow of the typical Nordic character, in the cemeteries of Normandy by Merovingian times the dolichocephals are becoming more rare and are mixed with brachycephals, and by the tenth and eleventh centuries the brachycephals are almost the only type, showing that by then the original Gallo-Roman population had resumed preponderance. Yet it is remarkable that while the tall stature and leptorrhiny disappeared almost at once, dolichocephaly, prognathism and the protuberance in the occipital region persist for a much greater length of time.

MODERN WHEAT BREEDING.—The aim and present position of modern wheat breeding is outlined by Sir Rowland Biffen and F. L. Engledow in *Research Monograph* No. 4 of the Ministry of Agriculture and Fisheries. So far as possible the account is couched in non-technical language to render it intelligible to farmers and other non-academic readers, and it presents a clear and concise picture of the methods adopted and the results attained. After a general statement of the problem the principles of heredity and various theories bearing thereon are discussed, together with the complications associated with linkage, chromosomes, races and species. Breeding may be for increased yield or better quality of grain, for greater resistance to disease or for straw less liable to lodging, and in each case specific methods have to be adopted. Increased strength of straw is a most important point, as in many cases farmers are afraid to cultivate in such a way as to obtain the maximum possible yield for fear lest the crop should lodge and the expense of the extra cultivation and manuring be lost without adequate return. The process of breeding new cereals is necessarily slow, since, owing to the rigid tests that are needed for purity for milling and baking, about ten years must elapse before any promising new variety can be placed on the market. The need in British farming is for a strong wheat with good yielding capacity, and in 1916, Yeoman wheat was introduced to meet these demands so far as possible. After several years' further experiments a still better wheat has been produced, known as Yeoman II., and it now remains to be seen whether this will fulfil its promise under ordinary methods of general cultivation.

HERRING, MACKEREL, AND PLANKTON. — Many naturalists have expressed the belief that movements or occurrences of herring and mackerel at certain seasons are influenced by the presence or absence of certain planktonic organisms. If this is so, then fishermen might benefit greatly by an instrument which would give them a quick indication of the state of the water in which they were proposing to fish. An instrument for use on commercial fishing craft must, however, be simple, strong, easily handled and rapid to use. In his paper, entitled "The Herring in Relation to its Animate Environment," Part 2 (Min. Agric. and Fish., Fishery Investigations, Ser. 2, Vol. 8, No. 7. London, H.M.S.O., 1925), Mr. A. C. Hardy describes trials of his 'plankton recorder,' which consists essentially of a cylinder carrying a white gauze filtering-disc. When the instrument is towed end-on through the water, plankton is deposited on the disc, imparting to the latter a distinctive colour which is dependent on the nature and number of the plankton organisms present. Discs used from commercial drifters in 1922 and 1923 during the herring fishery in the North Sea, and the south-west mackerel fishery from Newlyn, strongly suggested that poor fishing occurred in waters which gave a green disc (due to the predominance of Diatomacea or Phaeocystis). On the other hand, no very convincing correlation could be demonstrated between the number of copepods (red, pink or yellowish-pink disc) and the quantity of fish caught. Confirmation of the results of these preliminary trials is needed, and much interesting and useful information may be expected from an extensive use of this plankton recorder.

FISHERIES INVESTIGATIONS IN DENMARK.—The report of the Danish Biological Station for 1925 covers a wide range of work. Dr. Petersen, in a short discussion on the influence of fishing upon the stock of plaice in the Baltic, gives figures, based on official statistics of landings, which show that since the War there has been a steady decrease in the annual yield of plaice in that region. He suggests that the time has come for a suitable protection of plaice in the Belt sea, and, if possible, by the aid of international legislation, also in the Kattegat and certain parts of the Baltic. A report on the estimation of the density of oyster-population in the Limfjord gives instructive data of collections made by divers. In 1907 the density was estimated to be 1 oyster for each 3·2 square metres, but in 1924 it had dropped to only 1 oyster for each 38 square metres—a reduction to $\frac{1}{11}$ In addition to living oysters, the diver collected the shells of dead individuals. The shells of oysters which had died since the previous summer were easily recognisable, and thus an estimate could be made of the mortality during the season 1923–1924 An alarmingly heavy death-rate of 71 per cent. of the stock was indicated for the hard bottom area in the western parts of the Broad of Livo Dr. Blegvad gives an account of his continued studies on the quantity of fish-food in the sea bottom, by means of the Petersen bottom sampler, and the detailed examination of the stomach contents of fishes. He attributes the considerable variations in quantity of food for fishes, from year to year, to (1) good brood years of the chief food species, alternating with bad years; (2) the consumption by fishes and other predatory animals, although the effect of the consumption by fishes has probably been exaggerated, (3) physical reasons, such as cold and lack of oxygen, which often kill off large numbers of food animals, especially during the winter.

FERTILITY IN THE DOMESTIC FOWL.—Dr. F. A. E. Crew gives (*Proc. R. Soc. Edin.*, vol 46, pt. 2, 1926) the results of a series of experiments designed to determine the time of the onset of fertility in the domestic hen after the introduction of the male and the duration of fertility after his removal. He found that fertile eggs can be expected within 24-48 hours after the introduction of the male, though the onset of fertility varies with different matings. The length of life of the sperm within the body of the female is 15-20 days, but the eggs laid after the first week commonly fail to complete their development. If after the removal of the male a second male is introduced, the influence of the first sire is removed by the seventh-tenth day and there appears to be a relation between the general vigour of the male and the fertilising power of the sperm it produces. These results have an important practical bearing for the poultry farmer.

THE ANATOMY OF THE ELEPHANT.—Dr. N. B. Eales has made a careful and detailed dissection of the head of a fœtal elephant and has given an account of her results (*Trans. R. Soc. Edin.*, vol. 54, pt. 3, 1926) illustrated by twelve plates of beautifully clear and well-executed drawings. The work amplifies and corrects that of earlier workers and, as the specimen is unique, Dr. Eales has made the fullest possible use of it. The most interesting result obtained by the author is the evidence of ancestral history revealed by the characters of the lower jaw. The upper part of the skull is essentially like that of the adult and of all modern elephants, the differences being due to fœtal characters entirely. But the lower jaw exhibits the *longirostris* phase of the modern elephant's ancestry. It is relatively longer than in the adult, and the change to the adult condition is accompanied by a definite metamorphosis involving a relative shortening of the anterior part of the mandible. This interesting observation is of the utmost importance as corroborative evidence supporting the accepted facts of palæontology. Dr. Eales is to be congratulated on the completion of a distinguished piece of work.

CULTIVATION OF DROSOPHILA FOR LABORATORY PURPOSES.—Drosophila is now widely used as a laboratory animal especially in genetic investigations, and there is no reason why it should not be used extensively for class purposes to demonstrate the most important results of modern research in genetics, provided it can be kept successfully in the laboratory. With this end in view Prof. Raymond Pearl has investigated the possibilities of making a satisfactory synthetic food medium, free from the uncertainties of the standard banana medium now in use, which would give the required degree of quantitative precision desirable in genetical work. Such a medium is described in a recent paper by Prof. Pearl (*Journ. Gen. Physiol.*, March 1926, vol. 9, No. 4). It is an entirely artificial medium, containing no natural fruit juice and with a higher degree of acidity than the banana medium. On account of its high acidity there is practically never any contamination of the cultures by troublesome bacteria. Experiments with this medium have shown that it is greatly superior to the banana medium in respect of both the fertility and the mortality of the flies kept on it. These results should be of great service to laboratory workers and teachers who may wish to keep Drosophila for class purposes.

YIELD AND POSITION OF FIELD CROPS.—The effect of outside rows on the yields of kafir and milo crops has been determined by J. S. Cole and A. L. Hallsted in the United States over a period of eight years (*Jour. Agric. Research*, 32, 10). The outside rows of 10-row plots gave heavier yields than the inside rows except in 1915, a year of unusually low temperature and heavy rainfall. The increase was much greater in the yield of grain than of stover. On an 8-year average, the acre yield of kafir grain from the outside rows was 30 per cent. higher than that from the inside rows, but the stover was only 7 5 per cent. higher. With milo the figures were 43 per cent. excess grain and 8 per cent. excess stover in favour of the outside rows. The increased yield of grain from the latter proved to be roughly proportionate to the increased area of soil available to them. The relationship between the yields from all ten rows and the inside eight rows of each plot proved to be linear, the correlation being very nearly perfect, and consequently the relative merits of the methods represented could be equally well determined by either including or rejecting the outside rows The yields determined from the entire 10-row plots were, however, subject to a systematic error arising from the fact that the effective areas of the plots were somewhat greater than the conventional areas assigned to them in converting the plot yields to acre yields.

A NEW SPHYGMO-MANOMETER.—Messrs. Hawksley and Sons, Ltd., 83 Wigmore Street, London, W. 1, have submitted to us for inspection a specimen of the 'Baumanometer' devised by Messrs. W. A. Baum and Co. Inc., New York, for the measurement of arterial blood pressure. The instrument is a modified form of the well-known mercury sphygmo-manometer. To justify the introduction of still another instrument for measuring blood pressure the booklet supplied with the instrument finds two faults with the existing U-tube manometer, namely, the smallness and variability in the bore of the tube. It states that errors so great as 20 mm. may occur with the old pattern. We are not aware that such an error could be possible, especially as we know in Great Britain that the pressure depends merely on the difference in level in the two limbs of the U-tube, the capillarity effects being negligible. This head of pressure is independent of the shape and course of the intervening tube, and the exhortation by the makers to the physician "to admit his shortcomings on the mechanical side and review his elementary physics" might well be reciprocated. The desk-model submitted to us has a good appearance and is a well-finished instrument. The U-tube consists of a tubular left limb (bore ≃ 0·5 cm.) and a much wider right limb (bore ≃ 2 cm). The change of zero is compensated for by graduating the left limb in 'calibrated millimetres.' The shift and disregard of the right limb reading also necessitates the bore of the left tube being taken into account, which we find has been done. The instrument possesses two definite advantages which will be appreciated by the busy clinician, namely (1) the wider left bore prevents air pockets and (2) the scale divisions (≃ 0·9 mm.) are easier to read and only the left limb has to be read. It must be pointed out, however, that the scale calibration stressed in this instrument has become necessary owing to the makers' deviation from the usual simple manometer with uniform bore and double reading. Further, the great increase in size of the bore of the tube involves a corresponding increase in the inertia of the moving mercury and consequent damping of oscillations.

MAGNETIC ALLOYS.—Mr. P. E. Billinghurst, writing rom Camp Mizine, Salween River, Burma (c/o Messrs. Thomas Cook and Son, Rangoon), points out that if the atomic weight of each constituent of Heusler's alloy is multiplied by the fraction by weight of the element present and the sum taken, it is equal very nearly to the atomic weight of iron. He states hat he has produced a number of similar magnetic alloys containing gold, bismuth, tin, silver, copper, and zinc, and found that the above relation holds for hem equally well. Owing to the loss of his records by ire he is unable to give the actual figures.

LENGTHENED CHAIN COMPOUNDS OF SULPHUR.—We have received the advance proof of a paper on engthened chain compounds of sulphur by P. C. Rây nd K. C. Bose-Rây which is to be published in the *Journal of the Indian Chemical Society*, vol. 3, No. 2. According to V. Meyer, dithioethylene glycol reacts with ethylene bromide to give a mixture of 1:4 ithian and its polymer, the product varying according to the conditions. The polymer has been investigated by the authors and found to consist of a mixture of brominated long-chain compounds, including the substance $BrC_2H_4(S.C_2H_4)_{48}Br$, which s the first example of an organic sulphur compound with a molecular weight so high as 3068.

CADMIUM PHOTO-ELECTRIC CELL.—A cadmium hoto-electric cell has been designed by Messrs. I. D. Griffiths and John S. Taylor to measure ultraviolet radiation of the range of wave-lengths which re of therapeutic importance. It consists of the ell itself, in which cadmium forms the active element, nd a simple electroscope. The cadmium is deposited y distillation on a plate in front of which is a grid nsulated from the plate. The radiation is admitted through a quartz plate and the cell is filled with hydrogen at a low pressure. In use, the grid is charged positively and thus attracts the electrons released from the illuminated plate. The instrument was found very sensitive to unscreened radiation from a quartz mercury lamp. By the use of various filters, it was found that visible and ultra-violet radiation of a wave-length longer than 3500 ft. had no appreciable effect on the instrument. There was no fatigue to be detected during a prolonged exposure. The instrument is sold by Messrs. Watson and Son, Ltd.

WAVE-LENGTH AND THE PHOTO-ELECTRIC BEHAVIOUR OF CRYSTALS.—In the *Zeitschrift fur Physik* of July 12, Messrs. B. Gudden and R. Pohl direct attention to the apparent antagonism between the action of long and short wave-lengths when photo-electric absorption of light takes place in solid bodies. They show that it is not due to any real difference between the specific behaviour of the different waves. The essential effect of all wave-lengths is to split off electrons from the atoms, and the observed phenomena can be explained by assuming, in agreement with the experimental results, that a space element of the lattice is only able to support a definite maximum disturbance due to the photo-electric splitting off of electrons, the value of this maximum depending on the temperature. When the maximum is reached, a kind of breakdown takes place and the excited centres go back to their original unexcited state. The disturbances cause a widening of the spectrum on the long wave-length side, similar to that caused by thermal movements or lattice defects. The disturbances vanish as soon as the extra-long wave-length light absorbed owing to the above widening has split off enough electrons to increase them above the critical limit.

RESISTANT STEELS.—A paper communicated to the recent Congress of Chemists in London by Messrs. T. G. Elliot and G. B. Willey, dealt with various types of steel now produced commercially by Messrs. Hadfields, Ltd., having great resistance to high and to low temperatures and to attack by chemical agents. The steels are of the austenitic type, and are characterised by high ductility, and by a tensile strength which is retained at high temperatures, one of them giving a value of 31 tons per sq. in. at 700° C. The creep test is even more important than the ordinary tensile test, as it indicates the stress at which a heated mass of the metal could stand for an indefinite time without change of form. The steel in question has a creep stress of so much as 11 tons per sq. in. at 700°. Alloy steels of this class also resist both scaling and warping when heated for long periods in air and subjected to rapid heating and cooling, so that they find a wide application as furnace fittings, hardening boxes, recuperator tubes, etc. Another variety, apparently differing somewhat in composition, is used for turbine blading. A third is used in low-temperature plant, retaining its ductility even in liquid air. For example, a Frémont shock test figure of 50 kg.m. has been obtained at −195°, mild steel only giving 3 kg.m. The paper contains numerous figures relating to mechanical tests, and records of performance in use, including resistance to acids and other corrosive substances, a field in which so much progress has been made in recent years by the introduction of steels highly alloyed with nickel and chromium. The greater initial expense of such steels, and the greater difficulty of working them, are offset by the very greatly increased durability under the conditions to which the steels are exposed in chemical works and elsewhere.

The International Geological Congress at Madrid.

THE fourteenth session of the International Geological Congress was held in Madrid towards the end of May last. It was presided over by Señor D. César Rubio y Muñoz, under the honorary presidency of His Majesty King Alfonso. Señor Rubio is the President of the Board of Mines and was formerly President of the Geological Institute, entrusted with the preparation of the geological map of Spain. His successor, Señor D. Domingo de Orneta, who was to have taken an active part in the meeting, died shortly before it was held.

The Geological Congress is almost the sole survivor of the scientific congresses which formerly played such an important rôle in international scientific comity. It is still open to men of science of all nations, a distinction to which the scientific unions constituted under the International Research Council can lay no claim.

After a preliminary meeting of the Government delegates on the previous day, the congress was formally inaugurated by the King on Monday, May 24. The total number of members was more than a thousand. Many of these had already taken part in excursions to the Canary Islands and Morocco, or to Huelva, famous for its cupriferous pyrites, or other places of geological interest in the south of Spain. Toledo, Aranjuez, Almaden with its mines of mercury, and the Guadarrama mountains that separate Old from New Castile were visited during the meeting, and afterwards there were other excursions to the Balearic Islands, the potash deposits in Catalonia, the Pyrenees, the important coalfield of Asturias, and the iron ores in the neighbourhood of Bilbao.

The Spanish Government and the municipalities of Madrid and of the towns that were visited in the excursions extended splendid hospitality to the members of the Congress. There was a Royal reception at the Palace, a gala theatrical performance, a municipal garden party, and a banquet at which the speeches, twenty-seven in number, commenced with the fish course. This was followed by a charming exhibition of national costumes, dances, and singing, in which the performers were all amateurs.

In spite of these attractions, time was found in the different sections of the Congress for valuable discussions on matters of current geological interest.

There were a number of contributions on recent physical methods of studying the configuration and economic possibilities of the rocks of particular areas by electric, magnetic, and gravimetric methods, and observation of the propagation in the earth's crust of artificially produced vibrations.

The pyritic deposits of the south of Spain, to which reference has already been made, were the subject of important papers, and the greater part of two days was devoted to the discussion of the question as to whether they were formed by replacement or owed their origin to magmatic or pneumatolytic intrusion or deposition. Considerable attention was also given to the part played by Hercynian and Alpine movements in mountain building, more especially in Spain.

Perhaps, however, what was of the greatest interest to the British representatives was the consideration of questions of African geology in connexion with the proposed international geological map of Africa on a scale of one in five million, which was resolved on at the previous Congress at Brussels in 1922. A number of representatives of British African surveys were present as well as those of France, Belgium, Spain, Portugal, Italy, and Egypt. It was gratifying to note the progress that has been made in the interval. A geological map of the whole of South Africa has been recently published on a scale of one in one million, and one of Egypt on a scale of one in two million, and of South-West Africa on the same scale. Maps of the Anglo-Egyptian Sudan and Somaliland on a scale of one in three million, of the Gold Coast on one in one million five hundred thousand, and Gambia on one in five hundred thousand, and of all the remaining British African colonies or mandated territories, Nigeria, Uganda, Kenya, Tanganyika, Nyasaland, British Bechuanaland, and Northern Rhodesia, as well as of Southern Rhodesia, on a scale of one in two million, have been prepared, and work on other parts of Africa is well advanced. The map of the whole of Africa on the scale of one in five million will be prepared under the auspices of the Belgian Government as soon as all the materials are ready.

Of permanent value as a conspectus of the geology of Spain are the excellent guides, some nineteen in number, to the excursions. Many of them are published not only in Spanish but also in French, English, or German, or more than one of these languages At the same time the Municipality of Madrid presented the members of the Congress with a well-illustrated volume on the Quaternary rocks of the Manzanares Valley by José Péres de Barradas.

The greatest achievement of the Congress, however was the re-creation among geologists from all parts of the world of the atmosphere of friendliness and cordiality that prevailed in the days, which now seem so remote, 'before the War.'

Cancer Causation: Importance of Cell Physiology.

IN an interesting paper read before the German Chemical Society, at the meeting recently held at Kiel, Dr. Otto Warburg said that the attempts made artificially to produce carcinoma by tar-painting or by X-ray radiation showed that the normal tissues contain cells in which carcinoma may begin without help from any outside cells or micro-organisms. There is no cancer bacillus, just as there is no diabetes or arteriosclerosis bacillus. The cancer problem is a problem of cell physiology in the narrow sense, and limited to the physiology of the body cells.

Since cancerous tissue grows differently from normal tissue, that is to say, irregularly and to excess, it follows that the metabolism of the cancer cell differs from that of the normal cell. Since, on the other hand, the carcinoma cell as an actual body cell originates from normal cells, it becomes necessary to correlate carcinoma metabolism with normal metabolism. Like normal organs, the tumour consumes oxygen and give off carbon dioxide; the veins of the tumour contain less oxygen and more carbon dioxide than the arteries. Like normal organs the tumour require glucose, and its veins contain less glucose than the arteries. But, unlike the normal organs, the tumou produces lactic acid which is passed into the blood a portion of this acid being obtained from the blood sugar, which the tumour to a certain extent oxidise in the same way as normal organs, but for the most part splits into lactic acid. Careful research ha shown that there is lactic fermentation of the glucose and in fact there are a large number of different kind of malignant tumours, for example, transplanted ra carcinomata and sarcomata, the Peyton Rous chicken sarcoma, tar carcinoma in rabbits, and all kinds of human cancers, which qualitatively and almost quantitatively show the same result. We have here, therefore, a general characteristic of carcinoma and sarcoma cells which is entirely independent of any particular kind of irritation or of the nature of the normal tissue in which the tumours originate.

If, now, it be asked in what manner tumour metabolism arises out of normal cellular metabolism, it is necessary to inquire first of all under what conditions normal cells split glucose into lactic acid. Normal body cells produce lactic acid when their respiration is inhibited, either by cutting off the supply of oxygen or by poisoning The production of lactic acid from glucose is, therefore, no peculiar property newly acquired when tumours first form, but is a property common to all body cells. But whilst in normal cells lactic fermentation is only set up by absence of oxygen, tumour cells always produce lactic acid, even when they are fully supplied with oxygen.

The results of these investigations may therefore be summed up in the statement that the tumour, so far as its metabolism is concerned, always behaves as a normal growing cell in a state of asphyxia. If normal growing cells be deprived of oxygen, then we have the reaction of a carcinoma cell. Since by deprivation of oxygen respiration is inhibited, fermentation cannot be masked or prevented, and the asphyxiated cells continue to produce lactic acid in excess, even when the oxygen supply is restored. Most of the cells so treated die because they are unable to live at the expense of energy of fermentation. Only a small number of them remain alive, and in their nature, magnitude and action they are indistinguishable from carcinoma cells.

Dr. Warburg then considered the question whether the asphyxia of normal growing cells sufficed to bring about the cancerous state, or whether other unknown factors also played a part. Reference was made in this connexion to the recent experiments of Carrel, Dresel and Wind, in which the attempt was made to discover whether carcinoma cells can not only exist without breathing, through energy of fermentation, but can also grow. The general conclusion was that tumour cells, like yeast, cannot live their full period without oxygen, but that both kinds of cells are able to grow for a time without oxygen, by the energy of fermentation, and that the asphyxiation of normal growing cells is sufficient to produce the cancerous state

Hæmoglobin.

HÆMOGLOBIN, the oxygen-carrier in the blood of vertebrates, upon which life depends, is a substance of great interest and importance, the investigation of which has received considerable attention from research workers. Prof. J. Barcroft, whose lecture on hæmoglobin, delivered before the Chemical Society on February 11, 1926, has been published in the Society's journal for May 1926, gives an account of recent investigations on the subject.

The old idea that hæmoglobin is a compound of two bodies, called *hæmatin* (containing iron) and a protein, *globin*, is not altogether untrue. The well-defined crystalline substance *hæmin* is obtained by the action of glacial-acetic acid on dried blood. When hæmin is oxidised in the presence of alkali, hæmatin is obtained. Alkaline reduction of hæmin yields *hæm*, a substance having an ill-defined spectrum. Nicotine, pyridine, globin, etc., when added to hæm, produce a class of substances with well-defined and similar spectra, called *hæmochromogens*. Of these it appears that the globin compound alone can form a hæmoglobin by regulation of the hydrogen-ion concentration. Cytochrome, another substance well known to the biochemist, has been proved by examination of the absorption spectrum to consist of three hæmochromogens.

The determination of the equilibrium constant K for hæmoglobin and oxygen and for hæmoglobin and carbon monoxide by the ordinary methods of gas analyses is exceedingly difficult on account of the low pressures of the gases involved, and methods have been worked out which involve spectroscopic measurements. The velocity constants, k and k', for these reactions have been obtained by an ingenious form of apparatus which overcomes the difficulties due to the high order of velocity by very rapid mixing of the components. For the reaction $HbO_2 \longrightarrow Hb + O_2$, k' is relatively small, whereas the constant for the formation of the oxide is very large and is also comparatively independent of the temperature and hydrogen-ion concentration. It follows that the equilibrium constant, $K = k'/k$, must be a measure of the effect of the reduction phase. Parallel observations with carbon monoxide show that the slow-reduction phase in the case of oxygen is peculiar.

There is a shift towards the blue in the position of the important α-band in the absorption spectrum when the hæmoglobin is treated with carbon monoxide. This shift, measured in Ångström units, is called the 'span,' and a nearly linear relation is obtained between $\log K$ and the span of hæmoglobins from various sources, where $K[HbO_2] \times [CO] = [HbCO][O_2]$. This is supposed to indicate that "there are a limited number of hæmoglobins, say two, which in different animals are mixed together in different proportions." The difficulties encountered in the measurement of osmotic pressures are also considered and in conclusion attempts are made to reconcile the equation, $Hb_4 + 4O_2 \rightleftharpoons Hb_4O_8$, which these measurements indicate, with the shape of the equilibrium curves previously obtained.

Contact Catalysis.[1]

THE Committee on Contact Catalysis under the chairmanship of W. D. Bancroft has performed an excellent piece of work in collecting together and commenting upon the interesting peculiarities of surfaces in affecting the rates of chemical change of reactants at, or in close proximity to, those surfaces. Whilst certain purists may object to the term 'contact' in connexion with reactions the velocities of which are accelerated by the presence of substances which, although taking part in the chemical change, are not present either in the reactants or products in stoichiometric quantities; yet the word possesses advantages in differentiating homogeneous reactions from reactions heterogeneously accelerated.

In the United States, Dr. H. S. Taylor himself has been largely instrumental in stimulating interest in problems in this field, which during the last decade has attracted an increasing number of research students in all countries, and from which a remarkable crop of new technical industries, not without economic value, has already been harvested.

In 1917 Langmuir showed that chemical reaction was probably restricted to the molecules of the reactants actually in contact with the surface. Whilst the experiments of Bone and others at high temperatures indicate that this generalisation may not be always true, yet in a large number of reactions such appears to be the case. Even in combustion at hot surfaces, reaction chains may start from, or, electrons or ions which in turn effect reaction may be emitted from the surface. Four years later it was shown simultaneously in England and the United States that the whole of a surface could not be equally uniform in affecting the rate of chemical action, certain portions of the surface being more active than others. Data both on the quantities and heats of adsorption of gases and vapours as well as the effect of poisons on the rate of catalytic action have amply confirmed the theory of active patches, as is shown in the present report.

---

[1] Fourth Report of the Committee on Contact Catalysis. By Hugh S. Taylor. *Jour. Phys Chem.*, xxx, 145, 171, Feb. 1926

It is clear that the existence of active patches is due to the fact that the surface of the catalyst is not uniform, but composite, consisting of various planes, corners and edges of minute crystals in addition to atoms isolated on planes and edges as well as atoms in the planes and edges. The work of Born and Lennard Jones on the surface energies of heteropolar compounds leads us to hope that the surface energies of the various portions of a composite metal surface may in time be computed. Only in the case of certain charcoals and of nickel do we possess any definite information on the extents and specific activities of various patches of different activities, but further information on this subject as well as the variation in relative areas will doubtless be forthcoming.

When we are in possession of data on the variation of the surface forces with chemical reaction rate taking place at the surface, some clue may be given to the mechanism of chemical activation, the elucidation of which is stimulating at the present time a renewed interest in the study of photochemistry.

It is to be hoped that such reports may be continued although the labour involved may render their appearance less frequent in future. Both the committee and Dr. Taylor are to be congratulated on this successor to the three reports already published.

ERIC K. RIDEAL.

University and Educational Intelligence.

CAMBRIDGE.—Mr. C. P. T. Winckworth, Christ's College, has been elected Eric Yarrow lecturer in Assyriology. Dr. C. L. Withycombe has been elected University lecturer in advanced and economic entomology. Prof. B. M. Jones has been nominated as a member of the Advisory Committee on Aeronautical Education. Dr. J. L. Witts, University of Manchester, and Mr. J. O. W. Bland, Jesus College, have been elected John Lucas Walker students in pathology. A grant of 100*l*. has been made from the Balfour Fund to Dr. H. Scott, Trinity College, towards the expenses of an expedition to Abyssinia. Mr. H. G. Cannon, Christ's College, and Miss S. M. Manton, Girton College, have been appointed to the University's table at the laboratory of the Marine Biological Association at Plymouth. An industrial bursary has been awarded by the Royal Commissioners for the Exhibition of 1851 to C. Salter, St. Catherine's College.

An interesting report has been published by the Appointments Committee giving a list of all the teaching appointments made under the new statutes and the grants made to the different faculties and departments from the Government grant. The total amount of new grants already thus allotted is 18,710*l*., out of 20,000*l*. available for the purpose.

The following have been elected to research studentships: W. J. Dann at Trinity College; B. C. Saunders at Pembroke College; W. A. Waters (chemistry), R. V. Thomas (chemistry), E. G. Jones (economics), J. G. Adshead (mathematics), H. Stayt (anthropology), T. E. Allibone (physics), and W. R. Wooldridge (biochemistry) at Gonville and Caius College; G. H. Aston, A. Caress, O. H. Wansbrough-Jones and B. J. Wood at Trinity Hall; J. Hilton at Christ's College; J. H. Ratcliffe at Sidney Sussex College; G. E. Watts has been elected Charles Kingsley bye-fellow at Magdalene College.

Further details are now available of the will of the late Dr. J. E. Bles, whose bequests to the University of Cambridge have already been referred to in these columns. He left all his scientific instruments, scientific books, and the fittings and contents of his private laboratory to the University of Cambridge, and he empowered his trustees to expend a sum, not exceeding 500*l*., in completing any researches made by him and publishing the results of any researches not published at the time of his decease. The value of his estate was 42,677*l*.; failing issue, and subject to his widow's life interest and after certain bequests, he left the residue of his property to the University upon trust for a professorship of animal embryology to be called the Charles Darwin professorship, for research and teaching in the subject from a purely scientific aspect; apart from economic, technical, or medical aspects, and subject thereto upon similar terms for a professorship of bio-physics. In the event of these chairs being already constituted, the legacy would have been devoted to the promotion of biological science and subject to a board consisting of the professors of biological subjects, which is also to examine the position of the fund every twenty-five years.

THE Calcutta University Poverty Problem lecturer, Captain Petavel, has for several years been carrying on a campaign of advocacy of a scheme for establishing near Calcutta a co-operative colony of middle-class 'home-crofters,' and in connexion therewith a school of which the pupils would "be systematically organised to produce their food by their own labour, the work being made instructive for them." In his magazine *Bread and Freedom* for July, he announces that a Mr. K. K. Dutta, a well-known Calcutta attorney, has placed at the disposal of his organising committee a village and farm, while another member of the committee has promised to contribute a sum of 10,000 rupees towards a fund for putting the scheme into operation "on business lines." A somewhat similar scheme was recently advocated by Prof. J. W. Scott, of University College, Cardiff.

FROM Loughborough College, Leicestershire, we have received a calendar for 1926–27, giving very fully detailed and illustrated descriptions of the College laboratories and courses in engineering and in pure and applied science including chemical technology. The College has also a Department of Administration and Economics, an Extra-Mural Department, a school of Industrial and Fine Art, and a secondary school for boys. The Faculty of Engineering is noteworthy for its system of concurrent theoretical and practical training, made possible by the large scale of the workshops, half the student's time being spent in productive work. The governors award annually five scholarships in the Faculty of Engineering, each of the value of 75*l*. per annum, open to British subjects in any part of the Empire. Candidates resident outside Great Britain can be examined at local centres.

Contemporary Birthdays.

August 20, 1860. Sir William Henry Ellis, G.B.E.
August 21, 1866. Sir Gerald P. Lenox-Conyngham, F.R.S.
August 21, 1858. Mr Charles T. Heycock, F.R S.
August 23, 1875. Prof. W. H. Eccles, F.R.S.
August 25, 1851. Sir John A. F. Aspinall.
August 25, 1844. Sir Thomas Muir, F.R S
August 26, 1863. Mr. Edward Heawood.
August 26, 1873. Prof. William A Osborne.
August 26, 1860. Sir Thomas Ranken Lyle, F R.S.

SIR WILLIAM ELLIS is president of the Institution of Civil Engineers, and a past president of the Iron and Steel Institute. He was master cutler of Sheffield from 1914 until 1917.

SIR GERALD LENOX-CONYNGHAM, reader in geodesy in the University of Cambridge, was educated at Edinburgh Academy, afterwards entering the Royal Engineers branch of the army. He was superintendent of the Trigonometrical Survey of India from 1912 until 1921. Sir Gerald is a member of the National Committee for Geodesy and Geophysics of the International Research Council.

MR. HEYCOCK, mathematician and metallurgist, is a fellow of, and lecturer in natural science in, King's College, Cambridge. He was president of Section B (Chemistry) at the Cardiff meeting of the British Association in 1920 Mr. Heycock was awarded the Royal Society's Davy medal in that year on the ground of his researches in physical chemistry, more especially on the composition and constitution of alloys. While his work added to theoretical conceptions, it proved of importance also to industrial metallurgy.

PROF. ECCLES was born at Ulverston, Lancashire. He was the last dean and professor of applied physics in the City and Guilds of London Technical College, which was recently closed. Lately president of the Radio Society of Great Britain, he was, last month, elected president of the Institution of Electrical Engineers.

SIR JOHN ASPINALL was born at Liverpool. He was chief mechanical engineer of the Lancashire and Yorkshire Railway from 1886 until 1899. In 1919 he was appointed consulting mechanical engineer to the Ministry of Transport. Sir John is a past president of the Institution of Mechanical Engineers and of the Institution of Civil Engineers.

SIR THOMAS MUIR, for a long period—1892 until 1915—superintendent-general of education in Cape Colony, was born in Scotland. A graduate of the University of Glasgow, he was, early in his career, assistant professor of mathematics there. In 1883 the Royal Society of Edinburgh awarded him the Keith gold medal for his researches into the theory of determinants and allied questions. The unusual course was taken of allotting the medal again in 1897 for continued work in the same field, and once more in 1916 to mark the completion of the series down to 1915, all the memoirs having been published by the Society. Sir Thomas remains faithful to residence in Cape Colony.

MR. EDWARD HEAWOOD is known to a wide circle as the accomplished librarian of the Royal Geographical Society, a post he has filled since 1901. Born at Newport, Shropshire, he was educated at Queen Elizabeth's Grammar School, Ipswich, graduating at Gonville and Caius College, Cambridge.

SIR THOMAS LYLE was born at Coleraine, Ireland. He graduated at the University of Dublin. From 1889 until 1915 Sir Thomas was professor of natural philosophy in the University of Melbourne.

Societies and Academies.

ROME.

Royal Academy of the Lincei, June 3 —**Leonida Tonelli**: The quadrature of surfaces.—**A. Bemporad**: The astrographic catalogue of Catania.—**Ferruccio Zambonini**: The presence in the products of the present-day activity of Vesuvius of a cæsiferous variety of potassium fluoborate. For a crystalline sublimate from Vesuvius, consisting of potassium and cæsium fluoborates in isomorphous mixture, the name 'avogadrite' is proposed.—**Luisa Pelosi**: Certain geometrical maxima and minima.—**Mauro Picone**: The singularity of harmonic functions—**Oscar Zariski**: The impossibility of resolving parametrically by radicals an algebraic equation $f(xy)=0$ of the genus $p>6$ with general moduli.—**Umberto Crudeli**: Models of the helium atom.—**R. Maxet**: Oscillations of a liquid in connected vessels—**Vasco Ronchi**: The limit of resolution of spectroscopic apparatus. The expression 'resolving power' of a prism, grating, etc., is shown to be inaccurate, since such apparatus is characterised only by dispersion. The resolution depends on the means by which it is examined and, when diffraction images are observed, is only one-half as great as when interference images are employed.—**Mario Picotti**: The results of the physico-chemical researches carried out on the Royal Italian cruiser *Marsigli* in the Straits of Messina. Observations on the temperature and salinity of the water are described.—**Fausta Bertolini**: Conformation of the stomach of the Teleostei in relation to the nutrition.—**M. Sella**: The migration of the tunny studied by means of fish-hooks.

SYDNEY.

Royal Society of New South Wales, June 2.—**M. S. Benjamin**: A note on the rate of decomposition of commercial calcium cyanide. Decomposition was effected in a large closed glass container, and the percentage of hydrocyanic acid evolved was determined. The curves obtained indicate that carbon dioxide considerably accelerates the rate of change and factors other than the cyanogen content of the material affect the efficiency of a given dose of the material in practical fumigation.—**G. Harker** and **R. K. Newman**: Reactions depending upon the vapour at the interface of two immiscible liquids. The reaction between amyl acetate and acidulated water has been studied. The hydrolytic effect of liquid amyl acetate and of the mixed saturated vapour of amyl acetate and water at 100°, upon a surface of given area of dilute mineral acid, revealed a close agreement in the rate of hydrolysis. Taken in conjunction with the results previously obtained for benzyl chloride, it is therefore evident that at the interface of the two liquids the mixed saturated vapours of both liquids must be present. This is in agreement with the view of Van der Waals that there exists a continuous transition from the liquid to the vapour state at the boundary of any liquid.—**A. R. Penfold**. Notes on the essential oils from some cultivated Eucalypts. The specimens were grown from seed at Ashfield, near Sydney. The trees examined varied from three to eight years of age, and consisted of *E. Australiana, E. Macarthuri, E. citriodora* and *E. radiata (numerosa)*. The *E. Australiana* was grown from seed collected at Wyndham, N.S W., a place which yielded oils possessing a lævo-rotation of about $-3{\cdot}6$ and containing phellandrene in small quantity, and as it would not meet the requirements of the various pharmacopœias the district had to be abandoned. The oils obtained from material grown at Ashfield possessed an optical rotation of +2·5° to 3·2° and were free from phellandrene. *E. Macarthuri* gave remarkable yields, varying from 0·5 to 0·74 per cent., as compared with 0·2 per cent. yield from the ordinary native material, whilst the geranyl acetate varied from 62 per cent. to 75 per cent., thus showing the influence of ecological conditions. *E. citriodora* yielded oils from 0·5 per cent. to 1 per cent., containing from 90 to 98 per cent citronellal, and it would appear as if there were separate races existing within this species.—**Miss P. Nicol**: An investigation of the optical properties of selenium in the conducting form. Methods of preparing mirrors of selenium are described. The method gives values of ν_0 generally correct to within about 3 per cent. and of κ_0 to within 5 per cent. The values obtained vary within fairly wide limits, depending on the method of preparation (casting on glass, polishing, grinding, etc.). The results obtained are:

$\lambda = 6470\text{-}4170$ $\nu_0 = 2·7\text{-}3·36$ $\kappa_0 = 0·45\text{-}0·9$
$\lambda = 5890\text{-}5896$ $\nu_0 = 2·75\text{-}3·06$ $\kappa_0 = 0·77\text{-}1·07$
$\lambda = 21900\text{-}8100$ $\nu_0 = 2·59\text{-}3·02$ $\kappa_0 = 0·90\text{-}1·18$
$\lambda = 4400\text{-}4800$ $\nu_0 = 2·74\text{-}3·04$ $\kappa_0 = 1·05\text{-}1·27$

Some rough measures in the near infra red indicated $\kappa_0 < 0·1$ and ν_0 about 2·6. There was no definite indication of any relation between the temperature of transformation to the conducting form and the optical properties, nor was there any variation with the length of exposure to light or with the age of the specimen.

VIENNA.

Academy of Sciences, July 1.—**F. Hemmelmayr** and **J. Strehly**: Contributions to our knowledge of skoparin. Apparently this substance contains seven hydroxyl groups, and its formula is $C_{22}H_{22}O_{11}$ rather than $C_{20}H_{20}O_{10}$.—**L. Schmidt** and **R. Stöhr**: Two substances similar to stearine from *Asclepias syriaca*. A monovalent unsaturated alcohol $C_{31}H_{52}O$ and a divalent unsaturated alcohol $C_{45}H_{74}O_2$ have been obtained.—**L. Waldmann**: Petrographic description of the stones collected by L. Kober in the northern Hegas and in the Taurus.

Official Publications Received.

International Hydrographic Bureau. Special Publication No. 12: Investigation of Harmonic Constants, Prediction of Tide and Current, and their Description by Means of these Constants. By Rear-Admiral Phaff. Pp. 80+6 plates. 5 Swiss francs. Supplement to Special Publication No. 12: Tables for the Calculation of Tides by Means of Harmonic Constants. Pp. 136. (Monaco.)

Straits Settlements. Annual Report on the Raffles Museum and Library for the Year 1925. By C. Boden Kloss. Pp. 14. (Singapore: Government Printing Office.)

Union of South Africa: Department of Agriculture. Reprint No. 4, 1925: Weeds of South Africa, Part 3. By K. A. Lansdell. Pp. 34+5 plates. (Pretoria: Government Printing and Stationery Office.) 3d.

The National University of Ireland. Calendar for the Year 1926. Pp. viii+320+481+156. (Dublin.)

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1925, with Report of the Geological Survey Board and Report of the Director. Pp. vi+211+12 plates. (London: H.M. Stationery Office; Southampton: Ordnance Survey Office.) 4s. 6d. net.

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1925. Pp. 152+11 plates. (Bristol.)

Report of the Imperial Institute of Veterinary Research, Muktesar, for the Year ending 31st March 1925. Pp. ii+59. (Calcutta: Government of India Central Publication Branch.) 1.14 rupees; 3s. 3d.

Records of the Geological Survey of India. Vol. 59, Part 1: General Report for 1925, by Dr. E. H. Pascoe; The Zonal Distribution and Description of the larger Foraminifera of the Middle and Lower Kirthar Series (Middle Eocene) and parts of Western India, by W. L. F. Nuttall. Pp. 164+8 plates. (Calcutta: Government of India Central Publication Branch.) 2 12 rupees; 5s.

Ceylon Journal of Science. Section A: Botany. Annals of the Royal Botanic Gardens, Peradeniya. Edited by A. H. G. Alston. Vol. 10, Part 1, June 15th. Pp. 144+2 plates. (Peradeniya: Director of Agriculture; London: Dulau and Co., Ltd.) 3 rupees.

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 22: The Downy Mildew of Onions (Peronospora Schleideni), with particular reference to the Hibernation of the Parasite. By Dr. Paul A. Murphy and Robert M'Kay. Pp. 237-251+plates 12-15. 4s. Vol. 18 (N.S.), No. 23: A simple Method of Temperature Control for use with Refractometers and Polarimeters. By Michael T. Casey. Pp. 263-264. 6d. Vol. 18 (N.S.), No. 24: The Dehydration Rates of Conifer Leaves in relation to Pentosan Content. By Joseph Doyle and Phyllis Clinch. Pp. 265-275. 1s. (Dublin.)

Forestry Commission. Sixth Annual Report of the Forestry Commissioners, Year ending September 30th, 1925. Pp. 32. (London: H.M. Stationery Office.) 9d. net.

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1925. Pp. 23. (Jamaica, B.W.I.)

Diary of Societies.

SATURDAY, AUGUST 21.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Annual Meeting) (at Newcastle-upon-Tyne), at 2.30.

CONGRESSES.

AUGUST 27 AND 28.

IRON AND STEEL INSTITUTE (Autumn Meeting) (at Stockholm).—F. Adcock: The Effect of Nitrogen on Chromium and some Iron Chromium Alloys (Alloys of Iron Research, Part IV.).—J. H. Andrew and H. A. Dickie: A Physical Investigation into the Cause of Temper Brittleness.—Prof. C. Benedicks, H. Backstrom, and P. Sederholm: Anomalies in Heat Conduction, with some Determinations of Thermal Conductivity in Iron and Carbon Steels.—Prof. C. Benedicks and R. Sundberg: Electrochemical Potentials of Carbon and Chromium Steels.—G. F. Comstock: The Treatment of Steel with Ferro Carbon-Titanium.—G. A. Hankins, D. Hanson, and Miss G. W. Ford: The Mechanical Properties of Four Heat-Treated Spring Steels.—Prof. K. Honda: Is the Direct Change from Austenite to Troostite Possible?—A. Johansson and R. Von Seth: The Carburisation and Decarburisation of Iron and Some Investigations on the Surface Decarburisation of Steel.—A. Johansson and A. Wahlberg: The Development of the Swedish Iron and Steel Industry during the last thirty years.—R. Kinander: Notes on Jernkontoret.—A. Lundgren: The Testing of Hardened Steel.—W. Petersson: Notes on the Development of the Swedish Mining Industry during the last twenty-five years.—G. Phragmen: The Constitution of the Iron-Silicon Alloys.

AUGUST 29 TO SEPTEMBER 1.

SOCIÉTÉ HELVÉTIQUE DES SCIENCES NATURELLES (at Fribourg).—In Sections devoted to Mathematics, Physics, Geophysics, Meteorology and Astronomy, Chemistry, Geology, Mineralogy and Petrography, General Botany, Special Botany and Geographical Botany, Zoology, Entomology, Anthropology and Ethnology, Palæontology, Medical Biology, History of Medicine and Natural Science.

AUGUST 31 TO SEPTEMBER 8.

WORLD POWER CONFERENCE (at Basle), Technical Programme of Sectional Meeting:

Utilisation of Water Power, and Inland Navigation.
Exchange of Electrical Energy between Countries.
The Economic Relation between Electrical Energy Produced Hydraulically and Electrical Energy Produced Thermally. Conditions under which the two systems can work together with advantage.
Electricity in Agriculture.
Railway Electrification.

SEPTEMBER 1 TO 4.

INSTITUTE OF METALS (Autumn Meeting) (at Liége) (September 1, at 8.—Dr. W. Rosenhain: Ancient Industries and Modern Metallurgy) (Autumn Lecture).—Dr. C. J. Smithells, H. P. Rooksby, and W. R. Pitkin: The Deformation of Tungsten Crystals.—Prof. K. Honda: A Comparison of Static and Dynamic Tensile and Notched-Bar Tests.—C. H. M. Jenkins: The Constitution and the Physical Properties of the Alloys of Cadmium and Zinc.—H. J. Gough, S. J. Wright, and Dr. D. Hanson: Some Further Experiments on the Behaviour of Single Crystals of Aluminium under Reversed Torsional Stresses.—B. Otani: Silumin and its Structure.—G. B. Phillips: The Primitive Copper Industry of America. Part II.—Kathleen E. Bingham: The Constitution and Age-Hardening of Some Ternary and Quaternary Alloys of Aluminium containing Nickel.—Dr. A. G. C. Gwyer and H. W. L. Phillips: The Constitution and Structure of the Commercial Aluminium-Silicon Alloys. With an Appendix upon The Properties of the Modified Aluminium-Silicon Alloys, by Dr. D. Stockdale and I. Wilkinson.—J. D. Grogan: Some Mechanical Properties of Silicon-Aluminium Alloys.—Dr. C. S. Smith and Prof. C. R. Hayward: The Action of Hydrogen on Hot Solid Copper.—Capt. F. R. Barton: The Development of the Use of Nickel in Coinage.—A. Pinkerton and W. H. Tait: Season-Cracking in Arsenical Copper Tubes.—Prof. P. Chevenard: Thermal Anomalies of Certain Solid Solutions.—W. T. Cook and W. R. D. Jones: Preliminary Experiments on the Copper-Magnesium Alloys.—F. W. Rowe: Bronze Worm Gear Blanks produced by Centrifugal Casting.—L. Boscheron: An Account of the Non-Ferrous Metals Industry in the Liége District.

SEPTEMBER 6 TO 11.

AMERICAN CHEMICAL SOCIETY (at Philadelphia).—In eighteen Divisional Gatherings, dealing with various branches of Pure and Applied Chemistry.

SEPTEMBER 13 TO 17.

INTERNATIONAL CONGRESS OF PHILOSOPHY (at Harvard University, Cambridge, Mass.).

SATURDAY, AUGUST 28, 1926.

CONTENTS.

PAGE
African Natives and European Civilisation . . . 289
An Indian Clan in Wales. By Prof. R. L. Turner 291
Ice Ages. By C. E. P. Brooks 293
The Sylvester Programme in Algebra . . . 295
Our Bookshelf 296
Letters to the Editor:
    The Classification of Research Work.—Dr. W. Lawrence Balls, F.R.S. 298
    Science and Psychical Research.—A. A. Campbell Swinton, F.R.S.; Dr. R. J. Tillyard, F.R.S. 299
    External Capillary Action.—Sir W. Galloway . 300
    Scattering of Electrons in Ionised Gases.—Dr. F. M. Penning 301
    On the Law of Radiation.—Prof. G. Gianfranceschi 302
    The Electrical Polarity of Molecules.—Prof. C. V. Raman, F.R.S., and K. S. Krishnan . . 302
    Depth of Origin of the Earthquake of August 15.—R. D. Oldham, F.R.S. 302
    The Groma: an Ancient Surveying Instrument.—R. W. Sloley 303
    The Absolute Density and Coefficient of Expansion of Silicon Tetrachloride.—P. L. Robinson and H. C. Smith 303
    The Movements of Molecules.—Prof. A. Liversidge, F.R.S. 303
    Pernicious Grafting.—W. M. Macdonald . . 303
The Relation between Cultivated Area and Population. By Sir Daniel Hall, K.C.B., F.R.S. . 304
The Rate of Work done with an Egyptian Shadouf. By Dr. J. S. Haldane, F.R.S., and Dr. Yandell Henderson 308
Audibility of Explosions and the Constitution of the Upper Atmosphere. By F. J. W. Whipple . . 309
Obituary:
    Dr. J. F. Hall-Edwards. By Prof. S. Russ . 313
News and Views 313
Research Items 317
The Recently Discovered Gibraltar Skull . . 320
Adhesives and Adhesive Action. By E. H. . . 320
Herrings along the Baltic Coast of Sweden . . 321
University and Educational Intelligence . . . 321
Contemporary Birthdays 322
Societies and Academies 323
Official Publications Received 324
Diary of Societies and Congresses 324
Recent Scientific and Technical Books . . Supp. v.

Editorial and Publishing Offices.
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

African Natives and European Civilisation.

IN his presidential address to the British Association, H.R.H. the Prince of Wales spoke with singular felicity of the relations which do actually, and should, subsist between the State and scientific research. The discussion of a multiplicity of topics, which was released as it were from a floodgate immediately after the inaugural meeting, may have obscured the fact that the opportuneness of the Prince's reference to the application of scientific study to the problems of the Empire in our Dominions and Dependencies was conclusively demonstrated by the presidential address delivered in the Geographical Section on the following day. The lesson was further driven home by the discussion on the effect on the native races of Africa of contact with European civilisation which arose directly out of Mr. Ormsby-Gore's address, and took place in a joint session of the Sections of Geography and Anthropology.

His Royal Highness spoke as one who had had many opportunities in peace and in war to observe the facts, the necessities, and the possibilities of conditions in the Empire as a whole. In like manner, if in a more restricted field, Mr. Ormsby-Gore laid before his hearers the results of his journeys of observation in East and West Africa—journeys which may become as memorable and as far-reaching in effect as those of Joseph Chamberlain when the latter was Minister of State for the Colonies. Those who have followed the newspaper reports of Mr. Ormsby-Gore's travels with some knowledge of the problems which were then brought before him, will appreciate the acute observation and the balanced judgment which underlie his summary of the situation in regard to the economic development of tropical Africa and its effect on the native population. It is, however, of no little significance that his lucid summary of the needs of Africa and its people is followed by an acknowledgment of the greatness of our opportunities and our responsibilities and an appeal for the continued efforts not only of "officials and unofficials in Africa," but also of "the men of science over a whole range of human experience such as are meeting under the auspices of the British Association." It is pardonable if in these words we think we hear the statesman and the administrator rather than the president of Section E.

It cannot be denied that the need of constructive thinking for which Mr. Ormsby-Gore pleaded is urgent. The situation in Africa was summed up by one speaker in the discussion as one of depopulation and disintegration, and he went on to point out that the African native has passed in a brief space of time from the Stone Age to the present day. The final partition of Africa among the European powers began in the last decade of the last century. Since then the economic development of the country has proceeded at a rapid pace, but especially in the last few years. Figures are quoted in Mr. Ormsby-Gore's address which are worth repeating. Between 1921 and 1925 the domestic exports of Nigeria increased from 8,250,000*l.* to 17,000,000*l.*; in the Gold Coast in the same period from 6,000,000*l.* to 10,000,000*l.* In East Africa the increase is even more marked, due almost entirely to the development of cotton-growing. In Kenya and Uganda the figures for the corresponding years show an increase from 2,250,000*l.* to 7,820,000*l.*, and in Tanganyika Territory from 1,100,000*l.* to 2,900,000*l.* This sudden accession of wealth would not be without its element of danger in any community; but when it is realised that the greater part represents the earnings either as producers or as wage-labourers of a population to whom 'money' is still novel, and whose ideas of a currency and medium of exchange not so long ago were limited mainly to 'brass rods' or 'cloth,' it must be apparent that the problem is both immediate and grave. It is a problem which demands statesmanship, and a statesmanship which is informed with an intimate knowledge of the African, of his institutions, and of his needs.

It is not possible to set back the clock. For good or for ill, the economic development of Africa is bound to go on under pressure of an increasing world-demand for its raw materials and its market for imports. Apart from certain restricted areas which will be exploited for their mineral wealth, it will be developed as an agricultural country. In tropical Africa, where white labour is impossible, that development will depend upon the native. Even in South Africa it is doubtful if white labour will ever be able to hold its own. Whatever may be the ultimate result in South Africa, in the tropics it seems clear, owing to climatic conditions and the question of prestige, that the function of the white man is to act as an administrator or employer and the guide and teacher of the native.

Up to the present it cannot be said that this rapid development of Africa has been for the good of the native on the whole, even though it be recognised that certain benefits have accrued to him. It is doubtful, indeed, how far these benefits may be for his ultimate good unless steps are taken to neutralise the inevitable disabilities by which they are accompanied. It has also to be admitted, as has been pointed out recently by a resident of many years in the remoter parts of East Africa, that the native does not always accept the advent of the white man who comes to exploit his land as an unmixed blessing. The African has a distinctive culture of his own, in which the cardinal features are the religious beliefs which are interwoven as an essential element in every aspect of his life, and the communal spirit which informs his thoughts and actions as a member of a tribal group. Notwithstanding differences as between tribes and peoples in the form of their political organisation, this is true of all in general terms. Especially is it essential to remember that the ultimate sanction of chiefly and tribal authority is religious. Further, apart from provision for the needs of the family and any contribution due to the chief or the community, the idea of the economic value of labour applied to production from the land or of wage-earning is alien to the native mind. Until recently, and as is still the case in many tribes, wealth consisted exclusively of wives and cattle. One of the reasons for the imposition of a hut-tax on the native population in South Africa was the hope that incidentally it would familiarise the native with the advantages of wage-earning and thus increase the supply of labour.

It is self-evident that the sudden impinging of European civilisation on a culture of this type, and the rapid economic development of the country, are bound to result in an equally rapid disintegration of native institutions. The growth of a class of native producers and of wage-earners has rendered the individual conscious of his individuality as a unit rather than merely as a member of a social organism, while introduction to the tenets of Christianity, an individualistic body of belief, has still further strengthened this tendency. The authority of the chief and the sense of responsibility to the tribe have been undermined, and the religious bond upon which they depend has been loosed. In the coast towns of West Africa, natives have become completely detribalised, and if the process is allowed to go on unchecked the existing tribes are in danger of becoming undisciplined mobs. Again, the native system of land-tenure, about which, incidentally, insufficient is known, is in danger. The economic value of land is beginning to be appreciated by the native, and where land is vested in the chief, this has introduced an entirely new relation of landlord and tenant as between the chief and the individual member of the tribe. Of the importance of a knowledge of the system of land-tenure, the disastrous experience of South Africa up to the passing of the Glen-Gray Act is a sufficient indication. Here, too, notwithstanding the reservation system, detribalisation, except in the case of the Zulu, is proceeding rapidly.

Of the results of this tendency to detribalisation, little need be said. They are obvious. The lack of restraint, and the accompanying break-up of the *morale* of the native, unless checked, are bound in the long run to be disastrous. They must accelerate the depopulation of the country, which, owing to disease and especially infant mortality, is already a serious factor in the situation. Improved sanitation, a higher standard of nutrition, and increased efficiency in medical service may, however, be expected to cope with disease as time goes on; but an informed and intelligent guidance based upon a sympathetic understanding of native psychology, which will control and direct into safe channels the inevitable modification of the full tribal system, is an essential condition of the well-being of the native, and in the long run of the prosperity of Africa.

The present tendency to unchecked detribalisation is the more to be regretted in that the African native is one of the most adaptable of all the primitive races in the world, when the innate conservatism based on his religious taboos is not affected. This is shown by the readiness with which the native has mastered new arts of life in the course of the opening up of his country. Many of the African natives have beside, as the study of their history and institutions shows, a remarkable instinct for social and political organisation. The genius of Chaka, the great chieftain of the Zulu, is by no means unique in the annals of African tribes. This capacity for organisation and government is not confined to the men but has been displayed on more than one occasion by women, who by some accident or other have attained positions of authority.

A hopeful feature of the situation is the intense desire of the African for education. Hitherto the only form of education available for the native, with the exception of the interesting experiment at Achimotu, has been upon European lines; but education in Africa must take a new orientation. It is clearly of little use to offer the African a system of education which was designed originally to meet the needs of a European environment. Too often it has been the case that the curriculum of native schools has been framed with an eye only to the literary side of education, to the neglect of practical subjects. Yet it is not enough to insist on the need for vocational training. Even while recognising the excellence of much of the work which has been done in this direction, too great emphasis cannot be laid upon the fact that the education of the native must be based upon an intensive study of the culture, the institutions, and the needs of the African population. Much, it is hoped, may yet be effected through the Committee on Education of the Colonial Office. For many years the anthropologists have been collecting the facts, and although they are well aware that these facts may still be incomplete in certain respects, yet in response to Mr. Ormsby-Gore's appeal for the assistance of scientific workers they are ready and willing to place their knowledge at the disposal of the administrator for its practical application in the training and government of the native community of the new Africa.

An Indian Clan in Wales.

The Dialect of the Gypsies of Wales: being the Older Form of British Romani preserved in the Speech of the Clan of Abram Wood. By Dr. John Sampson. Pp. xxiii+230+419. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 84*s.* net.

THE majority of people are surprised when they are told that in almost every country of Europe, and even in America, there is spoken to-day a language which was brought out of India by a tribe or tribes between twelve and fifteen hundred years ago. This is the language of the people known to us as Gypsies, to themselves as Rom or the like, a word which phonologically is the exact equivalent of the modern Indian Ḍom, a general name for an outcast, so-called criminal tribe, who in many places act as scavengers and burners of corpses, and in all places are ready to augment their earnings by stealing or other anti-social practices. The Gypsies of Palestine and Syria still call themselves Dom, just as with them a spoon, *roi* in European gypsy, is *dowi* (and in modern Hindi *ḍoī*).

It has long been recognised that the speech of the Gypsies, which, as regards the European branch at least, differs comparatively little from country to country, is like the modern Indo-Aryan vernaculars of India—Kashmiri, Panjabi, Sindhi, Gujarati, Marathi, Hindi, Bengali, and the rest—descended from an old language of which we have the literary form in the language of the Rigveda and in Sanskrit. Consideration of its sound-changes and of its vocabulary makes it certain that the Gypsy language, or Romani, originally belonged to the same dialect-group as gave birth to the present central languages of India, such as Hindi. At a comparatively early period, however, which must be dated before the beginning of this era, they had wandered away to live for a time with the ancestors of the wild and little-known tribes of the north-west frontier, among the mountains of the Hindu Kush. Linguistically these tribes are very conservative in certain respects; and, being with them, the Gypsies preserved certain sounds and groups of sounds which were afterwards lost by those they had left behind in India proper. Whereas, for example, in India an original *t* or *d* coming between vowels was altogether lost, it is preserved in some form or other only by two of these north-western dialects and by Gypsy. European Gypsy keeps them under the form of *l*, Syrian Gypsy under the form of *r*. It is then of peculiar interest to note that, of the two north-western dialects which also preserve them, Khowar, spoken in Chitral, has *r*, and Kalasha, spoken farther south, has *l*. Thus the word which in Pali (a later form of Sanskrit) is *deti*, 'he gives,' is Hindi *de*, but Khowar *dŏr*, Kalasha *dali*, Syrian Gypsy *der*, European Gypsy *del*.

About A.D. 400 this region was disturbed by the Hun invasions of India. By them perhaps the Gypsies were set in motion towards the west. At all events, before A.D. 900 we find them in Persia, where various legends are related to account for their presence. A succinct account of their wanderings from here has been given by Dr. Sampson in a recent number of the *Journal of the Gypsy Lore Society*. Their path can be traced by the words which they picked up and adopted from the languages of the countries through which they passed. From Persia the Gypsies who changed original *-t-* to *r* migrated into Syria, from where some went north into Transcaucasia, others south into Egypt. Those, on the other hand, who changed *-t-* to *l* passed on into Armenia, where some remain until the present day; others, driven forward by the Turk inroads, migrated through Asia Minor into the Balkan Peninsula before the end of the eleventh century; and here it is that we first have definite historical record of this strange people. In Greece they stayed for a long period, to which also the numerous Greek loan-words in their language bear witness. But early in the fifteenth century—again before the threat of the Turkish invasion—they once more began their wandering. Their bands moved rapidly, and in a very short while they had appeared in almost every European country.

Wherever they went they were persecuted, and statutes were passed for their suppression and expulsion. It is therefore easily to be understood that it was greatly to their advantage to have a language which was not intelligible to their enemies. This doubtless was a powerful factor in the preserving of their old Indian tongue, despite the comparative smallness of their numbers and their wide separation both from the land of their origin and among themselves. Of recent times, however, and particularly in England, where they have never been very numerous, their speech has degenerated into a jargon, which is little more than a certain number of Gypsy words set in an English framework, with English grammar and English syntax. We may note, in passing, that the borrowing has not been entirely one-sided, and the number of slang words and phrases taken from Gypsy is probably considerable. One at least has acquired universal use: for the word 'pal' is English Gypsy *phal* (in which *ph* is an aspirated *p*, not *f*), meaning 'brother,' Continental Gypsy *phral*, and direct descendant of Sanskrit *bhrātā*.

Those readers (and fortunately they are many) whom the works of Borrow have acquainted with the Gypsies and their language, though already in a much degenerated form, will be astonished when they study the monumental work now before us on the language spoken by a Gypsy clan in Wales to-day. This is still really an Indian language, not a mere jargon. Students, not only of language and of the Indian languages in particular, but also of culture and folk-lore, owe a great debt to Dr. Sampson, both for his original discovery of Edward Wood, the Welsh Gypsy harper, at Bala in 1894, and for the enthusiasm and perseverance which has carried him through thirty-two years of patient collecting and sifting and arranging of stories and other linguistic material from this little Indian clan among the mountains of Wales, work which has at last resulted in a volume of more than 650 pages. It is by far the most complete and most accurate description of any Gypsy dialect that we possess. The first 230 pages are devoted to a description of the sounds, forms, and syntax of the language; the next 419 to a vocabulary, full of quotations, and precisely indicating the meaning and use of each word. If there is one part more than another to which we would refer as especially valuable, it is the pages which contain a minute and scientific description of the sounds of the language. We regret that it was impossible to include a certain number of texts, but presumably the already great size of the volume forbade a further addition. But those who are interested will find a large number of stories published by Dr. Sampson, with notes and translations, in the *Journal of the Gypsy Lore Society*.

In one respect only do we criticise Dr. Sampson's work adversely. Comparative philology, though almost the first impulse to its scientific study was given by that great English scholar and orientalist, Sir William Jones, has never been a plant of vigorous growth in England; and the languages of India, which Englishmen have had peculiar opportunity of acquiring, have suffered more at the hands of amateur philologists perhaps than any other group of languages. The scientific study of the history of the modern Indian languages is a comparatively recent growth, and the workers are still far too few. Gypsy, like the other Indian languages, has also suffered at the hands of amateurs. Some of its students have been famous linguists; but the greatest of them all, Miklosich, wrote before the fruitful ideas of the "Junggrammatiker" saw the light and changed the whole basis of the science of comparative philology. Dr. Sampson unfortunately yielded to the temptation to combine history with description; and throughout the book he attempts to trace the history of Gypsy from Sanskrit onwards. But though the science of language has made such enormous strides during the last fifty years, Dr. Sampson does not seem to have progressed beyond the days of Miklosich. Examples of this are to be found in profusion on almost every page. We will take two only, to serve as illustrations of our criticism.

Without a recognition of the principle of the constancy of so-called sound-laws, there can be no science of etymology. This principle is that a given sound in a given dialect will develop in the same way in all words in which it appears under the same conditions. Thus Sanskrit words containing intervocalic *-t-*, if they survive, will in Hindi lose the *-t-* altogether, in European Gypsy show it as *l*. An etymology which neglects this rule is at once suspect; and if it is to be upheld, some special reason must be sought, such as borrowing from another dialect or the like. But Dr. Sampson has no compunction in making etymologies which go contrary to well-established rules of Gypsy, and that without noting the fact or seeking for explanation. Thus it is a sound-law of Gypsy (and of nearly every other modern Indo-Aryan language) that original intervocalic *-k-* is lost: this is admitted by Dr. Sampson, who gives for example the Sanskrit ending *-ako*, which became Middle Indian *-ao* and Gypsy *-o*, or the Sanskrit *yūkā́*, 'louse,' which became Gypsy *juv*. Yet without hesitation he derives Gypsy *šukār*, 'quiet,' from Sanskrit *sukṛta-*, 'well done' (which in Gypsy would have become something like **suil*). It is, on the contrary, doubtless from Sanskrit *śukrá-*, 'bright, pure, clear.'

Secondly, Dr. Sampson compares Gypsy words not only with what he considers the Sanskrit originals, but also with their Hindi congeners. Now, just as French contains not only inherited Latin words (like *père*, derived from *patrem*), but also borrowed Latin words (like *paternité*, borrowed from *paternitas*), so too Hindi has both inherited Sanskrit words and borrowed Sanskrit words. If we wish to investigate the history of Latin sounds, say in Italian and French, we must compare the inherited Latin words in one language with the inherited Latin words in the other language, not an inherited word in one with a borrowed word in the other: we must compare Italian *padre* with French *père*, not with *paternité*. But Dr. Sampson, in countless cases, compares an inherited Gypsy word with a borrowed Hindi word: for example, he compares Gypsy *thulo*, 'fat' (connected with Sanskrit *sthūlá-*, 'strong'), not with, say, the inherited Nepali word *ṭhulo*, id., but with the borrowed (and only very literary) Hindi word *sthūl*.

Such an attitude and such mistakes invalidate the whole of Dr. Sampson's comparative work: it cannot be accepted as in any way a trustworthy guide. It is indeed a pity that this fine book, which is otherwise such a splendid monument to the author's scholarship, should be so marred. How far better would it have been if either he had followed his first intention (as expressed in the preface) and left the historical side alone, or by a much profounder study of comparative philology in general and Indo-Aryan philology in particular have fitted himself for the task of comparison with other Indo-Aryan languages. But since perfection is not attainable by man, we may be grateful that Dr. Sampson has given us a work which not many could have accomplished.

R. L. TURNER.

Ice Ages.

Ice Ages: Recent and Ancient. By Prof. A. P. Coleman. Pp. xliii + 296. (London: Macmillan and Co., Ltd., 1926.) 17*s*. net.

EARLY glaciologists wrote of 'The Ice Age,' next of 'The Great Ice Age,' and when it became obvious that there had been earlier refrigerations not inferior in intensity to the latest, of 'The Quaternary Ice Age'; now we have a glacial history of the earth, and from the hand of a master of the subject. Many of the glacial deposits described have only been discovered within the past few years; it is probable that many more will be found in the future, but Prof. Coleman presents enough material to enable us to form an idea of the distribution of glaciation both in space and time.

Deposits referable to ice are now known or suspected from nearly all the main geological formations, but many of them are of small extent and can be attributed to valley or at most piedmont glaciers. Major glaciations are known from the Lower Proterozoic or Huronian, the Upper Proterozoic to Lower Cambrian, the 'Permo-Carboniferous' and the Pleistocene. Minor glaciations are known or suspected at other levels in the pre-Cambrian (though owing to the difficulties of correlation it is not possible to say how many), in the Ordovician (North America and doubtfully in Europe), and in the Silurian-Devonian (Alaska, eastern Canada, Cape Town). The great 'Permo-Carboniferous' glaciation was manifested in five continents at least, but mainly in the southern hemisphere and in India; in strong contrast was the generally warm Mesozoic, from which only two glacial deposits are described, a tillite from central Africa west of Lake Tanganyika, probably Triassic but possibly older, and a Jurassic moraine from California, both probably formed by piedmont glaciers.

During the whole of the Mesozoic the sea-level temperature remained high, and the great cold-blooded reptiles were able to multiply and dominate the earth. Coleman attributes their sudden disappearance to a "slight dip in temperature at the end of the Cretaceous, too small to be called an ice-age." This slight cooling is indicated by the valley moraines of Cape Hamilton in the Antarctic and the Cordilleran region of North America; the ice-transported boulders of the Cretaceous of South Australia and England are not mentioned, presumably because they are attributed to shore ice and not to land ice. There may have been mountain glaciers in the Miocene of Iceland and Europe, but these were local, and the next great cooling occurred at the close of the Pliocene and still continues.

These phenomena offer a definite meteorological problem, which the author sets out clearly in words which are worth quoting:

> "Under normal conditions the world has a relatively mild and equable climate with no permanent ice at low levels even in the polar regions."
>
> "From time to time . . . there have been relatively short periods of cold accompanied by a great extension of mountain glaciers, and sometimes also by the formation of ice-sheets at low levels. In the most severe visitation of the kind ice-sheets invaded the tropics on three or perhaps four continents."
>
> "Ice ages are, in most cases, broken by interglacial periods of milder climate. Sometimes this occurs two or three or more times, indicating a comparatively rapid oscillation from cold to warm and warm to cold."
>
> "All parts of the world have their temperature lowered during an ice age, the tropics as well as the temperate and arctic zones."

The author then turns to the consideration of causes, but gives only a rather mechanical discussion of the various theories of climatic change which have been put forward from time to time. Wegener's theory of continental drift is mentioned, but without enthusiasm. Elevation perhaps comes nearest to a solution, but fails to account for world-wide cooling. The conclusion is that no single cause suffices; "some combination of astronomic, geologic, and atmospheric conditions seems to be necessary to produce such catastrophic events in the world's history."

The difficulty of the problem is increased by the apparently haphazard way in which glaciations have developed. Time and again the author comments on the paradox of field-work, especially on Permo-Carboniferous tillites, beneath an almost vertical sun in a temperature suggestive of anything but ice. On the other hand, so far as is known at present, the Antarctic continent escaped glaciation until the close of the Mesozoic, though of course the great Antarctic ice-sheet may hide traces of many older glaciers. The north-east of North America, where the Quaternary ice-sheets reached lower latitudes than anywhere else, has suffered glaciation over and over again. In the Upper Carboniferous this region bore glaciers which indeed pale into insignificance beside the contemporaneous ice-sheets of the south, but would be sufficiently remarkable in any other period. The same region was ice-covered in the Devonian, the Ordovician, at the close of the Proterozoic, in the Lower Huronian (a photograph shows the remarkable feature of a Huronian tillite smoothed and striated by a Pleistocene ice-sheet), and perhaps at two horizons in the Archæan —seven or eight glaciations in the same or neighbouring areas. Other regions which have suffered repeated glaciation are Alaska, South Africa, and south-east Australia, though South Africa was not glaciated during the Pleistocene.

It almost seems as if, given certain conditions, and especially a world-wide cooling, glaciers and even ice-sheets can develop in any latitude, but have a preference for certain localities. From this point of view it may be only an accident that the two great ice-sheets of the present day occur in high latitudes. Their formation is not entirely a matter of temperature, since we are faced by the idea that during most of geological time the polar regions were free of land ice even while lower latitudes were being glaciated. Apart from pole-wandering, the only theory which throws any light on this anomaly is Paschinger's, not mentioned by Coleman, that glaciation depends on the relation between the zone of maximum snowfall and the snow-line. It may be profitable to try to fit this theory to the facts before us.

As we go from the lowlands up the slopes of a mountain range, we find that the snowfall increases up to a certain level, above which it again decreases; this level depends mainly on the humidity and the temperature during the wettest season. Quite distinct, depending mainly on the summer temperature, is the snow-line. If the snow-line is above the zone of maximum snowfall, the glaciers will be small; if the snow-line is the lower, the glaciers will be large, and with sufficient snowfall may descend to low levels. In the moist equatorial regions the two zones are close together, and a small depression of the snow-line would produce a considerable extension of the glaciers.

It seems probable that glaciers or ice-sheets must always *originate* on high ground, but for a glacier to develop into an ice-sheet a large area of more or less level ground is required at a temperature low enough for the ice to spread out as a piedmont glacier. In high latitudes this land may be low, but in low latitudes it must be initially at a high level. Once the ice-sheet has reached a certain size, however, it imports its own climate, and the initially high plateau may be depressed nearly to sea-level without necessarily destroying the ice-sheet. There are several reasons for this; one of the most important is that a snow surface reflects four-fifths of the solar radiation falling on it, and another is that a large ice-sheet is naturally occupied by an anticyclone with outwardly directed winds. The relations between snow-line and zone of maximum snowfall probably depend on conditions of storminess and vertical temperature gradient which are due to general causes; when these are favourable, glaciers will form which may develop into ice-sheets in suitable localities, determined partly by configuration, which is independent of latitude, and partly by location relative to storm tracks and oceans. The latter proviso causes the repetition of glaciation in certain localities which are not necessarily the coldest parts of the globe. During the course of an ice-age the most suitable location may change, which brings us back to Coleman's speculation that the Greenland ice-sheet may represent the continuation of the eastward trend of glaciation in America, having commenced later than the American ice-sheets and persisting after them.

The author has done good service by uniting in one volume a large mass of material which was formerly only available in scattered papers or, in the case of his own observations, had not previously been published. The volume maintains the high standard which we expect of the publishers; it is lavishly illustrated by photographs of great interest, and the only error which the reviewer has noticed is the name "Grygalski" on page 286.

C. E. P. Brooks.

The Sylvester Programme in Algebra.

Matrices and Determinoids. By Prof. W. E. Cullis. (University of Calcutta: Readership Lectures.) Vol. 3, Part 1. Pp. xix + 681. (Cambridge: At the University Press, 1925.) 63*s.* net.

We are all familiar with Cartesian co-ordinates denoted by $[x, y]$, where two numbers written in an assigned order specify the position of a point in a plane. Unless $x = y$, the symbol $[y, x]$ denotes quite a different point. This simple geometrical illustration is enough to show that in pure algebra, quite apart from geometry, a pair of numbers (or indeed a whole row of n numbers) in an assigned order might be considered as a single entity A. Such an A is sometimes called a vector (if $n > 1$), but it is a special case of a matrix of rank one.

Yet, curiously enough, the more natural set of numbers to consider as a compound unit in algebra is not a row so much as a *square* arrangement of numbers. Nine numbers put in square formation, three by three, are what Cayley called a matrix of order three. Cayley first saw the value of treating it as a single magnitude. The reason is this: that matrices may be added, subtracted, or multiplied together and the result is always a matrix. This is not entirely true of vectors.

As a square is a special case of a rectangle, one may substitute for the idea of a square matrix that of a rectangular matrix of mn numbers, arranged in m rows and n columns. The author has taken this as his leading idea throughout the series of volumes, the third of which we have now reached. But the arrays

$$A = \begin{bmatrix} 1, & 2, & 3 \\ 4, & 5, & 6 \end{bmatrix}, \quad B = \begin{bmatrix} 1, & 2, & 3 \\ 4, & 5, & 6 \\ 0, & 0, & 0 \end{bmatrix};$$

show that the oblong case is really included in Cayley's square, since the actual properties of matrix A and matrix B are effectively the same.

The B matrix here may be extended to the fourth or higher order simply by fixing columns and rows of zeros to the right and below the existing square. All such matrices share with A the same rank: it is the *rank* of a matrix which is its most important feature. The rank of A or B here is two, and in general cannot exceed the smaller of m and n.

The work of which the bare elements have just been explained is founded on original ideas of three of our countrymen—Cayley, Sylvester, and H. J. S. Smith—and it dates from about seventy years ago. As so often happens in mathematics, work started in England has been brought to fruition abroad. So the work of Cayley was advanced almost out of recognition by Frobenius, and that of Smith by Weierstrass. Sylvester, who foresaw an important future for matrices, outlined a programme which has been systematically adopted by Prof. W. E. Cullis, who has done a real service to the mathematical world by carrying it out in all its breadth and detail.

The present book runs to seven hundred pages, yet it is only part of volume three. It is conceived in a spacious, leisurely spirit. There is something portentous in the massiveness of the structure. The author believes in his thesis, but is in no hurry to convince the sceptic or the ignorant. He promises in volume four a wealth of practical applications to analytical solid geometry, the theory of groups, dynamics, and the like, which will justify the patient elaboration of the preceding algebra. Everything is thoroughgoing and sound, and in fact volume three covers a larger field than its title implies. It is the only really complete account, in the English language, of many fundamental facts of algebra bearing on polynomials, factors, eliminants, and so on.

The book deals with three great branches of the matrix theory, as grouped round the conceptions of (1) *potent divisors*, usually called invariant factors (*elementarteiler*), (2) *commutants*, and (3) *invariant transformands*. The first of these is the difficult general theory governing the classification of algebraic systems illustrated at their simplest by the conic or the quadric surface, or a dynamical system of small oscillations. The second and third of these are bound up in the study of the respective equations

$$AX = XB,$$
$$AXB = X,$$

where A, B, X are matrices and X is the unknown quantity. Bearing in mind that ordinary algebra is the study of the simplest possible matrix, where $m = n = 1$, we have a clue to the interesting general case. Non-zero solutions exist provided A and B satisfy a specific condition analogous to $A = B$ and $AB = 1$ respectively, for this simple case.

Incidentally, a problem of Frobenius, to find the square root of a given matrix, is fully discussed.

The treatment of the work brings out forcibly the propriety of thinking of variables X and constants A in a relation

$$f(X, A, A', \ldots) = 0,$$

where X, A, . . . are matrices. The reader is brought to see how far-reaching are the ordinary conceptions of elementary algebra, such as the notion of solving an equation.

The book is not easy reading, in spite of the exceeding care taken to explain or prove everything. The reason is that the formal general case precedes special instances. Algebra is peculiarly adapted to the converse use: a chess board of nine or sixteen squares suggests most of the properties of a chess board of n^2 squares. Also several crucial results are disguised in small print.

The book has been carefully printed and contains few mistakes: one is only sorry that the Cambridge Press is unable apparently to do it full justice by returning to the use of the quality of paper or ink, or both, which go to make the first volume.

It may be added that the second name in the title is relatively unimportant in this volume. A determinoid bears to the rectangular matrix the relation which a determinant bears to the square matrix.

We are under a real debt to the distinguished author for this latest instalment of a mature and suggestive work, and we look forward to the promised further developments with interest.

Our Bookshelf.

Problems of Philosophy: an Introductory Survey. By Prof. G. Watts Cunningham. (Modern Thinkers' Library.) Pp. xxi + 453. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1925.) 8*s.* 6*d.* net.

THIS is a useful book, with a modestly misleading title. When a writer introduces 'problems of' or 'studies in' this or that subject, he is commonly taken to offer his own particular theories on a limited group of more or less connected topics. Prof. Watts Cunningham has a less personal and more generous and catholic intention. He writes, broadly speaking, about all the problems that there are, and with the utmost objectivity and detachment. What he gives us is, in effect, a guidebook to contemporary metaphysics, as clear and simple as it can well be made, and so skilfully compacted that the intelligent use of a table of contents and an index will conduct an inquirer's finger straight to the sections relating to any one of the major issues of current interest, and let him find there just how the controversy stands, and why it is where it is. That is no small performance—it has meant selecting and correlating the significant 'tendencies' of endless recent discussion, indicating the historical background of each question, and making plain the cruces of each decision.

The plan of the book is simple. Part 1 defines, partly by contrast, the scope of philosophy and the nature of its distinctive method. Part 2 examines some central problems in the theory of knowledge. Parts 3, 4, and 5 trace the evolution from matter to mind, taking the widest possible survey of what is involved in these terms. Part 6 discusses the nature and status of our experiences of 'value.' This bare indication of contents is perhaps all that need be given; for, all through, the writer is little concerned to recommend a theory, but rather to expose the issues, to show what considerations are relevant and what are the implications. Plainly enough, Prof. Watts Cunningham's own sympathies are with the idealist tradition; but his survey is thoroughly impartial in spirit and in execution. Nowhere, in the nature of the case, does it cut very deeply; but it very well points the ways.

H. J. W. H.

The Physical Chemistry of Steel-making Processes: a General Discussion held by the Faraday Society and the Iron and Steel Institute, June 1925. Pp. 167-296. (London: The Faraday Society, 1926.) 8*s.* 6*d.* net.

As Dr. W. H. Hatfield has said in the discussion before us, "there is to be found in this collection of papers by far the most weighty and valuable treatment of the subject of furnace reactions that we have had." Almost every phase of modern steel-making is dealt with, and, although the symposium reveals, as the chairman, Sir Robert Hadfield, pointed out, the many important gaps in our knowledge of the reactions which take place at these high temperatures and of the physical data necessary for their elucidation, the general feeling after reading the present volume will be that a distinct advance is being made in this important scientific and industrial subject.

The paper by McCance on "Balanced Reactions in Steel Manufacture," a continuation of earlier work by the same investigator, represents probably the most important single contribution yet made to the subject. Experimental confirmation on an industrial scale is necessarily a slow process, and there are clearly many points on which such proof is required, but the excellent manner in which all the threads hold together and the agreement with experimental fact, so far as has yet been found, offer good reason to believe that in time the confirmation will be obtained. "A Study of the Reactions of the Basic Open-Hearth Furnace," by Mr. T. P. Colclough, is another outstanding contribution. His contention that the influence of temperature is definitely subordinate to that of slag composition is of fundamental importance. Among the other papers, that on the reactions in the electric furnace, by Mr. F. T. Sisco, and another dealing with the general physico-chemical aspect of steel-making, by Mr. A. L. Feild, are well deserving of mention. To all those interested in any degree in the chemistry of the manufacture of steel, the volume is of the utmost importance and will be read with the greatest interest. F. C. T.

Science: an Introductory Textbook. By E. J. Holmyard. Pp. x+230. (London and Toronto: J. M. Dent and Sons, Ltd., 1926.) 4*s.*

MR. HOLMYARD is well known as one of the most active and vigorous exponents of the humanistic school of science teaching, and his viewpoint finds complete expression in this very entertaining and instructive volume. We could wish for nothing better than that the scoffer at the 'romance of science' should read it. For our part we found ourselves compelled to complete a first reading in one sitting. Mr. Holmyard's style is peculiarly happy and easy, and one feels that he thoroughly enjoyed his task. His object is to present science as a whole to the young beginner. He refuses to admit of barriers as between one branch of the subject and another, and in this he is right. Further, he has shown how it can be done. He enlists to his purpose the framework of the past—the Aristotelian scheme of the four 'elements' of air, water, earth, and fire, and after a historical introduction he deals with these one by one, and makes each the theme for a series of facts and phenomena of Nature. So we find simply and naturally interlocked a number of important and fundamental principles usually detached into separate 'subject' volumes. Finally, passing from the inanimate to the animate, the author presents a brief but interesting account of the phenomenon of life.

Naturally there is a serious danger of 'overdoing it,' but Mr. Holmyard has wisely preferred the errors of omission to those of commission. At the same time, we feel that the book would have been greatly strengthened by some short account of the astronomical scheme of the universe. In our view a general survey of science, even for the young beginner, definitely requires this, and its place is as pertinently at the beginning as is the study of life at the end.

The production by the publishers is, with the exception of some rather crude 'portraits,' very well done, and we have nothing but praise for a book that will commend itself to all interested in the teaching of science. I. B. H.

Life of Plants. By Sir Frederick Keeble. (Clarendon Science Series.) Pp. xii+256. (Oxford: Clarendon Press, 1926.) 5*s.* net.

AN initial embarrassment that confronts one who would become acquainted with the present achievements and aims of botanical science is the large number of books dealing with plants from which a choice may be made. The subject has been approached from so many points of view that curiosity is aroused as to wherein any new volume can differ from its predecessors.

Those who are conversant with the writings of Sir Frederick Keeble—who have read his fascinating "Plant Animals," for example—will not be surprised to find that the present book *is* different from those we already know. Excellent as many of the latter are in providing detailed and accurate information about plants, carefully and clearly though some of them are written, we have met with no book which succeeds in conveying to the same degree as does the present small volume the all-pervading importance of plants in the scheme of living things, or the wonder and romance of their activities.

The information is there also—the amount that has been packed into 250 pages is indeed astonishing—but the reader is given the impression of being led into a new country by roads which permit of ever more and more extensive views, the facts and arguments which border the road and define its direction never being allowed to grow into a hedge tall or dense enough to oppress the traveller or to obscure the surrounding prospect. Therein, perhaps, lies the one danger. The reader may be so enthralled by the scenery around him that he may be tempted to give insufficient attention to the details of the foreground. This omission can be made good, however, when the journey is repeated, as no doubt it will be more than once.

Few are the books which can justly claim to have completely fulfilled their author's hopes: fewer still those in which this or that modification would not seem an improvement to some reader. No doubt some will say that a rather disproportionate amount of space is given to Mendelism, or that the contrast between sporophyte and gametophyte phases, with the dominance of the latter in some groups of plants, has been insufficiently emphasised. Exception may also be taken by some to the wholehearted acceptance of hormones to explain the sensitive reactions of plants. Such, however, are but minor matters and do not affect the picture as a whole, which is surprisingly complete in view of the size of the canvass.

In the preface, the author pleads that we should judge leniently his failure to accomplish the task he set himself. If he has not succeeded in satisfying himself, he has earned the gratitude of his readers by giving them a delightful and stimulating book.

Comparative Philosophy. By Paul Masson-Oursel. (International Library of Psychology, Philosophy and Scientific Method.) Pp. vi+212. (London: Kegan Paul and Co. Ltd.; New York: Harcourt, Brace and Co. Inc., 1926.) 10*s.* 6*d.* net.

"COMPARATIVE PHILOSOPHY," by M. Masson-Oursel, gives the impression of a compilation. There is an introduction by Dr. Crookshank, a notice that Part II. has been translated by V. C. C. Collum, and a dedication to M. Lévy-Bruhl, whether by author or translator or editor does not appear. The book itself deals largely in generalities and is interspersed by a long table of comparative chronology and various bibliographies. There is nothing peculiarly original or even striking in the actual matter of the book, and now and then we come on fairly long quotations from the Greek which are left untranslated, although the book is scarcely designed to appeal only to scholars.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Classification of Research Work.

It has often been found difficult to discriminate between the different classes of work carried on by research laboratories. This difficulty is intensified when, for such purpose as the founding of an industrial research association, it becomes necessary to explain these differences before persons to whom such work had previously been an unknown quantity. In these circumstances the lack of an exact terminology can cause much confusion; three members of a committee can use the expressions 'fundamental,' 'pure,' and 'applied' research, when all three may nevertheless wish to imply the same thing. Such explanatory terms as 'deep-digging' and 'trouble-curing' are less unmistakeable, but they fail to convey shades of meaning.

One grouping which served a useful purpose was made by separating investigation from research proper. This gave the successive steps of pure research, fundamental research, applied research, investigation, invention, and routine. Here a distinction was intended to be drawn in the second instance between the pure research of a university laboratory, and research which is just as free to pursue its studies to any depth or intensity, without regard to their ostensible usefulness, provided only that they are restricted to material offered by the industry concerned. However, the nomenclature employed was confusing, but the writer eventually realised, while assisting to explain these meanings, that the conception of 'restriction' could be used to provide a very tolerable classification which was implicit in the whole discussion of the topic. Such a classification is almost obvious when research work is looked at from the organiser's view of an industrial research department, with its conjoint laboratories, workshops, and manufacturer's plant.

This classification may be illustrated by the mechanical analogy of degrees of freedom, such as those of a three-point support. The three essentials of any research for our present purpose are the Method, the Subject, and the Aim. Accordingly, as the research worker is left free to pursue his own course in each of these respects, or in so far as he is restricted to a limited choice of their possibilities, so we obtain eight separate classes of research activities, covering a very wide range.

The fundamental relation of the experimental method to the advancement of natural knowledge, observed by Francis Bacon, evidently sets the Method in a position of superiority over the other two. Consequently, such work as is done with its methods under restriction is, speaking scientifically, of a low order; such is the plain routine of works-control laboratories, or of a testing-room. On the other hand, the university laboratory is potentially unrestricted—finance excepted—not only in its methods, but also in the subjects studied, and in its aims; it is free in all three degrees, to use mathematics or glass-blowing, to study nebulæ or tadpoles, and to take its aim no closer than at the advancement of human knowledge. The testing-room is not only restricted to quick routine methods in making its tests, as also in the study of its statistical data, but its subject matter is restricted to such material as is manufactured or used in its own factory, and its aim is equally restricted to narrow and well-defined ends. Between these two lie six other possible classes, and it is interesting to see that they do actually correspond to most of the recognisable classes of research work. We will briefly examine them in regular order, though the reader will best draw his own examples out of his own experience.

(*a*) Freedom in Method, Aim, and Subject.—As already noted, this class is indubitably pure research, typified by that of the university.

(*b*) Freedom in Method and Aim, but Restriction in Subject.—This is what the most enlightened industrialists imply by the term 'fundamental research.' It consists in purely scientific study of such material as possesses industrial importance, and is undertaken to broaden the basis of knowledge upon which effort ultimately rests. A determination of the chromosome numbers in species of Gossypium for the cotton industry will serve as an example.

(*c*) Freedom in Method and Subject, with a restricted Aim.—For this class we might cite most of the work done on behalf of public health, which has one definite aim, though it studies mosquitoes or abattoirs, and uses statistics or string galvanometers.

(*d*) Freedom in Method only; Aim and Subject restricted.—The everyday research of most industrial laboratories falls into this class, which corresponds to the 'investigation' mentioned previously. It aims to effect paying improvements in specified materials and processes.

The next three classes are all restricted in the methods they may employ, and only possess freedom in the minor degrees. It will be seen that the latter are not in themselves sufficient permanently to characterise work as scientific research, and the examples are correspondingly vague. It is not in human nature to study without some speculation as to 'the good of it,' which provides an aim and alters the class. These three may be termed the 'unstable classes,' where true research merges into technicality, and 'gadgeteering.'

(*e*) Restricted in Method, but free Aim and Subject.—The usableness of a new discovery is investigated, such as Röntgen's rays, or the emission of electrons from a hot wire.

(*f*) Restricted in Method and Subject, but free to any Aim.—This class might be termed that of intelligent technical benevolence. It is obviously a temporary phase through which much research passes in the course of its development.

(*g*) Restricted in Method and Aim, but free in its Subject.—Most patented inventions deal with some particular way of achieving something; the invention itself may be applied to many different industries.

The remaining class is again clear-cut in its severe limitations.

(*h*) No Degrees of Freedom.—Testing rooms; works-control laboratories; such routine work as that done by junior assistants.

If it be agreed that these classes cover the whole range of pure and applied research, and that they differentiate between types of research which are not easily distinguished otherwise, it remains to provide them with terminology. Having regard to the varied meaning which has already been given to most of the available English words, it is perhaps better not to attempt to name each class, but to specify it when need arises as 'completely free (or restricted),' or else as 'free (or restricted) in (one respect) only.' This covers all the eight descriptions, if only one function is specified in the latter form.

For written notation we can use capitals and small letters. 'The MSa class of research' would be our class (*c*) above. It is for this convenience that the words subject and aim are used instead of material and object, or subject and object.

Using these notations it is possible to avoid a great deal of ambiguity when industrial research is under discussion, whether inside or outside the ranks of scientific workers. Further shades of meaning could of course be obtained by defining the amount of restriction, beyond the bare positive and negative here used, but it seems quite needless at present to do so.

W. LAWRENCE BALLS.

Rose Cottage, Meldreth,
Royston, Herts.

Science and Psychical Research.

PERHAPS I may be permitted to offer a few comments on Dr. R. J. Tillyard's article under this heading in NATURE for July 31. Dr. Tillyard's sympathy for the scientific men who take up the study of psychical research, and thus, as he complains, 'lose caste' and undergo persecution from their fellows, may appear pathetic, and his stated determination, in spite of all consequences, to join the noble army of martyrs, may even seem heroic. He may take comfort, however, in the reflection that, after all, Crookes's spiritualistic activities did not prevent him from attaining to that highest of scientific positions, the presidency of the Royal Society, nor to-day does Sir Oliver Lodge cease to remain highly honoured amongst all scientific men for his physical investigations, and especially for his pioneer work in wireless telegraphy, nor does he cease to be in the greatest request as an exponent of the most recondite theories in modern physics amongst all the best-known scientific societies and institutions.

Dr. Tillyard appears to be surprised at the attitude towards spiritualism adopted by most scientific men, but surely this is to be explained by just such expositions of the subject as Sir Arthur Conan Doyle's "History of Spiritualism." As Dr. Tillyard himself admits, psychical research is therein "most certainly very unscientifically handled." Indeed, this so-called history is no more a scientific book than its imaginative author's recent spiritualistic novel. It is replete with what has been rather aptly described as "determined credulity," and, like most of the fantastic and amazing literature that emanates from psychic bookshops, it trades on the credulous side of human nature, and especially on the emotions of those who, having lost friends who were dear to them, are distressed at the uncertainty of the survival of human personality, and, like the drowning man in desperation will clutch at any floating straw.

Dr. Tillyard makes light of the fraudulent aspect of spiritualism, and says that fraud exists in all branches of human affairs. I can offer no opinion upon the suggestion of biological fraud to which he refers, but speaking for physics, with which I am better acquainted, I cannot remember any case of such a kind worth mentioning during my lifetime. On the other hand, the whole history of spiritualism simply reeks with fraudulent deception. There appears to have scarcely been a single well-known spiritualistic medium who has escaped criticism of this nature. The pages of Sir Arthur Conan Doyle's book are filled with the achievements of spiritualists against whom fraudulent practices have been alleged, as it would seem to the unbiassed critic, on very convincing grounds, and quite a considerable portion of the history is devoted to explaining away these unfortunate lapses, the explanation in some cases consisting of the amazing suggestion that though evidence showed that the medium did cheat on certain occasions, on other occasions no signs of cheating on the part of this particular medium could be discovered, and therefore the manifestations produced must be considered to be genuine!

The fact is that the whole basis of spiritualistic investigation, as usually carried out, puts a premium on fraudulent practices. The so-called mediums that appear to be requisite in order to conduct the experiments, seem for the most part to be persons of inferior intelligence and education. Most of them are also needy, and eke out a precarious existence by payments for their services, which payments will only continue so long as they succeed in producing extraordinary manifestations.

Imagine for a moment research in ordinary physics made under such conditions as these, with the physicist unable to carry out his own experiments and make his own observations without dependence on the aid of assistants whose interests were all the time to fake the experiments and thus obtain startling effects, assistants, moreover, whose fraudulent delinquencies when discovered were excused and explained away, as seems to be the usual practice in the case of mediums caught cheating. Could any one have confidence in the accuracy of physical investigations carried out under such conditions?

But, says Dr. Tillyard, "we who have seen these things done under conditions precluding deliberate fraud, are not fools, but in full possession of keen faculties." Does he not know, then, that the experienced medium, just like the expert conjurer, both of whom prescribe to a large extent their own conditions, will fool the observer, however acute and scientific, nearly every time? Did he never, when young, attend at Maskeleyne and Cook's home of mysteries at the old Egyptian Hall in Piccadilly, and did he ever once find out how the marvellous phenomena there shown, admittedly by pure trickery, were produced?

How even the most distinguished scientific men can be deluded is evidenced by the well-known case of the "N" rays, for the discovery of which the French Academy of Sciences presented a gold medal to Prof. Blondlot, who, however, was neither a fraudulent medium nor a conjurer, but a well-known and highly respected physicist, who, as is now understood, was at the time of his discovery unfortunately afflicted by incipient insanity, from which he afterwards died. How the "N" ray myth was for ever exploded was recounted by Prof. R. W. Wood in NATURE, and is a case of genuine delusion that in the interests of truth should never be forgotten. It is a warning for all time demonstrating the extreme danger of accepting the objective reality of phenomena which, as is claimed, can only be observed, attested, or produced by particular individuals, such as so-called spiritualistic mediums, and not by all competent persons.

I have recently had some personal experience of spiritualistic methods which show how little reliance can be placed upon the support that Sir Arthur Conan Doyle gives to spiritualistic phenomena. Having read in the *Morning Post* that Sir Arthur had exhibited at the Queen's Hall a photograph purporting to be the ghost of the second Viscount Combermere, who was my uncle by marriage, I remembered that I had seen this photograph shortly after it was taken some thirty-five years ago, and that it bore no recognisable resemblance to the deceased Viscount, whom I had frequently seen and whose genuine photograph I happened to possess. I therefore publicly challenged Sir Arthur Conan Doyle to reproduce in the *Morning Post* the alleged ghost photograph alongside the genuine portrait, whereupon he appears to have suggested to the editor of the *Morning Post* that the ghost photograph could not be reproduced for technical reasons. This assertion was promptly refuted by the *Daily Sketch*, which—I having meantime obtained a copy of the ghost photograph—reproduced with great perfection both this and the authentic portrait in the issue of that paper for May 28 last. There these reproductions remain as evidence that any one can consult, and as I think all sane persons will admit, form a complete exposure of this particular spiritualistic myth.

Ex uno disce omnes.

A. A. Campbell Swinton.

40 Chester Square,
London, S.W.1,
August 9.

I would like to thank Mr. Campbell Swinton for his letter criticising my article on "Science and Psychical Research" in Nature for July 31 last. With what he says on the subject of spiritualism I agree almost entirely; but I had hoped that my article drew a clear distinction between spiritualism and psychical research. Unfortunately, the two are evidently confounded in Mr. Swinton's mind, though they are as distinct as, let us say, astrology is from astronomy, or alchemy from chemistry. If a physicist thought of taking up astronomy, would he read up a text-book of astrology to gain his first ideas of the subject? Or if he desired to study chemistry, would he begin with a history of alchemy? Yet this is just what such a man would be doing who thought to find in a book like Sir Arthur Conan Doyle's the elements of psychical research. Let me recommend to Mr. Swinton instead the careful perusal of Prof. Charles Richet's work "Thirty Years of Psychical Research."

That I in any way make light of the fraudulent aspect of mediumship I must emphatically deny. I think that the last sentence in the concluding paragraph but one of my article supports this denial. Mr. Swinton's remarks about mediums and psychical experiments show an entire misapprehension of the essentials of the problem. Mediums may be good or bad, just like chemical balances or microscopes, Some of them are below the average level of intelligence, others greatly above it; some may be paid for their services (and why not, when, like everybody else, they have to live?), and some never take a penny for the whole of their life's work.

These things, however, are entirely beside the point. In psychical research the medium is not one of the experimenters, as Mr. Swinton seems to think, but takes exactly the same place as the spectroscope in the study of light, or the microscope in the study of minute forms of life; that is to say, *the medium is the instrument through which the phenomena become objective to the experimenters*. Usually the medium is in deep trance and knows nothing of what is occurring. The only difference between the spectroscope and microscope on one hand and the medium on the other is that one is a man-made mechanism, the other a living being (if, as many materialists aver, both are merely mechanisms, then this difference vanishes). It is easier to control the mechanism than the living being, and that is why more stringent precautions are required in psychical research than in other sciences. If a spectroscope is found to give untrue results, it is thrown aside and a more trustworthy instrument is substituted; if a medium is found to be fraudulent, then the genuine psychical researcher will not proceed with him, but will endeavour to find a more trustworthy one. The spiritualists may make his apologia if they wish; that is no concern of psychical research.

Of all the great scientific men who have patiently and untiringly studied these phenomena—Crookes, Lodge, Richet, Flammarion, Wallace, Barrett, and others—can Mr. Swinton name a single one who has not become convinced in the end of their genuineness? On the other side we have either (*a*) some few who, having met with a fraudulent medium at the start, have adopted Mr. Swinton's motto *Ex uno disce omnes*, and have concluded, *without further investigation*, that the whole business was fraudulent, and (*b*) the great majority of scientific men, who have never experimented in the subject at all, but some of whom, nevertheless, consider themselves quite competent to pass a hasty judgment upon it. My article was simply a plea for a more scientific and logical attitude of mind from this second class. *Ex uno disce omnes* may be good Latin but it is bad logic; the hasty generalisation from insufficient facts is still, as always, the curse of modern science. A great teacher once chose twelve disciples; one of them turned out a fraud and betrayed his master. *Ex uno disce omnes*? Were all the apostles frauds because of Judas' defection? Surely not! If we must have a Latin motto, let us have a logical one, such as *Humanum est errare*; then, remembering that this applies equally well to physics, biology, or psychical research, let us make our dispositions for the detection and elimination of fraud and get on with the work.

If Mr. Swinton is really in earnest in desiring to do this, I would advise him to get into touch with my friend Mr. Harry Price, director of the National Laboratory for Psychical Research, 16 Queensberry Place, S.W. 7, and make an appointment to see over the laboratory. If his inspection proves satisfactory, perhaps he might even care to go further and arrange to be present at a sitting with a genuine medium like Stella C., when he might succeed in discovering the real reason for the peculiar behaviour of the thermograph during the production of psychic phenomena accompanied by cold breezes.

R. J. Tillyard

Zurich, Switzerland,
August 17.

External Capillary Action.

When a glass tube, 6·5 mm. in external diameter, 5 mm. in internal diameter and of any convenient length, one end of which has been drawn out into the form of a cone 55 mm. long with a hair-like apex 0·1 mm. in diameter and a correspondingly small aperture (Fig. 1 (1)) is filled with water containing, say, 1 per cent. of caustic soda, and held with its point downwards at an angle of 35° above the horizontal, a minute stream of water issues from its aperture, turns round underneath its lip and ascends to a distance of 33 mm. on its outer side in the form of a series of minute, disconnected, elongated globules which appear to encircle it. In flowing upwards these globules gradually lose their identity, and finally coalesce with each other to form a substantial drop at a point where the diameter of the cone is about 2 mm.

The drop encircles the cone symmetrically when the tube is vertical, but hangs from its lower side, as shown in (2) when the tube is held at an angle. After the drop has attained a weight of about 0·0113 gm.

with the tube shown, it breaks away from the influence of the force which has been holding it, sweeps swiftly down the lower part of the cone, carrying away the ascending globules, and falls from its apex. Immediately afterwards a similar series of globules begins to ascend and another drop is formed and falls away like its predecessor, and so on continuously. The weights of the drops and the rate at which they are formed vary with the angle of the tube, the magnitude of its aperture, the form of the cone, the magnitude of the head, and so on. With the tube shown in (1) a drop weighing 0·0113 gm. was formed every 2 m. 20 sec for 12 consecutive hours in one trial. (2) was photographed instantaneously while the globules were in the act of ascending the stem

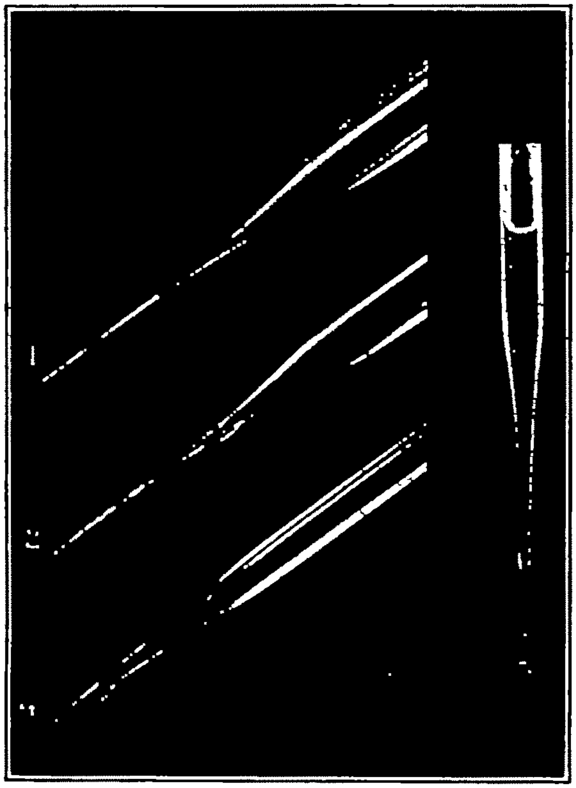


FIG. 1.—Scale, full size

With some tubes, and some heads, the globules run up the wet surface of the cone so rapidly as to make it quite impossible to count their number; with others, and in different circumstances, they follow each other at distances of several millimetres apart at a comparatively moderate rate, according as the head is greater or less.

(3) shows a tube held in a vertical position, (4) shows it held at an angle. In the former the drop encircles the cone symmetrically, in the latter it has gravitated round to the lower side.

The force which draws the water up on the *outside* of the cone in opposition to the force of gravity is obviously a function of the gradually increasing mass, and consequently of the gradually increasing attraction, of the cone.

The ratio of the weight of the salt to the weight of the decrement in the columns of solution of some salts is a *constant*. The ratio of the square root of the molecular weight of some salts (multiplied or divided by 1, 2, or 4), to the square root of the molecular weight of water multiplied by 4, is equal to the ratio of the weight of each of the same salts contained in its solution in water in a capillary column, to the weight of the decrement in water in the same column. W. GALLOWAY.

17 Park Place,
Cardiff.

Scattering of Electrons in Ionised Gases.

IN the November 1925 issue of the *Physical Review*, Langmuir published an investigation under the above title. From the collector characteristics of a mercury vapour discharge with a hot cathode, it was concluded that, in the tube, electrons must have been present with abnormally high velocities Langmuir expressly mentions that with these discharges no oscillations could be found. In several experiments which were made by me in consequence of this publication, oscillations could in fact be detected. In accordance with my results, summarised below, it does not seem impossible that the observed "scattering of primary electrons" is always accompanied and caused by these oscillations.

1. A small metal plate, connected to a crystal detector, was placed in the immediate neighbourhood of a tube, similar to the one used by Langmuir. A galvanometer, shunted by the crystal detector, showed a deflexion at the larger current densities, when the electron velocities became abnormal.

2. To screen off the influence of the glass walls a tube was built in which the anode completely surrounded the filament. Only a few small holes (diameter 0·5 mm.) were drilled in it, in front of a collector. In this tube also the velocities became abnormal at the larger current densities, when again simultaneously oscillations could be detected. With appropriate values of emission, anode voltage, and pressure, these oscillations could be brought on a Lecher system. As wave-lengths, values from 40 cm. to 100 cm. were obtained.

3. A similar tube was used for experiments with argon. Here also, under favourable conditions, the Lecher system could be used and showed wave-lengths of the same order of magnitude.

4. With the argon experiments under certain conditions of pressure, etc., it was observed that the steady state of the discharge was only reached a considerable time after the anode voltage was switched on. During the first few minutes, neither abnormal velocities nor oscillations could be observed. Then suddenly the final state was reached in a discontinuous way. At this moment, the electron velocities became abnormal (max. about 20 volts), and simultaneously the detector galvanometer showed a deflexion.

5. Finally, the relation between the abnormal velocities and the distance through which the electrons had gone was investigated. With a tube as described under (2) above, the collector of which could be moved, it appeared that the electron velocities did not become more and more abnormal with greater collector distances, but the reverse happened. This also is not in agreement with the explanation suggested by Langmuir.

A more detailed description of the experiments will be published in the Dutch periodical *Physica*.

F. M. PENNING.

Natuurkundig Laboratorium der
N. V. Philips' Gloeilampenfabrieken
Eindhoven, Holland,
July 27.

On the Law of Radiation.

THE view of physicists on the question of distribution of black-body radiation is that the equipartition principle cannot apply to the problem, and that "each step from matter to ether, or back again, demanded the quantum factor, and does demand it wherever such interaction occurs," as Sir Oliver Lodge recently expressed it in NATURE, June 26, p 891.

In the session of February this year I presented to the Pontifical Academy of Sciences, Rome, what I think is a new method of attacking the problem, on the basis of equipartition, with only the hypothesis that frequencies are distributed in the same way as velocities in Maxwell's law for gases

If we express the probability that frequency is between the limits ν and $\nu + d\nu$ by

$$\theta(\nu)d\nu = Ce^{-a^2\nu^2}\nu^2 d\nu,$$

where $C = \frac{4a^3}{\sqrt{\pi}}$, the corresponding number of oscillators will be

$$dn_\nu = N\theta(\nu)d\nu = \frac{4a^3N}{\sqrt{\pi}}e^{-a^2\nu^2}\nu^2 d\nu,$$

N being the total number in volume unit, and the density of energy in the emitting body, on the basis of equipartition

$$u_\nu d\nu = \chi TN\theta(\nu)d\nu = \frac{4a^3\chi TN}{\sqrt{\pi}}e^{-a^2\nu^2}\nu^2 d\nu.$$

Thence follows the expression for the emitted energy $k_\nu d\nu$; and assuming the Stefan law for totality of energy, it is easy to deduce $N = \frac{8\pi\sigma T^4}{\chi Tc}$, σ being Stefan's constant, and therefore for k_ν the expression

$$k_\nu d\nu = \frac{4a^3\sigma T^4}{\sqrt{\pi}}e^{-a^2\nu^2}\nu^2 d\nu.$$

In order to calculate the constant a we transfer the expression for k_ν in the corresponding E_λ through the relation $E_\lambda d\lambda = k_\nu d\nu$ and introduce Wien's law of displacement. The expression for E_λ becomes

$$E_\lambda d\lambda = \frac{4a^3\sigma}{\lambda^4\sqrt{\pi}}\lambda T e^{-\frac{a^2}{\lambda^2T^2}}d\lambda,$$

where a is Wien's constant multiplied by $\sqrt{2}$.

The law of distribution hence will be

$$F(\lambda, T) = \frac{4a^3\sigma}{\lambda^4\sqrt{\pi}}\lambda T e^{-\frac{a^2}{\lambda^2T^2}},$$

corresponding to Wien's condition, and containing only the Wien's and Stefan's constants. When λT is large the formula reduces to Lord Rayleigh's expression

The new formula agrees very satisfactorily with the measured energy distribution in the solar spectrum

G GIANFRANCESCHI.

Università Gregoriana,
Rome

The Electrical Polarity of Molecules.

ON attempting to correlate the electrical double-refraction (Kerr effect) of gases and vapours which has been measured by Leiser, Hansen and Szivessy, with the optical anisotropy of the molecules determined from observations on light-scattering, it is found that electrically polar molecules generally exhibit a Kerr effect which is very large in relation to their optical anisotropy. This indicates that the orientative action of the field on the molecule in such cases is chiefly due to the permanent electric doublet present in it, and is much larger than would be the case if the molecules were non-polar. In the case of molecules having an axis of optical symmetry to which the electric doublet is parallel, or is inclined at some known angle, it is possible to calculate the permanent electric moment from the value of the Kerr constant and the constant of depolarisation of the scattered light. Conversely, if the moment is known, the inclination of the electric doublet to the optic axis can be found. For example, in the case of the simple dipole molecule HCl, we may assume the optic axis to be parallel to the doublet.

The constant of depolarisation as recently measured by Ramanathan is 0·010, and the Kerr constant from the measurements of Hansen = $0{\cdot}90 \times 10^{-10}$. From this, considering the orientative action of the field to be due only to the permanent doublet, we find its moment to be $1{\cdot}06 \times 10^{-18}$ electrostatic units, while if the orientative couple on the induced doublet is also taken into account as in the case of non-polar molecules, the value of the permanent moment comes out to be $1{\cdot}04 \times 10^{-18}$. The recent determination by Zahn from dielectric constant measurements gives $1{\cdot}03 \times 10^{-18}$, thus showing good agreement

When the optical ellipsoid of the molecule has three unequal axes, measurements of the factor of depolarisation and of the Kerr constant are by themselves insufficient for an accurate determination of the electric moment. But if the moment is known from measurements of the dielectric constant, the data mentioned are of much assistance in fixing the position of the axis of the doublet. For example, if the Kerr constant of a substance is negative, we can assert definitely that the axis of the permanent doublet does not coincide with the longest axis of the optical ellipsoid. It is interesting to note in this connexion that, so far as is known, all substances having a negative Kerr constant are polar.

C. V. RAMAN.
K. S KRISHNAN.

210 Bowbazaar Street,
Calcutta, India.

Depth of Origin of the Earthquake of August 15.

THE earthquake of Sunday morning, August 15, was one of those for which no method of determining the depth of origin had been devised until recently, and offers an opportunity for applying that which was published in the *Quarterly Journal of the Geological Society* for February last. The extreme limits of the area over which the shock was felt appear to have been Llandrindod Wells and Blackheath, which are about 150 miles apart; the maximum violence seems to have just about reached the lower limit of VI° of the Mercalli scale, or an acceleration of about 150 mm./sec.^{2} Applying the coefficients in the paper referred to, the resulting depth of origin is not far from thirty miles. This estimate is based on the newspaper reports and subject to correction when more precise data are available. The maximum acceleration may have been more than the figure adopted, the limiting value of acceleration, of a shock which is just sensible in England, may be less than the 20 mm/sec.^{2} adopted, and either of these would lessen the resulting depth of origin. On the other hand, the description of the shock at the limiting stations suggests that it must have been sensible even beyond them, and this would give a greater depth Taking all these circumstances into consideration, it seems probable that the earthquake originated at a depth of some 25 to 30 miles, say 40 to 50 kilometres, below the surface of the ground.

R. D. OLDHAM.

The Groma: an Ancient Surveying Instrument.

A FEW weeks ago, while looking through some miscellaneous objects at the premises of the Egypt Exploration Society, I discovered a portion of a groma, an ancient surveying instrument, commonly used in Græco-Roman times for setting out straight lines and directions at right angles, in building operations as well as in land instruments.

There are several references to this instrument in the literature, but the only other specimen known was one unearthed at Pompeii in fragments in 1912. This was reconstructed by M. Della Corte and a model is in the South Kensington Museum There is a representation of a groma on the tombstone of a Roman 'Mensor' found in the neighbourhood of Turin

The portion now brought to light consists of two roughly shaped pieces each about 12 inches in length, formed of the centre rib of a datepalm leaf, bound together at the centres by a lashing of datepalm fibre, forming a loop for suspension. Near the ends of each piece are in-cuts to locate the plummet strings which were suspended from the ends.

So far as is known, this is the first specimen of the kind known, and special interest attaches to the fact that it came originally from Egypt, having been brought from the Fayum in 1899. Since then it has lain unrecognised among the Museum surplusage in the Society's basement. It probably dates from the Græco-Roman period and may be a tomb model.

The specimen has been acquired by the South Kensington Museum authorities and will shortly be exhibited there.

R. W. SLOLEY.

Amersham,
Bucks.

The Absolute Density and Coefficient of Expansion of Silicon Tetrachloride.

IN a recent paper on "A Comparison of the Atomic Weights of Silicon from Different Sources" (*Jour. Chem. Soc*, 1926, 128, 1262) the density of silicon tetrachloride from different sources was determined by means of glass floats. These were calibrated at one temperature and used in the actual measurement at another, but in making the calculation we omitted to take into consideration the alteration in volume of the floats consequent on this change in temperature. After we had instituted inquiries for a trustworthy coefficient of thermal expansion for the 'Durosil' glass used, in order to correct the reported figures, we received a private communication from Mr. A. G. Milligan pointing out this omission, which leads us to take this early opportunity of publishing a provisional correction. Applying the probable value $14{\cdot}1 \times 10^{-6}$ for the cubical expansion of 'Durosil' to the data already published (*loc. cit*), the mean density and coefficient of thermal expansion of silicon tetrachloride become $1{\cdot}481461 \pm 0{\cdot}000020$ and $0{\cdot}0014048 \pm 0{\cdot}0000022$ respectively. We hope to publish elsewhere a complete résumé of the densities, etc., when our inquiries have yielded a trustworthy coefficient of expansion for this glass.

It should be noted, however, that the application of this correction to the five densities in question makes no alteration in their relative magnitudes, and thus leaves unaffected the essential conclusion of our paper (*loc. cit.*).

P. L. ROBINSON.
H. C. SMITH.

Armstrong College,
Newcastle-upon-Tyne,
July 30.

The Movements of Molecules.

IN a very interesting little book on phosphorescence by T. L. Phipson, Ph.D., published in 1866, on p. 184 he says: "We have no proof that the molecules of bodies vibrate in straight lines; their motion is more probably circular. Indeed, my ingenious friend, M. Porro, has endeavoured to show the great resemblance which seems to exist between these molecular movements and those of celestial bodies; and it has been supposed by some philosophers that the molecules of matter are as distant from each other, in proportion to their size, as the planets themselves" "But in the present state of knowledge, all these considerations are premature."

Ignazio Porro (1795–1875) was a French physicist who made improvements in the binocular telescope, the telemeter, and other optical instruments. It would be interesting to know if he had any inkling as to the existence of moving particles or electrons in atoms. I have looked through the list of his published papers given in the Royal Society Catalogue, but did not see any titles which appeared to bear upon the subject; perhaps some readers of NATURE may know of some which do.

A. LIVERSIDGE.

Fieldhead,
George Road,
Coombe Warren,
Surrey.

Pernicious Grafting.

To reply fully to the question asked by Dr. Grabham in NATURE of July 17 would entail a much greater demand upon the space available than the subject would at present appear to justify.

A study of the question as set forth by Dr. Grabham immediately suggests to the practical cultivator that root control would remedy the evil: nobody expects the best results from peach or nectarine trees grafted on any stock unless systematic root pruning is practised, and from the tendency of the wild 'individuals' in Madeira to flower before the fall of the leaf one adduces the fact that there is a lack of sympathy between stock and scion; therefore root pruning might be the means of modifying the flow of 'incompatible' sap to the need of the cultivated variety at that period. Moreover, a cool moist condition of the soil during the winter being essential to successful peach cultivation, it may be necessary to adopt means of providing these conditions in Madeira, as well as a careful selection of root stocks.

W. M. MACDONALD.

14 Canongate,
St. Andrews, Fife,
July 23.

The Relation between Cultivated Area and Population.[1]

By Sir DANIEL HALL, K.C.B., F.R.S.

RECENT considerations of the problem of the capacity of the world to continue to feed its growing population appear to have begun with the late Sir William Crookes's address as president of the British Association when he discussed the ultimate curtailment of the wheat supply through exhaustion of the soil nitrogen. Crookes's views attracted little more than academic attention at the time (1898) because the great tide of wheat that was setting in from the newer countries still in the process of exploitation was barely slackening; moreover, Crookes had neglected a factor then imperfectly appreciated—the fact that land under any of the conservative systems of farming adopted in the old settled countries does not become exhausted. Generally speaking, a soil will remain itself indefinitely at a certain level of production. Latterly in Europe that level has been raised by the introduction of extraneous fertilisers. In his review Crookes predicted the development of the synthetic processes of bringing nitrogen into combination which are to-day rendering that prime element of fertility so abundant and so cheap.

Though we no longer fear the exhaustion of soils, of late years certain sociological considerations have revived interest in the old thesis of Malthus. Over-population and unemployment have become terrible realities in Great Britain and other countries; many States are finding themselves under pressure to maintain their standard of living against the intrusion of neighbouring races propagating recklessly down to the barest margin of sustenance. Again, various studies of the course of prices of wheat have led to the conclusion that before the War the real price was rising continuously, and that this tendency is manifesting itself again, however much the true sequence of prices has latterly been obscured by fluctuations of currency.

These considerations led Mr. Keynes to envisage the approach of scarcity: his attitude is very much a return to Malthus. On the other hand, Sir William Beveridge, addressing the Economics Section two years ago, dismisses this fear as regards the world at large; whatever may be the troubles in Britain, "the limits of agricultural expansion are indefinitely far." On the whole that seems a very safe proposition; it has been so amply fulfilled for the last hundred and fifty years—during the greatest expansion of population the world has ever known—that it would almost seem to be necessarily true, especially as it can be buttressed by agricultural experiments showing the enormous potentialities of production from the soil.

There is, however, one aspect of the case that appears to have received insufficient attention: the capacity of agriculture to provide food for the people depends upon the extent of land available as well as upon the pitch of cultivation. To what degree can the tuning-up of methods be made to compensate for a non-expanding acreage? The first step towards a more exact consideration of the problem may therefore be an estimate of the amount of cultivated land that is required to maintain one unit of population—man, woman, and child.

We may make our estimates by either of two methods—abstract or actual. The Food (War) Committee of the Royal Society adopted the figure of 2618 calories as representing the minimal daily energy requirement of one unit of the population, and calculated that the actual United Kingdom consumption in the five years 1909–1913 amounted to 3091 calories per head per day. An average English acre of wheat yielding 32 bushels will produce food, in the shape of wheat, flour, and pig obtained from the offals, of a calorie value of about 2½ millions. As the average consumption was about 1·13 million calories per head per year, we arrive at the conclusion that one acre of wheat would support more than two head, the relationship being more exactly 0·45 acre to feed one unit of population. But this figure is of no service in our more general consideration. The yield of wheat of 32 bushels per acre is far above that of the wheat-producing areas, and is that of only a few selected countries growing but a limited acreage. It is again the produce of land under the plough, and is consumed in the main as a vegetable product.

The great areas of grassland have a lower output of energy than the cultivated land, and the conversion of vegetable into animal food, whether of natural or cultivated fodder crops, is always attended by a great waste of energy. In the most economic production of pig-meat or milk, the energy recovered is only about one-sixth of that consumed, and this represents the machine at the top of its efficiency. The longer period of beef production results in a recovery as beef of only one-eighteenth of the energy consumed, and in practice the actual wastage of fodder and feeding-stuffs doubles or trebles the inevitable losses by conversion. Moreover, just as man is not a vegetarian making the most of the mere sustaining power of the land, so he does not use the land for food alone, but also for drink, for wool and fibre and other industrial materials, and for amenities.

We shall not get far on the theoretical basis, and I have only mentioned it as indicating the order of the superior limit of the maintaining power of land.

THE UNIT OF MEASUREMENT.

We must approach the question in a more empirical fashion and endeavour to ascertain the existing relation between the land in use and the people fed by it. Taking again the estimates of the Royal Society's Committee, it concluded that the United Kingdom production of food for the five pre-War years was 42 per cent. of the food consumed; 46·7 million acres of cultivated land then produced 42 per cent. of the food consumed by a mean population of 45·2 millions, which works out to 2·5 acres to each unit of the population. This figure, however, is somewhat misleading in that it does not do justice to British agriculture, since our farming is to a considerable degree concentrated on the more costly elements of diet like meat or milk rather than upon cereals and sugar. For example,

---

[1] From the presidential address to Section M (Agriculture) of the British Association, delivered at Oxford on August 9.

49 per cent. of the food production at home, as against only 24 per cent. of the imported food, consisted of animal products.

The importance of this relation between cultivated area and population is so great, and the calculations by which it can be ascertained are so approximate and subject to so many estimates of a speculative kind, that I may be allowed to set out various results obtained by different methods.

We may begin by comparing population and area of cultivated land for all European countries except Russia, to which we add the United States, Canada, Argentine, Australia, and New Zealand, as the white countries which are also the chief exporters of food to Europe. I exclude all oriental countries because in them the mass of the population possesses a different standard of living, and I have excluded the other South American States and the Union of South Africa and other African colonies because they all possess a very large 'native' population and their exports do not bulk large in the food account of Europe. We must recognise, however, that the errors in the calculation will be loaded on to one side, because all the unenumerated countries, Russia and the tropical lands, are to a greater or less degree exporters and not importers of food. However, with this proviso we find that in the States enumerated there are 464·1 million hectares of land under cultivation and a population of 481·5 million persons, or 2·4 acres per head.

In the United States about 356 million acres are in cultivation: from this may be deducted as producing exported materials, for cotton 24, for wheat 16, for maize 3, for meat products 22 million acres, or 65 million acres in all. Other products are exported but may be regarded as balanced by imports, so that we find 291 million acres of cultivated land devoted to supplying a population of approximately 112 millions, or 2·6 acres per unit of population.

France we know is a country that is largely self-supporting; it has a population of 39·3 millions and 36·3 million hectares under cultivation. To this acreage we must add 0·9 million for imported wheat, 0·5 for other cereals, and 1·1 for imported meat; the exports of wine and fruit we may regard as balanced off by other imports. The net result is approximately 1 hectare, or 2·4 acres, for each head of the population.

A similar calculation applied to Spain, a country in the economy of which neither exports nor imports of food play a large part, gives more than 4 cultivated acres per unit of population; but then the so-called 'cultivated' land includes a considerable proportion of mountain pasture of a very low order of productivity. On the other hand, Denmark, with the most highly developed agriculture of all countries, shows a production well above the average. A much closer calculation of production is possible for Denmark than for other countries—the data are set out in Mr. Harald Faber's paper before the Royal Statistical Society in 1924. Denmark is a country exporting agricultural produce chiefly in its most costly form as meat, butter, and eggs, but the means for equating the export against consumption is supplied in Mr. Faber's paper by the reduction of production and imports to food units. Making the necessary corrections for imports, it would appear that for the years 1909–1913 the population of Denmark was maintained on 63 per cent. of the production of her own land, or 1·82 acres per person.

Putting the various estimates together, we arrive at the conclusion that under the existing conditions of agriculture among the Western peoples, it requires something between 2 and 2½ acres of cultivated land to supply the needs of one unit of population living on the standard of white peoples.

We may confirm this estimate by a consideration of the growth of population during the last century. Between 1800 and 1920 the number of the white peoples increased from about 200 millions to about 700 millions. Data, however, for the land under cultivation in 1800 are very imperfect, and again there was another factor of improved agriculture which came into play in the first half of the nineteenth century. If we take 1870 as our jumping-off point, we may estimate the increase in the white man's numbers up to 1920 as approximately 225 millions. During the same period the addition to the cultivated lands in Europe, United States, Canada, Argentina, Australasia, and South Africa, the countries which have provided the white races with food, has amounted to about 450 million acres. Again we reach a relation between cultivated land and population of between 2 and 2½ acres per head.

This brings me to the central point of my argument, that an increase of population is in the first instance dependent upon an increase in the area of cultivated land. The expansion of the white peoples in the last century was an event unprecedented in the world's history, and was achieved only because of the vast areas of unoccupied land, chiefly in the Americas, which suddenly became available for settlement through the power conferred by the railroad, the steamship, and modern weapons. It will be noticed that the population of Europe previously had become comparatively stable, even as it has become approximately stabilised in France at present—the expansion came with the opening up of the new lands and in proportion to the amount that could be settled.

ENERGY VALUE OF PRODUCE.

Accepting as a basis for further discussion that under the present system of agriculture something more than two acres of new land will have to be brought under cultivation for each unit of increase in the population, we may examine if any means exist of modifying this relationship before considering its consequences.

I have already suggested that a vegetarian diet is the more economical of the resources of the soil, and that meat and all animal products like milk and eggs are produced with an expenditure of energy which may be so low as seven but also so high as twenty times the energy available from them. It is true that to a certain extent the animal will utilise material otherwise of little service to man, like milling offals and low-grade fodder crops—roots, hay, or straw. None the less, if the maximum of population supported by a given area of land is the objective, vegetarianism becomes increasingly necessary, as we see among the crowded populations of India and China. At the same time, the tillage of lands now given up to the grazing of animals becomes possible because of cheapness of labour resulting from a redundant population. Most of the beef and mutton supply comes from land left untilled because of the costliness of labour relative to products; the meat may represent a very low level of production from the land and yet a high cash return for the labour expended. Hence the apparent paradox of grazing being general in Middlesex because of the proximity of London.

Another item of waste which would have to be eliminated in case of stern necessity is the conversion of potential food into alcoholic drink. Great Britain ferments the equivalent of one and a half million acres of barley. France devotes 4,000,000 acres, nearly 4·5 per cent. of her cultivated area, to vineyards. Without going so far as to say that beer or wine possesses no food value, it is certainly not half of that which could have been grown from the land thus used for the production of drink. In such matters it is vain to prophesy, but I cannot help feeling that the race (not individuals) which cuts out meat and alcohol in order to multiply is of the permanent slave type destined to function like worker bees in the ultimate community.

INTENSIFICATION OF PRODUCTION.

The second question that merits very careful consideration is whether the current agriculture cannot be intensified so as to bring about a great increase of production from the existing area of cultivated land. A cursory examination of the average yields of our chief crops in different countries shows what an immense potential increase of production is here open. The average yield of wheat (1921 to 1924) for all the countries of the world collecting statistics was 13·2 bushels per acre; the average yield in Denmark for the same period was 41·4 bushels per acre—more than three times as much. Of course the area devoted to wheat in Denmark is about 200,000 acres in all, or 3 per cent. of her arable land, whereas the wheat acreage of the world amounts to about 250 million acres. The mass production of wheat in the world is from countries of low yield; more than half is grown in countries in which the average yield is less than 13 bushels per acre.

It is from these countries with the low yield per acre that wheat is exported, and their production determines the world market, with the consequence that wheat production has been increasing in these and similar countries, while it has been shrinking in the European countries with a higher yield per acre.

The dominating factor has been cost of labour; speaking broadly, it may be said that increased yields per acre are associated with higher expenditure per bushel for labour, and the great wheat-producing countries with a low yield per acre are the countries with a correspondingly high yield per man employed. It may be estimated that in England a man's labour produces about 960 bushels of wheat, in Australia 1500 bushels. A more exact comparison shows that in England the labour cost amounts to 1*s.* per bushel of wheat, against 8*d.* in Canada; this with an average wage rate of 30*s.* to 36*s.* a week in England as compared with 60*s.* in Canada.

All this goes to show that intensification is only to be purchased at the cost of labour, and that in the past, extending the cultivated area has been a cheaper way of getting the wheat required by the world than higher farming.

This general statement, however, does not tell the whole story; particularly it disguises the intensification of yield that may be obtained without a commensurate increase of labour. For example, the introduction of more heavily cropping varieties, originated by the skill of the plant breeder, may add greatly to the production from a given area without increasing costs other than those of harvesting and marketing.

One must not, however, expect too much of the plant breeder. Over the greater part of the cultivated land of the world the gross amount of production is limited by external factors such as water supply, temperature, available fertility of the soil, etc. For example, the wheats and barleys grown in England had long been subjected to selection and improvement before the scientific methods of plant breeding were evolved, and the further steps in improvement are going to be neither big nor easily won, depending as they do upon altering what Dr. Beaven has called the migration ratio, whereby the plant will convert more of the material obtained from the air into useful grain and leave less as straw. The chief opportunities, in fact, lie in the elimination of susceptibility to disease or destruction by frost, or general tenderness of constitution, by which means the range of the high-yielding cereals, or even of cereal growth at all, may be enormously extended.

ARTIFICIAL FERTILISERS.

The general enhancement of production by processes which induce improvements of the water supply or the temperature, as by irrigation and drainage, soil amelioration, cultivations, etc., suffers from the disadvantage of calling for labour, until it may prove far more costly than the increased produce can repay. Fertilisers appear to offer more promise. It may be recalled that the general level of production from English land was raised by nearly 50 per cent. between 1840 and 1870. At the beginning of the period the average yield of wheat was of the order of 20 bushels per acre, this being the crop the land was capable of maintaining under a conservative rotation with no extraneous source of fertility. But between 1840 and 1870 artificial fertilisers were introduced and became a generally accepted part of British farming, with the result that the yield of wheat had risen to about 30 bushels per acre, though no other marked change in the routine of cultivation had been adopted during the period. The employment of fertilisers still lags far behind the opportunities of employing them to profit.

The various processes of bringing atmospheric nitrogen into combination, to which the War gave such a stimulus, are now being developed on a vast scale in all civilised countries, and will result in an almost unlimited increase in the amount of nitrogenous fertiliser available at low prices compared with the prices of agricultural produce. Here at least is the opportunity for another step up in production from our cultivated lands comparable with the progress that was made between 1840 and 1870. It is not all plain sailing; the farmer has to study carefully where an increased supply of the cheapened nitrogen can be most suitably applied to his land and what changes in his system of cropping are demanded. The plant-breeders' art is needed; on most of our land any great enhancement of growth of cereals brought about by the use of nitrogenous fertilisers is attended with the danger of lodging. Few of our cereals possess stiff enough straw to remain standing on a soil enriched to the degree even that is reasonably practicable to-day. Thus the more immediate outlet for the new fertilisers would appear to be the fodder crops which are convertible into meat and milk.

In the solution of the main problem under discussion—the possibility of intensification of production from the existing farmed land to meet the needs of a growing population—the development of the synthetic nitrogen fertilisers must play a dominant part. Crookes's prophecy is coming true.

THE ECONOMICS OF PRESENT-DAY AGRICULTURE.

The present annual increment in the white population may be estimated at about five millions. This, taken alone, would necessitate the taking into cultivation of twelve million acres of new land every year. No process of the kind is going on; indeed, for many crops there has been an actual shrinkage in the acreage since the War. The shrinkage is doubtless no more than a temporary matter, the back-water of the wild fluctuations of prices and values brought about by the War, but it does not promise well for that continued expansion of the cultivated area which the still growing population demands. Indeed, we may detect a new influence at work, the growing disinclination of the civilised peoples to continue in agriculture because of its small and uncertain returns as compared with those of other occupations.

The flight from the land is manifest equally among the wage-earners of large-scale agriculture and among the peasants or family farmers in whose hands resides the greater part of the cultivation, whether in the old settled countries of Europe or the newer exploitations of America. Again and again it must be urged that the determining cause is economic; for the last half-century, save for the abnormal War years, farming has not paid a return on the capital and labour expended comparable with that obtainable elsewhere. It has been said that even the American farmers of the Middle West, who cut prices for all the world, made no profits during the last half-century except those derived from the accretion of land values; and the peasant farmer, who counts neither the capital he has in the business nor the hours of labour he gives to his land, who in Europe is held to the land by secular tradition, finds agriculture unattractive so soon as the growth of industries and the spread of communications render an escape possible. If not the peasant himself, at least the sons look for an easier and less exacting mode of life.

At this stage it would be impossible to begin to diagnose the causes of the comparative unprofitableness of agriculture. Fundamentally it is due to the weakness of the farmer as a commercial unit; the smaller the farmer the more ruthlessly does he compete with his neighbours and reduce prices to a bare level of sustenance for his long hours of labour. Even the large farmers who can put into practice some of the economies of an ordered industry are helpless against the large commercial organisations which pass on their produce to the customers. Always there is the peasant farmer to cut prices.

I cannot, however, pursue this issue. I return to my original text: that if we are to continue to feed the growing population of the world on the present methods a continued expansion of the cultivated area is required; new land is called for year after year. I cannot see where this new land of the necessary quality is to be found in quantities commensurate with the immediate demand. Doubtless the white races will insist on maintaining their rising standard of living and will apply deliberate checks to their fertility, a process we already see in action. But the restriction of increase will not take effect all at once even under economic pressure, and the danger lies in the period preceding the comparative stabilisation.

As it cannot be supposed that the development of the civilised races can be allowed permanently to be checked by lack of food when food is obtainable, it follows that resort must be had to the intensification of production from the area already under cultivation. The means for that intensification are already in sight, more will be supplied with the advancement of research. Intensification, however, is in the main attended by a higher cost of production, and movement in that direction is likely to be slow until it is stimulated by a rise of prices. Organisation will have to be introduced into the industry, and it may be expected that organisation will take one or other of three forms. The farmer may be left as the producing unit, but his methods will be strictly controlled and standardised by the great selling corporations that handle his produce, and these corporations may be either commercial ventures or co-operative associations of the farmers themselves. The co-operative venture appears to imply an even more rigid discipline of the individual than that imposed by the capitalist firm. Alternatively, the capitalist may venture upon the direct exploitation of large areas of land and industrialise farming as he has industrialised other producing businesses. But capital will only be tempted back to farming, whether for the organisation of the business or even to enable the individual to take advantage of the possibilities of intensification, if prices rise to a definitely remunerative level.

I hope I have given reasons for supposing that prices must rise, because the surge in population set up by the unprecedented extension of the cultivated area last century cannot all at once be checked, whereas the new land still available is either inadequate in amount or unsuited to cheap production by the old methods. How close at hand the period of pressure may be it is unsafe to prophesy, but it may be agreed that pressure is sooner or later inevitable and that one of the biggest problems before the world at present is to prevent the pressure developing suddenly or becoming unbearable. The intensification of production is the only remedy, and, again, the only means of rendering intensification practicable is the continued pursuit of scientific research.

The Rate of Work done with an Egyptian Shadouf.

By Dr. J. S. HALDANE, F.R.S., and Dr. YANDELL HENDERSON.

THE shadouf is a man-power apparatus which from time immemorial has been used in raising water from the Nile or from canals, etc., for local irrigation purposes in Egypt. Great numbers of them can be seen in operation throughout all parts of Upper Egypt, and there appears to be little tendency towards their displacement by power-driven pumps.

With a shadouf water is lifted, usually about ten or eleven feet, in a goat-skin bucket, and delivered into a water-channel at the higher level. During low Nile in Upper Egypt, three shadoufs, or pairs of shadoufs, working in series, are commonly employed to lift water from the Nile level to that of the adjoining land. The bucket (Fig. 1) is carried on a wooden hook lashed to a light upright pole of tamarisk wood. This pole is attached at its upper end by rope to one end of a light beam made from a branch, or two branches lashed together, of acacia wood, which is sufficiently strong and rigid to support the weight of the bucket without much bending. At about three-fourths of the distance to the lower end, the beam is pierced by a hole through which passes a wooden pin on which the beam is pivoted. This pin is suspended by short cords from a stout wooden bar, of which the ends rest on two upright pillars consisting of either wood or maize-stalks and dried mud. Round the other end of the beam is plastered a globular mass of dried mud and chopped straw to serve as a counterpoise. Acting on the short end of the beam it is sufficiently heavy (about 230 lb.) to raise a bucket-full of water suspended at the other end.

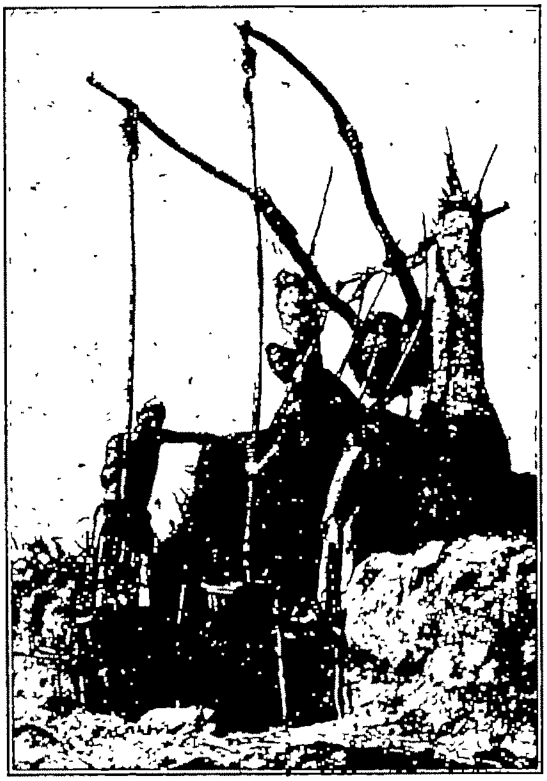


FIG. 1.—Pair of shadoufs working in parallel. After a photograph by Messrs. Gaddis and Seif, Luxor.

The bucket consists usually of goat-skin, although light metal buckets of similar size and shape are used in some places, and is held open by a wooden ring about sixteen inches in diameter, and has a cross-bar to which the wooden hook is attached. Since the counterpoise pulls up the water, nearly all the work done by the man is performed in pulling downwards the upright pole carrying the empty bucket. During this operation his body becomes bent to extreme flexion, and has to be straightened as the bucket ascends. He has also to tip the bucket when it reaches the higher level, and just as it reaches the lower level he gives the pole a slight jerk, so as to make the bucket enter the water edgewise, and thus fill instantly.

During a recent visit to Egypt we took the opportunity of measuring the rate of work done in raising water by means of a shadouf. All shadoufs appear to approximate very closely to the figures here reported. We found that the bucket holds about 60 lb. of water when nearly full, as in the lift, and is raised 11 feet 6½ times a minute, or up to 8 times a minute for a correspondingly less elevation. Thus the work done in raising the water is about $60 \times 11 \times 6{\cdot}5 = 4290$ foot-pounds per minute, or nearly 600 kilogram-metres per minute. Two men, working alternately for about an hour at a time, are employed on each shadouf, and each man works for a total of about 6 hours daily. Thus the work per day is about 1,550,000 foot-pounds or 700 foot-tons. The shifts are measured by means of a simple sundial, improvised on the spot. Its essential part is a cord stretched horizontally north and south between the tops of two pegs a few inches above the ground, with marks to indicate the endings of the shifts by the progress of the shadow. The intervals between shifts are devoted to light occupation, meals, and rests.

From other well-known physiological data we may reckon that the gross efficiency of the work during the raising of water is about 20 per cent. As the work done is 1,550,000 foot-pounds, the corresponding amount of energy liberated in the body is therefore equivalent to about 7,750,000 foot-pounds, which is equivalent to almost exactly 10,000 British thermal units, or 2500 calories. This is at a rate of about 417 calories an hour, or 7 calories a minute. During the remaining 18 hours of the 24 the average energy liberated cannot well be less than 80 calories per hour, so that the total liberation of energy will be at least 4000 calories. To cover this expenditure the shadouf worker will, if we make the ordinary allowance of 10 per cent. for waste, require food of the energy-value of at least 4400 calories.

The men working on the shadoufs are erect and finely developed, looking a picture of health and physical grace, and doing the work without signs of fatigue. They take several meals daily between shifts. These meals consist usually of cakes made fresh each day from maize or wheaten flour, with cheese and sour milk. Hot meals, with lentils or beans, and occasional meat, are taken at home. The work could not be kept up day after day if the food were not abundant. We were told that this food is almost entirely the produce of the land the men are irrigating and cultivating. The actual men who work the shadoufs and do the other work on the land are joint farmers. They thus work jointly for themselves and pay the rent jointly, taking all the produce and profits from its sale after the rent has been paid. The rents seem enormous by British or American standards, but the land, as actually worked, is extremely productive. It is very improbable that if the men were working on daily or weekly wages they would work so effectively or obtain the same net earnings. It seems also to be for essentially the same reasons that modern power-driven appliances have not displaced the shadouf. A shadouf is not only extremely efficient mechanically, but can be made from materials on the spot, and can be at any time repaired by the men who use it. To judge from carvings on a tomb near Luxor, the shadouf was practically the same more than three thousand years ago as it is now.

The work done on a shadouf is of special physiological interest, because it is so well standardised, employs so many muscles, and is so easily measured directly. In most kinds of standardised work we can only measure the work indirectly from the oxygen-consumption. In the late Mr. Jervis Smith's book on "Dynamometers" (edited by Prof. Boys) a description is given, on page 10, of another easily measured form of standardised human muscular work. This form of work was employed early last century in raising the earth needed in the construction of forts round Paris. The earth was loaded into a bucket attached to a rope passing over a pulley, and was then drawn up by the action of a counterpoise consisting of a man, whose work consisted in continuously ascending a ladder and coming down as a counterpoise to the ascending earth. It was found that the work done in this way amounted to 4230 foot-pounds per hour—a figure very close to ours for the shadouf worker as regards the rate per hour, though the French navvies kept up this rate during eight hours daily.

There can be no doubt that where the motive is adequate a man in good physical training, and fed in correspondence with the work, can keep up day after day, for say eight hours, a considerably greater rate of measured work than corresponds to these figures; and for short periods far greater rates are possible. Thus Henderson and Haggard (*Amer. Journ. of Physiology*, 72, p. 264, 1925) found that over a four-mile race in 22 minutes each oarsman of a university crew did average measured work at a rate of 0·45 horse-power, or 15,000 foot-pounds a minute, with a total energy-expenditure of 19 calories a minute, or at the rate of 1140 calories per hour. This rate is 3½ times that of the shadouf workers, but, of course, could not be kept up nearly so long. In a 1¼ mile rowing race the rate rose to 0·57 horse-power, or 18,770 foot-pounds a minute. For very short periods of less than a minute, still higher rates are possible, even for an untrained man. For example, Douglas and Haldane, with the view of producing maximum discharges of lactic acid from muscles during their temporary lack of oxygen, used short bursts of climbing work at a rate of 30,000 foot-pounds per minute (*Journ. of Physiology*, 38, p. 431, 1909). The rates of work of the shadouf men and of the French navvies are, however, worthy of record, as these rates could, without unusual effort, be maintained day after day throughout the working period.

We have pleasure in acknowledging the help we received from Mr. George Gattas, of Luxor, a chief dragoman on Messrs. Cook's Nile Service steamers.

Audibility of Explosions and the Constitution of the Upper Atmosphere.

By F. J. W. WHIPPLE.

PHYSICISTS who are interested in the problem of the temperature and constitution of the upper atmosphere have been awaiting with some impatience the publication of the official reports on the audibility of the experimental explosions arranged by the International Commission for Investigations on the Sound of Explosions. The first experiment was made (at Oldebroek in Holland) in October 1922, but the full report on the second experiment or series of experiments has appeared first. This report[1] has been prepared by Prof. Charles Maurain, head of the Institut de Physique du Globe at Paris. Some idea of the mass of evidence that has been digested may be gathered from the facts that 405 observations were plotted on the map showing the audibility of the first explosion, 360 and 240 on the maps for the second and third

The site of the explosions was at La Courtine; this place is about half-way between Paris and the Pyrenees; as it is more than 250 km. from the nearest sea, the audibility in all directions could be investigated. There were four explosions, on May 15, 23, 25, and 26, 1924. In each of the first two, about ten tons of melanite was spent, in each of the others, five tons. Observers did not receive sufficient warning in the last case, and M. Maurain's report is practically confined to the other three.

The great advantage of organisation is manifest throughout the report. When explosions have occurred by accident, the places at which they were heard have in many cases been mapped successfully, but accurate records of the time have been rare. With an experimental explosion the observers are ready to note the time to a second at which the sound reaches them. In many of the places from which Prof. Maurain received reports, the agreement between the observers was excellent. Perhaps the best example of precision is provided by the observations at Bordeaux on the first occasion. In the observatory and near by, four observers gave the time as 19 h. 44 m. 5 s., two gave 19 h. 44 m. 4 s., and one 19 h. 44 m. 3 s.

Another advantage is that full information can be obtained as to the meteorological conditions. There were at least two soundings of the upper air in France on each of the three 'La Courtine' days, and the stratosphere was reached on each occasion. Special

[1] Annales de l'Institut de Physique du Globe. Fascicule spécial consacré aux expériences de La Courtine sur la Propagation des ondes aériennes Paris, 1926.

pilot balloon ascents gave the direction of the air currents in the lowest three or four kilometres.

In the discussion of the observations, Maurain distinguishes between normal and abnormal audibility; for normal audibility the quotient of distance and time is approximately equal to the velocity of sound near the ground, whereas for abnormal audibility the quotient is considerably smaller. In each of the three La Courtine experiments there was a well-defined zone of silence separating zones of normal and abnormal audibility. The maps illustrating the last two experiments are comparatively simple and remarkably consistent. In each, the zone of normal audibility extends about 100 km. N.E. from La Courtine (with the wind), but barely 25 km. in the opposite direction. The zone of abnormal audibility occupies a quadrant to S.W., the minimum distance being about 160 km.

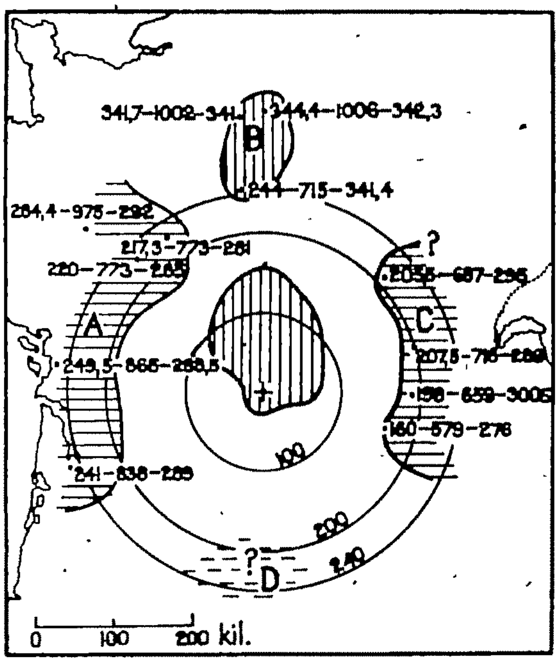


Fig. 1.—The numbers against the dots representing reporting stations are.—The distance from La Courtine in kilometres, the time after the explosion in seconds, and the quotient in metres per second. The circles are not in the original.

Two or three small detached areas of audibility are also shown to the east and north. The map for May 15, which we reproduce (Fig. 1), is of special interest on account of its remarkable symmetry. There were zones of abnormal audibility to east and west of the explosion. A detached region of normal audibility is also mapped in the neighbourhood of Paris, but it is to be noted that the observations in this area were instrumental. The records suggest waves of long period, beyond the range of the ear. With the favouring wind, the long waves travelled better than short ones through the lower atmosphere. As evidence for the favouring wind, it may be mentioned that the Upper Air Supplement of the Daily Weather Report shows that there was a current from the south crossing the English Channel at the cirrus level; the velocity deduced from nephoscope observations was about 100 miles per hour.

In a report of this kind the presentation of the observations in a convenient way is the main issue; it is to be regretted, however, that in the theoretical discussion the author has ignored details and adopted very rough approximations. Although he has been at pains to record the distribution of wind and temperature in the lower atmosphere, he boldly assumes that the sound rays in that region are straight. Moreover, he assumes that the stratosphere is uniform in temperature and composition up to 50 km. above ground, and does not test alternatives. His conclusions are that the high temperature postulated by Lindemann and Dobson for the atmosphere at 60 km. and above (say 300° A.) is not high enough to account for the recurving of the sound rays, and that Von dem Borne's hypothesis of the hydrogen atmosphere must be invoked. He goes so far as to hazard the estimate of 92 per cent. of hydrogen in the constitution of the atmosphere at 116 km., the height suggested for the apex of the path of the sounds heard at Bordeaux.

Fortunately, the observations provide us with a simple criterion by which such statements can be tested. Prof. Wiechert has reminded us recently that there is a close relation between the rate at which the intersection of a sound wave with the earth progresses and the velocity of sound at the apex of the trajectory. In the case of absence of wind and uniform stratification, these are equal. If there is a wind at the level of the apex, the component of the wind velocity in the direction of propagation of the sound must be allowed for. Now, in the La Courtine experiments there are three cases in which the radial velocity of the disturbance in the zone of abnormal audibility can be estimated.

In the first experiment there were well-supported observations to the north-west of La Courtine, at Chinon, and at Angers.

	Distance from La Courtine = X.	Time after explosion = T.	ΔX.	ΔT.	ΔX/ΔT.
Chinon . .	220 km	773 sec.	..	..	..
Angers . .	284·4	975	64·4	202	0·319.

On May 23 there were observations at Angoulême, Rochefort, and Bordeaux, and as the straight line from La Courtine to Angoulême when produced bisects approximately the line from Rochefort to Bordeaux, we may take the average of the co-ordinates of those two stations for comparison.

	X.	T.	ΔX.	ΔT	ΔX/ΔT.
Angoulême . . .	162 km.	614 sec.	..	..	..
Bordeaux and Rochefort	244	845	82	231	0·355.

On May 25 there were observations at Vélines between La Courtine and Bordeaux.

	X.	T.	ΔX.	ΔT.	ΔX/ΔT.
Vélines	191 km.	690 sec.	..	..	..
Bordeaux . . .	241	843	50	153	0·327.

It will be seen that in each of these cases the sound travelled across the zone of abnormal audibility with a speed differing but little from the ordinary speed of propagation, which for the temperature 17° C. is about 341 metres per second. In each case the sound was travelling against a light surface wind and would be retarded thereby.

Two deductions may be made:

(1) In the outer part of the zone of abnormal audibility the wave fronts were nearly vertical, the rays nearly horizontal.

(2) Unless the apexes of the sound rays were in a region of strong wind, they must have been at a level where the velocity of sound was about the same as at ground level.

Prof. Maurain's hypotheses are at variance with these deductions from the observations. He contemplates rays, the inclination of which at the ground is only 22° from the vertical, and the velocity of sound at the apex of such sound rays is said to be 786 metres per second. It is clear that further discussion of the observations is called for.

In our diagnosis of the conditions, we start with the known facts with regard to the state of the atmosphere on May 15. As a good approximation we take the temperature of the surface air as 290° A., the lapse rate of temperature 6⅔° per km. up to 12 km., and assume a uniform temperature 210° from 12 km. upwards.

The region of uniform temperature may be supposed to extend to a height H_2. Above H_2, temperature is higher. It may be supposed that at the height H_3, temperature is the same as on the ground, 290° A., the inverted lapse rate being the same from H_2 to H_3 and beyond. With these assumptions, wind being ignored, a sound ray consists of arcs of cycloids in the troposphere and the upper atmosphere and of straight lines in the stratosphere.

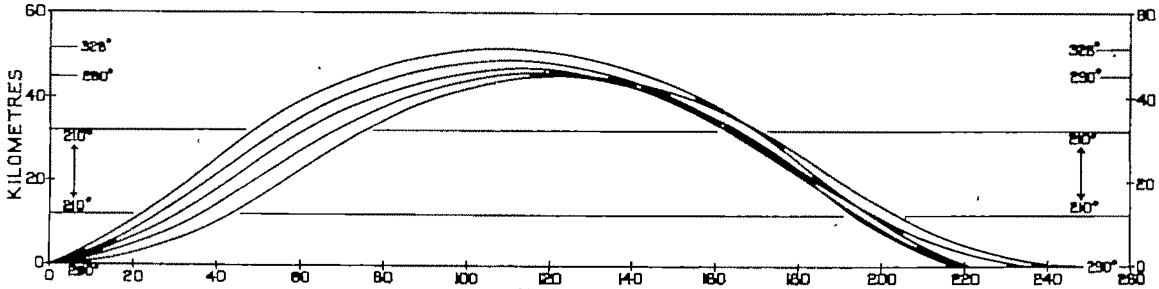


FIG. 2.

For a ray starting with a given inclination to the horizon, the range, etc., can be expressed a linear functions of H_2 and H_3. For example, for a ray starting with the inclination $\psi = 15°$, we have the formulæ:

Range in kilometres $= X = 17·8 - 5·46H_2 + 8·35H_3$
Time of passage in seconds $= T = 36·54 - 14·55H_2 + 16·64H_3$
Height of apex in kilometres $= Z = 1·26H_3 - 0·26H_2$

The observations of audibility give values of X and T and, if the inclination of the sound ray is assumed, such formulæ can be used to determine H_2 and H_3.

Four examples are quoted in the following table:

	X.	T.	ψ.	H_2	H_3.	Z.	θ	V.
1.	220	773	15	32	45	48·6	311	0·354
2	220	773	5	33	44	44·1	292	0·343
3.	284	975	0	34	51·5	51·5	290	0·341.
4	160	579	20	30	37	40·7	328	0·363.

ψ = initial inclination of ray, θ = temperature at height Z, V = corresponding velocity km./sec.

In the first two, the values of X and T are those appropriate for Chinon on May 15; the alternative values 15° and 5° are assumed for the inclination.

In the third example, the figures for Angers are used, this being a case of a very long range, and in the fourth example, the figures for Unieux are selected to illustrate a very short range.

It will be seen that in each of these cases it is indicated that the region of high temperature begins at about 30 km. above ground. The apex of the specified ray is between 40 and 50 km. above ground, and the temperature there is in the neighbourhood of 300° A.

Values of H_2 and H_3 having been determined, we can compute the values of X and T for rays of various inclinations. Thus, if H_2 is 32 and H_3 is 45·2, we obtain the following table:[2]

ψ.	X.	T	ΔX	ΔT.	ΔX/ΔT
0	247·5	853·7	..	..	.
5	234·4	815·4	13·1	38·3	0·342.
10	225·3	789·0	9·1	26·4	0·345
15	220·3	774·8	5·0	14·2	0·352.
20	219·8	773·3	·5	1·5	
25	224·3	785·6	−4·5	−12·3	0·370

It will be seen that the range is a minimum for an inclination about 18°. The figures in the last column illustrate Wiechert's principle.

The course of the rays in this example is illustrated in Fig. 2. The figure shows how the rays which return to earth are distributed over a rather narrow zone. That the zone of abnormal audibility is actually wider in observed cases is no doubt to be explained by the complication introduced by wind. The computation of the exact forms of rays with the influences of wind and temperature both taken into account is very cumbersome. To discover a hypothetical distribution of both elements consistent with all the reported observations would therefore require much laborious arithmetic. It is to be hoped that some one will carry this through. It is not likely, however, that the general result, that the observations imply a region of high velocity and high temperature between 30 and 50 km. above ground, will be modified. That this was probably the interpretation of the La Courtine observations was noticed when the preliminary account was published (F. J. W. Whipple, *Meteorological Magazine*, 1925, p. 16). Wiechert has come to the same conclusion as the result of the study of all the available evidence with regard to abnormal audibility (*Met. Zeitschrift*, March 1926, p. 90).

The existence of high temperatures at great heights was deduced by Lindemann and Dobson from the evidence provided by observations of meteors (*Royal Soc. Proc.* A, vol. 102, 1922, pp. 411-437). That this hypothesis would explain the 'abnormal' audibility of explosions was seen at once. There is, however, an apparent discrepancy. Lindemann and Dobson considered that the stratosphere with its uniform temperature might be regarded as reaching nearly to

---

[2] The figures quoted for 15° elevation do not tally precisely with the formulæ for X and T in which the coefficients have been rounded

60 km., and credited the higher temperature to the region above that level. The discussion of audibility brings the transition down to 30 km. It seems, however, that the meteor observations are not inconsistent with this modification of the hypothesis.

In Fig. 3A, which is reproduced from part of Fig. 3 of Lindemann and Dobson's paper, the density of the air at different levels is shown by crosses and dots. Each cross shows the density computed for the point of appearance of a meteor, each dot that for a point of disappearance. The curve shows the density calculated on the assumption of a uniform temperature 220° at all levels above 12 km. The curve runs fairly through the points representing meteor observations below 60 km. As Lindemann and Dobson point out, above 60 km. the meteor observations "all indicate densities very much greater than those calculated on the assumption of a uniform air temperature of 220° A., but consistent with a considerably higher temperature." They state that the rate of change of density with height shows that the temperature is probably about 300° A., but how this estimate is reached is not clear. I have shown in Fig. 3B the curve which represents the relation between density and height on the assumption that temperature is 220° from 12 km. to 50 km., that there is a uniform gradient to 60 km., and that temperature above 60 km. is 300°. It will be seen that the curve does not represent the meteor observations at all well. In Fig. 3C I have adopted the hypothesis that the transition from 220° to 300° occurs between 30 km. and 40 km. The fit is now a little better. Finally, in Fig. 3D, I have made the rise of temperature begin at 30 km. and assumed a regular increase up to 50 km. At that level and beyond, the temperature is 380°. The assumptions are now in reasonable agreement with the observations.

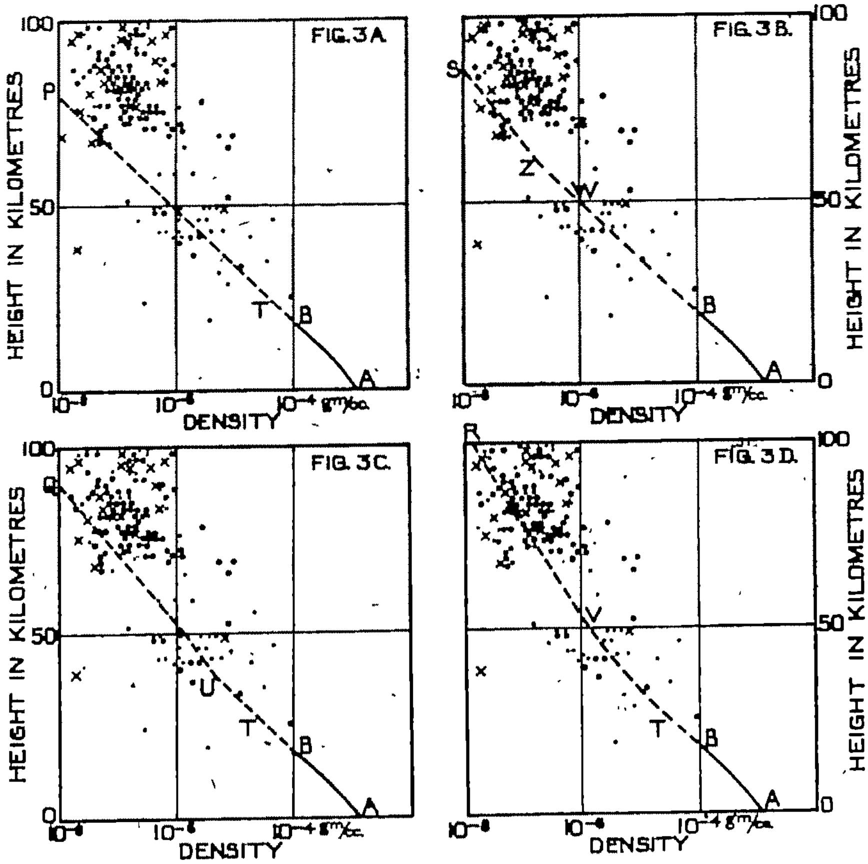


FIG. 3.

It is difficult to believe that the atmosphere at 60 km. is really at a temperature above the normal boiling-point of water. That seems, however, to be the logical conclusion from the theory of Lindemann and Dobson. For our present purpose the essential point is that the meteor observations do not conflict with the hypothesis suggested by the phenomenon of abnormal audibility, *i.e.* that temperature is about 220° up to 30 km., about 300° at 40 km., and possibly higher above that level.

The apparent inconsistency between the theory of Lindemann and Dobson and their conclusions was pointed out recently by C. M. Sparrow, who interprets their diagram as implying a temperature of 480° (*Astrophysical Journal*, 63, March 1926, pp. 90-110). Sparrow does not accept the theory, and puts forward one of his own, which does not require high temperatures at all. The reply of Lindemann and Dobson to Sparrow's arguments has not yet appeared.

Realisation of the probability that the transition from the uniform temperatures of the stratosphere to much higher temperatures begins at the comparatively modest height of 30 km. makes it desirable to extend the range of soundings by free balloons to that height, and beyond. By the proper choice of balloons that should be possible.

Another line of attack is also open. We are familiar with the fact that, during the War, gunfire was heard regularly at distances exceeding 100 miles. Why should not similar observations be made systematically in peace time? I should like to inquire whether gun practice at Portland is heard in South Wales. If there is any quiet spot in that region where the sounds are heard frequently, observations should be timed and, with a little organisation, valuable information would be obtained. The advantage of frequent observations of this kind as compared with the occasional 'big bang' is obvious.

Since this article was written I have had an opportunity of testing the possibility of timing the passage of the sound of gunfire. Listening at Grantham on June 28 for the discharge of guns at Shoeburyness, 115 miles away, I found that the time of passage increased gradually from 10¾ to 11¼ minutes and then began to decrease. Details have been published in the *Meteorological Magazine* for August.

Obituary.

DR. J. F. HALL-EDWARDS.

WE regret to record the death on August 15, at the age of sixty-seven years, after many years of suffering due to extensive X-ray injuries, of Dr. J. F. Hall-Edwards. He was educated at King Edward's School and at Queen's College, Birmingham, and after qualifying in medicine he went into practice. Soon after the discovery of X-rays, Dr. Hall-Edwards took up their application in medical work and was one of the earliest authors in radiography. He served in the South African War as surgical expert in X-ray work to the Imperial Yeomanry Hospitals at Deelfontein and Pretoria, receiving the Queen's medal with four clasps. In spite of disabilities which might well have deterred him from any further executive work, he applied for and received a commission as temporary Major in the R.A.M.C. at the outbreak of war in 1914, and served in a radiological capacity to such effect that official recognition of his services was made on two occasions. He was an honorary member of the Röntgen Society and the author of several original papers in the journals of this Society and of the Electro-therapeutic Section of the Royal Society of Medicine.

Dr. Hall-Edwards made a great fight for many years against the insidious damage which he had suffered when using X-rays in his medical work. Like other pioneers he suffered because protective methods were unknown. His services in the public cause which so unhappily affected him, were recognised by the award of a Civil List pension in 1908, and later, in 1922, he received the Carnegie Hero Trust Medallion with an annuity.

S. RUSS.

WE regret to announce the following deaths:—

Dr. Charles W. Eliot, for forty years president, and since 1909, president emeritus of Harvard University, who was largely responsible for raising Harvard to its present high position among the universities of the world, on August 22, aged ninety-two years.

Dr. D. E. Flinn, formerly medical inspector of the Local Government Board, Ireland, editor of the *Health Record* and author of works on public health and hygiene in Ireland, on August 18, aged seventy-six years.

News and Views.

SIR ARTHUR EVANS's paper on "The Shaft Graves of Mycenæ and their Contents in Relation to the Beehive Tombs," which was read before the Anthropological Section of the British Association at Oxford, was something in the nature of a bomb-shell, of which the effects will be far-reaching. The relation of the great beehive tombs at Mycenæ, which were found empty of their sepulchral contents, to the shaft-graves, so rich in sepulchral relics, found by Schlieman within an extension of the Acropolis wall, has always been a puzzle to archæologists. Sir Arthur's paper revived a theory, first put forward by Prof. Gardner and arrived at independently by himself, that at a time of danger the royal burials had been transferred from the mausolea outside the walls to a site which could be included within the enceinte. This theory has not found favour among archæologists, and the view generally held is that the two classes of tombs correspond to earlier and later dynasties at Mycenæ. Mr. Wace recently has carried the matter further and suggested that the two finest shaft-graves, the "Treasury of Atreus" and the "Tomb of Clytemnestra," belong to the latest groups, making them contemporary with a time when the Palace of Knossos was in ruins and the civilisation of Crete on the downward path. Sir Arthur Evans's latest discoveries render this theory untenable. He has found decorative sculptures, not later in date than the end of the Third Middle Minoan period and in vogue about 1700 B.C., which run parallel with those of the façade of the "Atreus" tomb. Vases characteristic of the same epoch were found in the "Tomb of Clytemnestra." He was able to demonstrate archæologically that the finest of the beehive tombs belong to the same date as the earliest elements in the shaft graves, and that both are equally Minoan. On this view their culture, with the exception of certain intrusive barbaric elements, can no longer be regarded as a 'mainland' culture and, as Sir Arthur pointed out, the term 'Helladic' as applied to it becomes a misnomer.

SIR FREDERICK KEEBLE, Sherardian professor of botany in the University of Oxford, has accepted an appointment with the Synthetic Ammonia and Nitrate Co., which is associated with Messrs. Brunner, Mond and Co., for the promotion of research in the application of synthetic nitrogen compounds to agricultural purposes. He will probably be released from his chair at Oxford at the end of next term, and start upon his new duties in January. This appointment marks a further step in the movement towards a closer association of fundamental scientific research with commercial enterprises in connexion with agriculture. The growing use of artificial fertilisers renders it imperative that possible fresh sources of supply should be investigated and the value of the products thoroughly tested. As a measure of economy and as a means of protecting agriculturists from loss that might be incurred by using new and comparatively untried fertilisers, research with regard to their economic application is essential, and it is this that Sir Frederick Keeble will endeavour to foster. His wide and varied experience has already brought him into contact with certain aspects of the problem, for on the practical side he has served as controller of horticulture to the Food Production Department of the Board of Agriculture, as assistant secretary to the Board of Agriculture, and as director of the Royal Horticultural Society's Gardens at Wisley, and on the scientific side as professor of botany at Reading and at Oxford. The possibilities in connexion with the use of synthetic nitrogen compounds as fertilisers are of great importance to agriculture, as was pointed out by Sir Daniel Hall in his presidential address at Oxford to Section M (Agriculture) of the British Association, which appears elsewhere in this issue, and the development of this line of work will be followed with much interest.

FURTHER records of the British earthquake of August 15 show that the disturbed area is much larger than was at first supposed, for it was felt at King's Lynn, Gainsborough and Harrogate, so that the total area shaken may amount to 60,000 square miles. This is a high estimate, but it must be remembered that the shock was felt chiefly in upstair rooms and at a time when there were few disturbances to hinder its observation. The position of the epicentre is still uncertain, but it is probably nearer Ludlow than Hereford. That the depth of the focus was considerable is clear from the slow decrease outwards in the strength of the shock in the central district, and from the large area shaken. The shock seems to have been registered at most British stations. The interesting record obtained at Kew is reproduced in the *Daily Express* for August 17. At Stonyhurst, according to the Rev. J. P. Rowland, S.J. (*Times* for August 20), the first preliminary tremors began at 3h. 58m. 46s. A.M. (G.M.T.), and the second at 3h. 59m. 5s., implying that the origin was 103 miles from the observatory or close to Ludlow. "The chief element of uncertainty," he adds, "lies in the determination of the time of commencement of the preliminary tremors, which are very small and difficult to read."

WHAT was probably the first important geological discovery from the air was made in 1920 by Dr. P. Chalmers Mitchell in the course of *The Times* African aeroplane flight. Between Khartum and Wady Halfa the Nile follows an S-shaped course. Flying over the unexplored country within the southern loop of the S, Dr. Mitchell observed a great plain of lava diversified with a number of craters and resembling, as he said, "an enlarged view of the moon." Part of this previously unvisited volcanic field has now been explored by motor car by Mr. H. C. Jackson (*The Times*, August 18). South-west of Sani Wells two conspicuous extinct volcanoes were found; one of the somma type, and the other, graphically called "the Place of Gloom," with an apparently complete crater "of awe-inspiring dimensions." Dr. Mitchell thinks that these craters lie to one side of those over which he passed, and states that Dr. Grabham, the Government geologist of the Sudan, hopes soon to make a survey of the area. Geologists will await with interest the petrological and tectonic description of the field, for its situation is in a line with the western branch of the Rift Valley system, though far to the north of any hitherto suspected continuation of that branch. It is clear from this example alone that many parts of the world may still hold surprises, even for geographical explorers.

THE president of the Board of Trade has appointed a standing committee to consider and advise on questions connected with the economic use of fuels and their conversion into various forms of energy, having regard to national and industrial requirements and in the light of technical developments. The members of the committee are: Sir Alfred Mond, M.P. (chairman), Mr. J. Baker, M.P., Mr. Mark Brand, Sir John Cadman, Sir Arthur Duckham, Sir William Hart, Mr. Frank Hodges, Prof. F. A. Lindemann, Sir David Llewellyn, Mr. M. Mannaberg, Mr. C. H. Merz, Sir Alexander Walker, and Mr. D. Milne Watson. The secretary of the committee is Mr. W. Palmer, and the assistant secretary Mr. R. J. Moffatt. All communications should be addressed to the secretary, National Fuel and Power Committee, Board of Trade, Great George Street, S.W.1.

PROF. ELLIOT SMITH, in the *Morning Post* for August 23, again raises the question of the origin of American culture, apropos of the articles by Dr. T. W. Gann on his discoveries on ancient Maya sites in Central America, which appeared in that journal in the early part of the year. Prof. Elliot Smith now offers the interesting suggestion that the remarkable stone causeways of the Maya found by Dr. Gann are distinctive of work of that period in Indo-China and Java, where there were definite reasons for their construction, and that they were introduced from those countries into Central America, where, however, the reasons for their construction no longer existing, they continued to be constructed from force of habit. He goes on to refer to the arguments recently advanced by Dr. C. Handy that the Maya temple and the Polynesian oracle-house were both copies of the Cambodian temple. A third class of evidence to which Prof. Elliot Smith directs attention is connected with the cultivation of the sweet potato. The methods of cultivation employed are identical not only in New Zealand by the Maoris and in America, but also throughout Oceania, Cambodia, China, and Japan. Further, it is held that *Kumara*, the Maori word for the sweet potato, also occurs in Ecuador and Peru as *Kumar*, but in addition, F W. Christian has recently suggested that the word itself is to be derived from the Sanskrit word for the white lotus.

MAJOR FRANCO and Capt. Ruiz de Alda have published a book "de Palos al Plata" giving an interesting record of their adventurous voyage in a seaplane across the South Atlantic from Palos in Spain to Buenos Ayres. They make it clear that an important factor in their success was due to the Marconi direction finder and the radio telegraphic apparatus they carried. On several occasions the direction finder prevented them from making unnecessary detours. There was a fog when approaching Las Palmas. They signalled the radio station there to send continuous signals so as to ensure a good descent. This was immediately done, the signals increasing in loudness until they were directly over Las Palmas, and a good descent was made. They experienced bad visibility again when approaching San Vincente, and again the direction finder proved to be of the greatest value. During their flight they were frequently in communication with passing ships, which sent them their bearings and sometimes sent radio messages announcing their progress to their next stopping place. The authors conclude that the direction finder enabled them to navigate with a maximum inaccuracy of about 3°. This is equivalent to efficient dead reckoning navigation and even to very fair astronomical navigation. They consider that radio telegraphy is indispensable for flights over the sea or sparsely populated countries.

RESULTS of meteorological observations made at the Radcliffe Observatory, Oxford, in the five years 1921–1925, prepared under the direction of Mr. H. Knox-Shaw, Radcliffe Observer, have recently been published by order of the Radcliffe Trustees. The work consists of five annual parts which deal with the observations for the several years. Commencing with 1925, changes in the routine of observation have been introduced; the numbers of eye-readings have been reduced from three to one each day, and the photographic barograph and thermographs which have been in use since 1881 have been superseded. Various other alterations of smaller detail have been introduced, but they are clearly stated. Now that observations have been recorded for seventy-five years or thereabouts, the mean results of barometer, temperature, and rain are as accurate as they will ever be. The mean of the maximum or day temperatures is 70°·8 F. in July, which is the warmest month of the year, and the mean of the day readings in January, the coldest month of the year, is 43°·7 F. The mean of the minimum or night readings for the corresponding months are respectively 53°·3 F. and 34°·5 F. The rainfall for seventy-five years gives the annual average 25·99 in. The wettest month is October, with an average fall of 2·84 in., and the second wettest month is July, with 2·58 in. The driest month is February, with 1·65 in., and the next driest March, with 1·73 in.; but making allowance for the different lengths of the two months, less rain falls on a March day when the average daily fall is 0·056 in., while in February it is 0·058 in. The sunshine records cover forty-five years; the sunniest months are May and June, each with average sunshine for 194·5 hours; the least sunny month is December, with the average sunshine 43·8 hours.

ACCORDING to a despatch of the Cairo correspondent of the *Times*, which appears in the issue of August 16, Mr. Alan Rowe, field director of the Palestine Expedition of the University Museum, Philadelphia, has succeeded in identifying the two temples of the Philistines mentioned in the First Book of Chronicles, x. 10. Of the four temples at Beisan (Beth-shan) built during the Egyptian occupation, two belong to the reign of Rameses II., and of these the southern is identified with the 'Temple of Dagon,' which was dedicated to the warrior god Resheph; the northern, which was dedicated to the warrior goddess Antit-Ashtoreth, was the 'House of Ashtoreth.' It is conjectured that a sanctuary was established in one or other of these temples by David after he had destroyed and partially reconstructed them. A consideration of the results of the season of 1925, and the examination of the archæological objects then obtained, has afforded material for suggestion as to the relation subsisting between Crete, Anatolia, and Philistia before the driving out of the Philistines by King David. The Egyptian mercenary troops who occupied Beth-shan appear to have included an Ægean-Anatolian element before the coming of the Philistines. The walls of the temples of Seti I. and Rameses II. apparently were built by the mercenaries themselves. Some bricks bear signs identical with certain Minoan signs, and not only are the cylindrical cult objects and ring flower-stands Minoan, but also they do not appear on the site before the time of Seti I. The presence of Cretans among the mercenaries had not previously been recognised.

IN the July issue of the *Quarterly Review* Mr. Robert Steele has an illuminating article on the early days of chemistry. He points out that in the Dark Ages of Europe there were two great civilisations, still at the height of their powers, with a foothold in Europe, namely, the Byzantine and the Arab. Byzantium was, however, cut off from Atlantic Europe, whereas the Arab civilisation seems from the first moment of reviving curiosity as to science to have been that to which all eyes turned, in spite of the difference of religion and language. By the middle of the twelfth century a learned world had come into being in Europe, but this renaissance was literary: it knew nothing of science. A century later, however, science was beginning to come into its own, through the efforts of such translators as Adelard of Bath, Gerard of Cremona, Robert of Chester, and Plato of Tivoli. Among the other Greek sciences which thus came to Latin Christianity by way of the East was alchemy, which had been studied widely and enthusiastically by the Muslims. Mr. Steele's sketch of alchemy in Islam is brief but clear, and by basing it upon recent investigations into this subject he has avoided the errors and misconceptions which are commonly met with. His unrivalled knowledge of medieval Latin alchemy has enabled him to present the salient features of an interesting period in a way which the general reader will find easy to follow and the specialist extremely suggestive.

MR. THOMAS SHEPPARD, director of the Hull Museum, has issued (*Hull Museum Publications*, No. 87) a catalogue of the various exhibits relating to shipping and fisheries which are permanently housed in a special building presented by the late Mr. C. Pickering and situated in Pickering Park, Hull. At one time the whaling trade at Hull was of immense importance, and from it has sprung the present fish and oil trades of that port, which have now grown to an enormous size. It is, therefore, a fitting centre for an exhibit of this kind, and much trouble has been taken to bring together all relics of the old whaling industry which was connected with Hull so early as 1598. The collections are of remarkable interest, embracing as they do an historical series of whaling implements and many valuable old prints and paintings representing the gradual growth of the shipping and fisheries industries. There are many other things in the museum, which is by no means confined to whaling, but all are connected with shipping, fisheries, or exploration in some way, and there is a nucleus of a good library on these subjects. We note that the Adélie penguin (No. 174), brought by the *Terra Nova* from Capt. Scott's last Expedition, is unfortunately described as coming from the Arctic, instead of the Antarctic. Mr. Sheppard is to be congratulated on the catalogue, which adds very much to the value of this interesting little museum.

THE Board of Education has issued a "Report on the Science Museum for the Year 1925." Our copy is marked "For Official Use"; at the same time it is said to be published by H.M. Stationery Office at 1*s*. net. The restriction of the report to 24 pages does not permit elaborate treatment, but enough is said to show that many objects of considerable interest were placed on exhibition during the year. The more important among them were mentioned in NATURE at the time. The value of this museum may be inferred from three classes of visitors. School children come in large numbers, both on their own account and under the guidance of their own teachers. Students make much use of the collections. Officers and technical experts have found here alone the evidence that enabled judgment to be passed on various claims arising out of the War. The space allotted to the exhibition galleries is therefore fully justified. At the close of 1925 it amounted to 155,000 square feet, and the addition of galleries giving 22,000 square feet was authorised by the Government. Even this, however, will not suffice, and of it 45,000 square feet is in old buildings not considered sufficiently fire-proof. "The construction of the centre block, to provide about 100,000 square feet, is therefore an urgent need." The War, while retarding the building operations, gave a great impetus to invention, and thus, on both counts, enhanced the congestion. The Science Museum, it should be remembered, is only one of a number of rapidly expanding institutions in a limited area.

IT is stated in *Science* that the gold medal of the American Geographical Society has been awarded to Dr. Erich von Drygalski, professor of geography in the University of Munich and leader of the German South Polar Expedition of 1900 to 1903.

THE following have been elected officers of the Röntgen Society for the session 1926–1927: *President*, Mr. N. S. Finzi; *Vice-Presidents*, Dr. Robert Knox, Prof. A. W. Porter, Prof. S. Russ; *Hon. Treasurer*, Mr. Geoffrey Pearce; *Hon. Editor*, Dr. G. W. C. Kaye; *Hon. Secretaries*, Mr. Russell J. Reynolds, Prof. F. L. Hopwood.

A QUANTITY of palæolithic implements, stated in the *Times* of August 17 to number more than 200, has been obtained from a gravel pit, at a depth of 12 feet, on the City of Norwich sewage farm at Whitlingham. The discovery is due to Messrs. H. H. Halls and J. E. Sainty, who, in examining the material thrown from the pit by workmen, found two well-made examples of the hand-axe. Mr. J. Reid Moir has examined the deposits and the implements. He has pronounced them to be of Acheulean type, and considers that the gravels in which they were found were laid down just before the third glacial epoch. The implements exhibit a brownish-yellow patination and some exceed 1 ft. in length.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant bacteriologist in the department of pathology and bacteriology of the University of Sheffield—The Registrar (September 11). A lecturer in mathematics at University College, Nottingham—The Registrar (September 14). A junior technical officer in the aerodynamics department of the Royal Aircraft Establishment—The Employment Department, R.A.E., Farnborough, Hants (September 18, quoting Reference A. 122). An engineer to take charge of the Wood Preservation Section of the Forest Products Research Laboratory of the Department of Scientific and Industrial Research—The Secretary of the Department, 16 Old Queen Street, S.W.1 (December 1). A teacher of biology at Gordon College, Khartoum—The Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1. A part-time lecturer in mathematics at Birkbeck College—The Secretary, Birkbeck College, Breams Buildings, Fetter Lane, E.C.4.

Research Items.

Music of the San Blas Indians.—Advantage was taken of the opportunity afforded by the presence of Tule Indians of Panama in Washington in 1924, to investigate their physical characters and certain aspects of their culture. It will be remembered that the chief point of interest about these Indians, who were brought to the States by Mr. R. O. Marsh, centred in the question whether there was among them a truly 'white' element, as Mr. Marsh claimed. Observations on their music were made by Frances Densmore, and these are now published as No. 11, Vol. 77 of the *Smithsonian Miscellaneous Publications*. The "official musicians," with the chief and the doctors, are the most important people in the villages. Of these the chief may act as a doctor, but not the musician. There are four musicians, two "Chief" and two "Assistant Musicians," in each village who know the songs and teach them for pay. Social gatherings, weddings, etc., are attended by one chief and one assistant musician, never more, for the entertainment of the people. In addition to the songs sung for entertainment there are songs with a definite purpose, such as the treatment of the sick, and songs sung as "charms" which are sold by the doctors. The principal instruments are the flute and the panpipes. The man from whom the songs in the present record were obtained was an amateur who had learnt his songs, some thirty in all, from the official musician. The first song he had learnt was that which brought success in catching a turtle. He also learnt the medicine man's songs, though not himself a medicine man. These include songs to make medicinal herbs effective, to cure headache and other ailments, and the songs that were sung after a man's death. The vocal and instrumental music of the Tule Indians is a form not hitherto recorded. It appears that though the substance of the words and the general character of a song is learnt, each performance is an improvisation. The tone is artificial and extremely difficult to acquire. It is very hard, with a pinched forced quality. The principal occasions for singing were the treatment of the sick, the scene after a burial, the maturity of a young girl and her wedding.

The Australians and South America.—In No. 18 of the *Compte rendu sommaire de la Société de Biogéographie*, Dr. Paul Rivet discusses the possible routes which might have been followed by the Australians in the migrations postulated to account for the Australian linguistic elements which he claims to have discovered in the language of the Ona of Tierra del Fuego. The sea route across the Pacific is out of the question in view of the scanty equipment of the Australian for navigation. No evidence can be brought forward to support the view that the Australians entered America from the north as did the immigrants from Asia. A third hypothesis was suggested by Mendez-Correa, namely, that they came by the south. The journey might have been performed by making use of the islands of Auckland, Campbell, Macquarie, Esmeralda, Wilkes Land, King Edward VII. Land, and Grahamland as stages. The powers of endurance of cold displayed by the Ona, which surpass those of the Eskimo, might be a result of a prolonged sojourn in these inhospitable regions. In present conditions, however, it is difficult to admit that the islands and shores of the Antarctic are habitable. It is, therefore, desirable to investigate whether there has been a change in climate in this area sufficiently recent for linguistic resemblances to survive, or whether there has been a glacial extension sufficiently marked to shorten the crossing by sea and on which the people could have found game for their subsistence. In discussion it was suggested that the zoological evidence pointed in the direction of this hypothesis and possibly to an extension of Tasmania to the Antarctic, while the geographical and bathymetric distribution of echinoderms suggested a more temperate climate and warmer water at one time in the Antarctic area.

Early Development of Human Embryo.—In the latest volume of "Contributions to Embryology" (Vol. 17, 1926, *Carnegie Institution Publication*, No. 362) Profs. G. W. Bartelmez and H. M. Evans have published a detailed account of the development of the human embryo during the period of somite formation, including embryos with two to sixteen pairs of somites. The material dealt with comprises twenty-five embryos belonging mostly to the collections of the Department of Embryology of the Carnegie Institution and the Department of Anatomy at the University of Chicago. The memoir, which is illustrated by a fine series of plates, deals with many points of interest It is shown that the cranial flexure is present from the beginning of somite formation, and is due primarily to the more rapid growth of the dorsal as compared with the ventral lamina of the mid-brain folds. The asymmetry, which in the case of the neural folds is a striking feature of the external form, is quite as marked in other systems. It is interpreted as due to localised differences in the rate of growth on each side. Differentiations in the ectoderm foreshadow certain regions of the head, and definite parts of these contribute to the formation of certain of the cranial ganglia in the 16-somite stage. The closure of the neural folds begins at the level of the fourth pair of somites in the 6- to 7-somite stage, and the neural crest is proliferated at about the same time. The origin and early development of many other structures are described in detail, and their phylogenetic and physiological significance are pointed out. Owing to the comparatively large amount of material available, the time-sequence in which the various parts appear has been traced far more fully than in any previous accounts of early human development.

Neuroglia Cells.—Those who are interested in the study of neuroglia will welcome the paper by Dr. C. Da Fano in the current (June) issue of the *Journal of the Royal Microscopical Society*, in which the recent methods for demonstrating the neuroglia cells are carefully described These methods were devised by Cajal and Del Río-Hortega, but Dr. Da Fano has given due weight in his account to his personal experience gained chiefly through a short stay in Del Río-Hortega's laboratory in Madrid. It is impossible to give a summary of the methods; the paper, which is illustrated by eight figures, should be consulted for the details of the several processes.

South African Mollusca.—Two papers on mollusca from South Africa appear in the *Annals of the Natal Museum*, vol. 5. Mr. J. R. le B Tomlin contributes a paper on marine forms, including the description of eleven supposed new species, and one new genus belonging to the Tectibranchiata. This last, *Alexandria natalensis*, n. gen. et sp., the author places in the Acteonidæ on account of the shell apex, the radula and operculum. The paper is illustrated by one of Miss G. M. Woodward's excellent plates. Mr. H. C. Burnup supplies Part 2 of his memoir

"On some South African Gulellæ, with Descriptions of Some New Species and Varieties." The genus Gulella was formerly reckoned as a section of the genus Ennea, under which name most of the numerous species were formerly described. The fascinating little group, which externally calls to mind the British 'chrysalis shells,' is remarkable for the armature of the mouth, which in some is so studded with teeth that the occupants must be seriously incommoded when issuing or retreating. Twelve species are dealt with in this instalment, of which four are described as new, and the whole illustrated by the author on a plate of 39 figures.

COPEPODS IN THE BAY OF BISCAY.—In his account of the Copepoda from the collections made by Dr. G. H. Fowler on board H.M.S. *Research* in the Bay of Biscay in 1900, Mr. G. P. Farran (*Journal of the Linnean Society* (*Zoology*), vol. 36, April 1926) not only enumerates the various species but also gives most valuable data concerning their diurnal and nocturnal movements; thus treating the subject in a somewhat similar manner to that employed by Dr. Fowler himself for the Ostracoda in the same collections (1909). The samples were all taken in July, approximately in the centre of the Bay of Biscay, mainly along a diagonal line about 65 miles in length from the N.W. to the S.E. corner. The soundings taken lay between 1219 and 2341 fathoms, and the author divides his material into the epiplankton hauls made chiefly down to 100 fathoms with horizontal non-closing nets which lasted an hour or more, and the deep water hauls, almost all of which were made with closing nets hauled vertically. The former could not be treated quantitatively, but in the latter all the copepods were counted. The copepod population from the surface to 100 fathoms was found to be approximately doubled during the night by an upward migration consisting mainly of *Metridia lucens*, *Pleuromamma robusta* and *P. gracilis*, and from 50 fathoms downwards, *Undeuchaeta minor*, several other species joining in the migration. In the deep water hauls a number of little-known forms are noted whilst the new genus Bathyidia and fourteen new species are described, three of which belong to Calocalanus and five to Scolecithrix. The view that *Aegisthus dubius* is the male of *A. mucronatus* has been rejected by Sars, but the present author seems to have good cause to regard the question as still an open one

FISHERIES AROUND GREENLAND AND ICELAND.—The report of the North-western Area Committee (*Conseil Internat. Expl. Mer*) for the years 1924 and 1925 contains seven papers dealing with the hydrographical and biological researches undertaken in Greenland and Iceland waters. Hydrographical observations in the Faroe-Shetland Channel on May 3-14, 1924, showed that the water at the surface was composed of Atlantic water, while that at the bottom was bottom water from the Norwegian Sea. Between the two there was an intermediate layer formed by the mixing of Atlantic and bottom water with water introduced from the east Icelandic Arctic current. The biological part of the report deals with the five species of fish under the Committee's observation, namely, cod, halibut, herring, haddock, and plaice. It seems now beyond doubt that a particular stock or population of cod exists in Greenland which is indigenous to the waters of western Greenland. In Iceland, however, an almost unparalled density of young cod is experienced off the north and east coasts, in spite of the fact that very few cod-eggs are spawned there. Thus, the stock is recruited by drift, and the quantity must depend on the success of this drift. Faxe Bay, at the south-west part of Iceland, has proved to be a most important nursery-ground for the halibut, and there is little doubt that an enormous destruction of undersized halibut is caused by trawling operations in this area. The herring investigations are said to establish the fact that there are two distinct races of herrings in Icelandic waters, a spring herring and a summer herring, and that, as yet, no characters are known by which the Iceland spring herring can be distinguished from the Norwegian spring herring. Interesting figures from the estimations of age of haddock in Icelandic waters, in material collected over a number of years, show the way in which certain year-classes dominate. Thus, material of 1908–1909 showed an absolute dominance of the 1904 year-class, while that of 1924 indicated the predominance of the 1922 year-group. The study of the growth of haddock reveals the fact that growth is greatest off the south coast. Samples of plaice from Faxe Bay and Skiálfiandi Bay in Iceland were examined as to their age composition, and important conclusions were drawn from the analyses of catches at intraterritorial and extraterritorial trawling stations.

A NOVEL CURRENT METER.—In No. 2 of the *Journal du Conseil International pour l'Exploration de la Mer*, Mr. J. N. Carruthers describes a current measuring instrument which, lowered from an anchored raft or vessel, records the direction and velocity of the current. It is an advance upon the customary form of meter in that it may be left working for several days, when the velocity and direction of the residual current or drift of the water, over and above the tidal oscillations, can be found. The instrument has been put to fairly extensive use and has already provided very interesting information. It will undoubtedly prove of considerable value for purposes of fishery research in relatively shallow areas such as the North Sea and eastern end of the English Channel, where the drift of water carrying the egg and larval stages of fish plays an important rôle.

PROPORTIONS OF KRYPTON AND OF XENON IN THE ATMOSPHERE.—The values obtained in 1898 by Ramsay and Travers, shortly after the discovery of the above gases, and those obtained by Ramsay in 1903, differ greatly from one another. In the *Comptes rendus Acad. Sci.*, Paris, July 19, Messrs. C. Moureu and A. Lepape describe measurements made by the spectrophotometric method previously used by them. The two gases were fractionated from commercial argon by means of coconut charcoal cooled to suitable temperatures. The volumes obtained per unit volume of air were, kypton $1{\cdot}0 \times 10^{-6}$, xenon 9×10^{-8}.

SWEDISH RAINFALL.—The Swedish rainfall statistics for 1925 are already published in fairly considerable detail in Part 7 of *Årsbok* of the Swedish Meteorological and Hydrographical Institute. The greater part of a considerable volume is occupied with the data from 705 rainfall stations. In each case and for every month the figures given are the total, the heaviest fall in twenty-four hours, the number of days with precipitation of various stated amounts, and the days with hail and snow. The depth of the snow and its rainfall equivalent is added for certain stations. For the various departments of Sweden the duration of snow covering on the ground is given in another table. There are small scale rainfall maps for each month and a somewhat larger scale map for the year. The volume is very complete in the data it affords, but contains no discussion of the figures nor comparisons with the mean or any previous year.

Climate of New York State.—This subject is discussed by Mr. R. A. Mordoff in Bulletin 444 of the Cornell University Agricultural Experimental Station, Ithaca, New York. It is mentioned that the first organisation for local climatic observation in America was that inaugurated in 1825 by the New York Board of Regents. This was continued until 1863, when it was abandoned owing to the Civil War. In 1870 the National Weather Service was organised and five weather-observing stations were established in New York. Later, under the administration of the United States Weather Bureau, the number was increased to nine regular stations. It is said that New York State has a diversity of climate not usually encountered within an equally restricted area. Charts are given for each month showing the average temperature over the State. The temperature is greatly influenced by the proximity of the Lake Ontario and Lake Erie. Charts are also given showing the highest and the lowest temperatures recorded. During the summer months the maximum temperature often reaches 90° F. or above, and in winter temperatures of −40° F. are experienced in exposed localities. Frosts are dealt with and the periods when killing frosts occur. Precipitation over the State is shown by monthly rainfall maps; the heavy summer rains are largely due to thunderstorms. There is a good distribution of rainfall throughout the growing season. A serious drought affecting the State as a whole is of rare occurrence; the two most serious in recent years occurred in 1889 and 1908. Winds, sunshine, and humidity are discussed. Analysing past records, it is asserted that no change of climate can be traced.

The Inhibition of the Glow of Phosphorus.—It is now fairly certain that the propagation of the glow that accompanies the slow oxidation of phosphorus is a process comparable with the passage of flame through a combustible gas mixture. It is therefore possible to determine the rate of propagation by measuring the blast of gas necessary to maintain the glow in a fixed position. H. J. Emeléus describes the application of this method to experiments on the inhibition of the glow of phosphorus by ethylene, in the *Journal of the Chemical Society* for June 1926. Measurements of the effect of temperature on the action of the inhibiting substance at constant volume and constant pressure are included, and the mechanism of inhibition is discussed.

The Atomic Weight of Silicon.—The apparent variation of the atomic weight of boron with the source of supply, and the discrepancies between the published values of the atomic weight of silicon, have led P. L. Robinson and H. C. Smith to redetermine the atomic weight of silicon in materials from different sources. In order to make the comparison it was decided to determine the densities of silicon tetrachloride with great accuracy. The tetrachloride was prepared by chlorinating ferrosilicon manufactured from silicon from different sources, and was carefully purified by fractionation, shaking with mercury, sodium amalgam, and finally fractional distillation in a vacuum. A full description of the density determinations is contained in the *Journal of the Chemical Society* for June 1926, the measurements involving the use of glass floats, calibrated in a standard liquid (bromobenzene) with properties similar to those of the tetrachloride. It appears from the results that there is no variation in the atomic weight greater than 0·005 of a unit. (See letter by authors in the present issue of Nature, p. 303.)

Element 61.—Moseley's work on X-ray spectra showed definitely that an element with an atomic number 61 should exist between neodymium and samarium. Its isolation and X-ray analysis are the subjects of two papers by J. A. Harris and B. S. Hopkins, and by these two authors and L. F. Yntema, published in the *Journal of the American Chemical Society* for June 1926. When suitable rare earth minerals are fractionally crystallised using the double magnesium nitrates, element 61 concentrates between neodymium and samarium, but the ratio of the quantities of the new element and its neighbours is such that X-ray analysis fails to show its presence. Detection by absorption spectra, although more sensitive, fails on account of the width of the neodymium and samarium bands. If, however, the fractionation is carried out with the bromate series, element 61 concentrates with terbium and gadolinium, the former having one absorption band and the latter having none. By continued fractionation of this series the presence of a band was revealed which had always been regarded as due to neodymium. The crystallisation was continued until a fraction was obtained which contained sufficient of the new element for X-ray analysis. The *L*-series was investigated, and lines were obtained corresponding closely to the theoretical values for L_α and L_β of element 61. It is proposed to call the element illinium (Il), in honour of the state of Illinois and of the University (*v.* also Nature, June 5, p. 792).

Cosmical Creation of Matter.—The issue No. 15 of the *Sitzungsberichte Acad. Sci.*, Vienna, for 1926 contains a suggestion by Dr. A. Haas as to the possibility of the creation of matter at any point of the universe at which, at a given instant, radiation is excessively concentrated. If at such a point an incandescent gas is present having a mean molecular speed of the order of one-half or one-third of that of light, about a hundredth of the molecules will have speeds equal to that of light, and energies equal to that of a proton and an electron. The observations of the Compton effect show that it is possible that a light quantum impinging on such a fast-moving molecule may have its frequency increased, and a repetition of the impacts may so raise the frequency of the quantum that its energy becomes equal to that of a proton and electron, and it is transformed into these two constituents of matter.

A Mumetal Magnetic Shield.—A paper by Prof. A. V. Hill, describing an effective magnetic shield for a moving needle galvanometer, is published in the July number of the *Journal of Scientific Instruments*. The shield is constructed of 'mumetal' strip, wound alternately with copper strip on a copper cylinder. At each end it is closed by two mumetal plates separated by a copper plate. Although only two pounds of actual magnetic material is used in the device, a screening ratio of 1000 to 1 is obtained, which is a great advance on the screens in ordinary use. It seems highly probable, therefore, that moving needle galvanometers, after being neglected for some thirty years, will again come into favour. The sensitivity of these instruments is far higher than that of moving coil instruments, and the coils used can have a much lower resistance as they are not limited by the resistance of the suspension. Their only drawback is their liability to magnetic disturbance, and this has proved most troublesome in the past. It can now be almost wholly prevented by this shield made of a nickel-iron alloy. The editor of the *Journal* makes the useful suggestion that a shield could be employed as the case of a chronometer watch, and doubtless other uses can be found for it. It seems certain that cobalt steel permanent magnets and the use of nickel-iron shields will raise the sensitivity and greatly widen the sphere of usefulness of moving needle instruments.

The Recently Discovered Gibraltar Skull.

AT the Oxford meeting of the British Association the first authoritative account of the discovery by Miss D. A. E. Garrod of a human skull associated with Mousterian implements at the Devil's Tower, Gibraltar, was given in a session of the Anthropological Section. The discovery was made on a site which first attracted the attention of the Abbé Breuil in 1917, who observed fragments of bone breccia in a cleft facing an old signal station known as the Devil's Tower. From this he obtained a few Mousterian implements and bones of a variety of animal species, including hyæna and panther, which are now extinct in Spain.

Miss Garrod, who undertook the excavation of the site at the suggestion of the Abbé Breuil, found that the cave contained a succession of seven deposits, which emerge from the mouth of the cave and spread fanwise in a succession of steps. All levels of the deposits contained a large number of animal bones, some broken and burnt by man, some evidently the relics of an animal's lair. As the cave faces north, it was probably occupied by man in summer only and by animals in the intervals of human occupation. The animal bones included deer, wild goat, boar, and rabbit in abundance, and, rarely, horse and ox. Resting on the raised beach which formed the seventh and lowest deposit was a carpal bone of an elephant. Implements of Mousterian type were found at all levels down to the fifth, those of the second level being definitely assignable to the upper Mousterian, but no implements of a later industry and no pottery were found.

The removal by dynamite of a large block of limestone in the hard travertine of the fourth level opened up a number of fissures and led to the discovery of a human frontal bone at a depth of 15 cm. from the surface of the deposit. The left parietal was discovered half a yard away, but, whereas the frontal bone had been loosened from its matrix, the parietal was firmly embedded in the travertine and had to be brought away in a mass of that material for reduction in the laboratory. As explained by Mr. L. H. Dudley Buxton, to whom that task was entrusted, the freeing of the interior from the mass of deposit with which it was filled proved a particularly difficult and tedious operation. Implements of quartzite and flint definitely of Mousterian type, but less well made than those of the overlying levels, were found near the skull. The fact that the skull and the implements were found embedded in the travertine in a manner allowing no possibility of disturbance places the Mousterian age of the skull beyond question.

The anatomical characters of the skull were described by Mr. L. H. Dudley Buxton. Owing to the fact that the greater part of the month which had elapsed since the skull had been brought to England had been taken up by the task of freeing the fragile bone from the travertine in which it had been embedded, it was possible to put forward tentative conclusions only; but an attempt had been made to reconstruct the upper part of the skull. There is no doubt that the two fragments belong to the same skull. From various characters it would appear to be that of a very young person; but the exact age and the sex are difficult to determine. A comparison with the three skulls of Neanderthal man of immature age available—a skull of a child of five from La Ferrassie, the skeleton of a youth found at Le Moustier, and fragments of the skull of a child, perhaps of eight years of age, from La Quina—shows that it agrees with them in the characters in which they differ from those of modern skulls of corresponding age. The measurements, which, however, must at present be regarded as entirely provisional, indicate that the skull is broader in its proportions than would have been expected, nor are the eyebrow ridges and temporal fossæ developed in the manner distinctive of Neanderthal man. The most striking feature in the parietal bone is the fact that the parieto-squamous suture, which is more or less straight in the apes and the human infant and bowed in the adult man, in the Devil's Tower skull is most markedly bowed; but instead of a regular squamous suture, with a bevelled edge, the actual edge of the bone is only recessed very slightly—a condition which is to be attributed to age and not to race. On the provisional measurements which have been made the cranial index works out at 80, a high figure which further consideration may make it necessary to correct.

In view of the very tentative character of the conclusions put forward by Mr. Buxton, it would be premature to offer any comment. Opportunity to appreciate the bearing of the discovery will occur later when the skull has been examined more carefully and the results have been made public at a meeting to be held by the Royal Society. It may be pointed out, however, in the meantime, that its importance is two-fold. It affords some degree of corroboration of the Mousterian date of the Gibraltar skull discovered in 1848 not far from the Devil's Tower site—a corroboration much needed in view of the fact that the collection of implements made at the time of the earlier discovery has disappeared; and secondly, it adds another to the number of skulls of the Neanderthal race, and, what is most important, the specimen is of an age which will add much needed information to our knowledge of the process of growth in that interesting and peculiar variety of early man.

Adhesives and Adhesive Action.[1]

IN reviewing the first report of the Adhesive Research Committee, the present writer had occasion to remark on the extreme persistence of the three main types of adhesives, which documentary evidence shows to have been quite familiar to craftsmen of the eleventh century. Believers in proverbial wisdom, may incline to the opinion that this familiarity, continued through generations, has indeed bred the contempt with which the subject of adhesion—with or without adhesives—is generally treated in the literature of physics. In this respect the second report breaks entirely new ground in Appendix IV., entitled "Adhesives and Adhesive Action," by Prof. J. W. McBain and Dr. D. G. Hopkins, in which the authors attempt, with a considerable measure of success, to develop rational theories of the mechanism of adhesive action.

The first important conclusion at which they arrive is that there are two fundamentally different types of joints: those between porous surfaces and those between smooth, non-porous ones. In the first type the penetration of the adhesive, while liquid, into the pores of the surfaces to be united is an essential part of the effect. This view is borne out strikingly, apart from much other evidence, by comparison of the strengths of glued joints, made between plain and stained specimens of the same woods; the latter are considerably weaker, as the stain (a spirit varnish) fills the pores and prevents the penetration of the adhesive. It is in complete accord with this explanation that the diminution of strength is less marked with a very porous wood, like deal, than with a closer grained one, like walnut.

---

[1] Second Report of the Adhesives Research Committee, Department of Scientific and Industrial Research. Pp. iii + 118. (London: H.M. Stationery Office, 1926.) 3s. net.

For the second kind of joint, that between smooth, non-porous surfaces, the authors postulate some specific action between material and adhesive, and refer to Hardy's views on lubrications. They arrive at the conclusion that any liquid which wets the surfaces and can somehow be transformed into a solid will act as an adhesive for these surfaces. As soon as the statement is put in this form, it would seem to follow quite naturally from considerations of continuity, which does not lessen its novelty or importance. Very remarkable examples of such 'specific' joints are given; *e.g.* shellac joints between metal surfaces with a tensile strength of more than two tons per sq. in. Space does not permit more detailed discussion of the paper, which will be read with profit not only by those interested in adhesives, but also by any one who derives pleasure from seeing a complex problem attacked by the whole armoury of research.

Prof. Schryver briefly describes his attempts to isolate a pure standard gelatin or, incidentally, to decide whether a body of uniform composition answering to this description exists; the results are not conclusive. Dr. J. C. Kernot and Miss N. E. Speer have achieved a result of technical and economic interest by producing from suitably treated fish skins a glue quite free from "an ancient and a fish-like smell," such as in ordinary fish glues is disguised—or, as sensitive people might say, accentuated—by various additions. The same authors in another paper suggest improvements in the manufacture of bone glue. Appendix V. deals with the mechanical tests of adhesives for timber used by the Royal Aircraft Establishment; the general conclusion is reached that the causes of the large variations in the results of timber tests remain obscure, and that "until the degree of these variations has been reduced the present forms of test-piece are unsuitable for experimental or even inspection purposes."

Readers of the report will learn with regret, though without surprise, that important investigations on the manufacture of glue have had to be abandoned owing to lack of financial support from manufacturers—a position which is perhaps explained, though scarcely justified, by the great fall in the price of glue.

E. H.

Herrings along the Baltic Coast of Sweden.

IN *Publications de Circonstance* of the Conseil Permanent International pour l'Exploration de la Mer, No. 89, Chr Hessle surveys the herring investigations which have been carried on during the past few years along the Baltic coast of Sweden. Nets, both drifting and anchored, land-seines, and big traps are all used for the fishery, but the main part of the total catch is fished by nets. Although the bulk of the fish is landed between July and November, considerable quantities are taken during the winter and early spring. Ice on the water is a severe hindrance to the net fishery during the colder months, and in some places it may put a stop to fishing when, by all evidence, herrings are still present. In the archipelagos nets are sometimes used actually under the ice.

Baltic herrings are characterised by their small size, the low average number of vertebræ, and of the keeled scales behind the ventral fins. In contrast to these, the average number of the first vertebræ with closed hæmal arches is rather high. Both autumn-spawning and spring-spawning herrings occur, the former being of the greater economic value. Catches of autumn-spawners nearly always contain a percentage of spring-spawners, the proportion varying with the season and from year to year. In these catches of mixed fish the spring-spawners are generally smaller in size This is due partly to the greater percentage of smaller fishes among the spring-spawners, but also to the fact that the rate of growth of the spring-spawners is inferior In both classes the rate of growth is exceedingly slow after the second or third year. Spawning would seem to occur in the same places for both autumn and spring fish, the former spawning at a temperature of 11°-14°, and the latter at 6°-10°.

In the innermost parts of the archipelagos, and especially in the fjords which penetrate deep into the country of the Middle Baltic, there is a fishery which is based on stationary local races in waters so closed and isolated that sea herring do not enter them. The size and rate of growth of these isolated fjord herrings show a very great variability. Gudingen and Gamlebyviken are two fjords separated only by a narrow strip of land: in Gudingen the rate of growth is quite normal, but in Gamlebyviken sexually ripe fish of only 10 cm. in length have been taken.

Along the coast of the Gulf of Bothnia herrings are caught in traps, fishing commencing as soon as the ice breaks up in the spring, and lasting until midsummer. The bulk of these 'ice herring' are spring-spawners, and a typical feature of the catches is the great number of remarkably large fish which show a peculiar mixture of characters and habits typical of one or another of the races previously dealt with. Altogether Hessle has provided us with a most interesting and instructive paper.

University and Educational Intelligence.

ABERYSTWYTH.—Dr W. Robinson, senior lecturer in the department of cryptogamic botany in the University of Manchester, has been appointed to the chair in botany in University College, Aberystwyth, in succession to Prof. Lloyd Williams, who retires under the age limit in September.

CAMBRIDGE.—The University Commissioners have published a number of regulations that they have made for bringing into action next term the new statutes governing the General Board and the various faculty Boards. They have also published further regulations which they propose to make—after discussion by the Senate—on the election of members of the Council, degree committees, the Buildings Syndicate, and University finance. The chief point on which discussion is likely to take place is the proposal that members of the Council shall be elected by the method of the single transferable vote. So far as the election of ordinary members of the Regent House is concerned, where four members are elected at a time, this provision is probably suitable, as it will ensure representation on the Council of different groups of electors. It is doubtful, however, whether this method secures the most effective result in the case of the election of the other two groups—(*a*) heads of colleges, and (*b*) professors and readers. Here only two members are elected at a time in each class. So far as University politics is divided into two fairly even parties, this method generally means the election of one candidate from each party—not by any means necessarily the best way of electing an executive body.

Mr A. Hopkinson, Emmanuel College, has been reappointed demonstrator in anatomy.

THE Air Ministry announces further appointments to short-service commissions in the Royal Air Force to be made in September Applications are specially welcome from young men who have had some engineering training or have shown a bent towards mechanical matters in their private amusements, as well as from those who are keen sportsmen and have a leaning towards travel and adventure. Short-service officers are taught to fly and at the same time receive instruction in aeronautical engineering, armament, navigation, etc Service in the R.A F. counts in part towards the period necessary to become associate members of the Institute of Mechanical Engineers. Applications for regulations should be addressed to the Secretary, Air Ministry, Adastral House, Kingsway, W.C.2. Candidates must be between 18 and 25 years of age, should have received whole-time education at least up to the age of 16 years, and should possess good physique and eyesight.

THE Ramsay Memorial Fellowship Trustees have made the following awards of new fellowships for the session 1926–27 :—A British Fellowship of 300*l*., tenable for two years, to Dr. R. F. Hunter, for work at the Imperial College, London ; a Glasgow Fellowship of 300*l*., tenable for two years, to Mr J. D. Fulton, for work at the University of Manchester ; a Swedish Fellowship of 307*l*., to Mr. Gunnar Hagg, for work at University College, London , a Swiss Fellowship of 300*l*., tenable for one year, to Dr. Max Brunner, for work at the University of Cambridge. The Trustees have renewed the following Fellowships for a year , Mr. G. A. Elliott (British Fellowship)—at University College, London ; Mr. T. Corlett Mitchell (Glasgow Fellowship) — University of Cambridge , Dr. D. McKay Morrison (Canadian Fellowship)—University of Cambridge ; Mr W. G. Burgers (Netherlands Fellowship)—Royal Institution, London; Dr. Ekonomopoulos (Greek Fellowship)—University College, London ; Dr. P. Misciattelli (Italian Fellowship)—University of Oxford ; Mr. Erik Rudberg (Swedish Fellowship)—King's College, London.

THE League of Nations Committee on Intellectual Co-operation has received from its sub-committee of experts recommendations concerning the instruction of children and young people in the existence and aims of the League. These recommendations raise questions of principle of the highest importance. It is proposed to request Governments to include the subject in their programme of studies and to ensure that the relevant text-books mention it, that education authorities should arrange that in examinations, questions on the League should be set whenever practicable, and that universities should organise special courses of at least six lectures which all students might attend. In addition numerous devices are recommended for propagating knowledge of the League and its gospel, such as the dissemination of books and periodicals, lantern slides, kinematograph films and radio broadcast addresses, special courses for teachers, celebration of League Days at schools, essay competitions, inspirational lectures, and national conferences. The exact place which this instruction will occupy in the curriculum and the time to be allotted to it are, the sub-committee remarks, questions which should be left for the national or local authorities to decide, but it is recommended that it should be correlated with the lessons in " geography, history or civics." Where civics is included in the school curriculum a teacher may fairly be expected to give some instruction about the League of Nations, but where it is not, it is open to question whether such instruction should be smuggled in as " geography " or " history."

Contemporary Birthdays.

August 27, 1865. Prof. James Henry Breasted.
August 28, 1858. Prof. Roland Thaxter.
August 30, 1871. Sir Ernest Rutherford, O.M., P.R.S
September 1, 1877. Dr. F. W. Aston, F.R.S.
September 1, 1859. Dr. Walter Gardiner, F.R.S.
September 2, 1877. Prof. Frederick Soddy, F.R.S.
September 3, 1882. Dr. William Lawrence Balls, F.R.S.

Prof. J. H BREASTED, the accomplished American Egyptologist, was born at Rockford, Illinois. His interests early centred in the University of Chicago. Since 1905 he has been professor there in Egyptology and Oriental history. In 1894–95 he was collecting in Egypt for the University, and, later, director of its Egyptian Expedition. In 1920 he was in charge of an archæological survey of Mesopotamia. Prof. Breasted is an honorary fellow of the Society of Antiquaries of London, and D Litt , Oxford.

Prof. THAXTER, who was born at Newton, Mass., U.S.A., graduated at Harvard Assistant professor of cryptogamic botany there from 1891 until 1901, he later occupied the chair, and he has been, since 1919, emeritus professor. He is the author of many papers on the fungous diseases of insects. Prof. Thaxter is a foreign member of the Linnean Society.

Sir ERNEST RUTHERFORD, president of the Royal Society, Nobel laureate in chemistry, 1908, was born at Nelson, New Zealand. He was educated at the University of New Zealand and Trinity College, Cambridge. After prosecuting research work at the Cavendish Laboratory, he left England in 1898 to occupy the chair of experimental physics in McGill University, returning in 1908. His record of accomplishment in the domain of radioactivity and atomic structure is world known.

Dr. ASTON, Nobel laureate in chemistry, 1922, was born at Harborne, Birmingham, and educated at Malvern College and the University of Birmingham. In 1910 he became one of Sir J. J. Thomson's research assistants at the Cavendish Laboratory, Cambridge. Here it was, under stimulating associations, that Dr. Aston engaged in his classical researches on isotopes. In 1922 the Royal Society awarded him its Hughes medal for his " discovery of isotopes of a large number of the elements by the method of positive rays."

Dr. GARDINER was educated at Bedford, graduating at Clare College, Cambridge. Sometime a science lecturer at Girton, and University lecturer in botany, he received one of the Royal Society's Royal medals in 1898, at the hands of Lord Lister. His researches in vegetable histology established that the protoplasm in the tissues of plants is continuous from cell to cell. Other work of his dealt with the function of tannin, protoplasmic contractility, and the phenomena accompanying stimulation in insectivorous plants.

Prof. SODDY, Nobel laureate in chemistry, 1921, a graduate of Merton, was born at Eastbourne Early, at McGill University, Montreal, he was working under the inspiring guidance of Sir Ernest Rutherford, engaged in researches on radioactivity ; afterwards he was with Sir William Ramsay at University College, London, a period when proof was obtained with the spectroscope of the production of helium from radium. Occupant of the chair of chemistry in the University of Aberdeen from 1914 until 1919, he left to become Lees professor of chemistry in the University of Oxford.

Societies and Academies.

CAMBRIDGE.

Philosophical Society, July 26.—P. A. M. **Dirac**: On quantum algebra In this algebra the commutative law of multiplication no longer holds, but the other axioms of ordinary algebra are still valid. A general definition of a function is proposed, and the differential coefficient is defined without introducing the idea of a limit —Miss B. **Swirles**: The polarisabilities of atomic cores The polarisabilities of the cores of several atoms are calculated from the terms of their spectra by means of a formula due to Born and Heisenberg. The values so obtained agree with those given by a modification of the dispersion formula of Kramers and Heisenberg —J. R **Oppenheimer**: On the quantum theory of the problem of the two bodies. (Preliminary communication.) In addition to the Balmer terms derived by Pauli, Schrodinger and Dirac, the line intensities are computed; for example, the first Balmer emission line is 12·2 times as intense as the second Lyman line, and the first Balmer absorption line is 5·37 times as intense as the second. The probabilities of transition and capture are derived, and a method of obtaining the deflexion spectrum is sketched. The argument is based throughout on Schrödinger's theory.—G. P. **Thomson**: An optical illusion due to contrast. A blackened strip on a photographic negative sometimes has the appearance of being blacker at the edges than the centre, though the reverse is found to be the case when measurements are made by a photometer The edges are narrower and clearer the more rapid the transition from light to darkness, but become too narrow to be seen when the transition is made as abrupt as possible. The eye appears to see rapid change of blackness as enhanced blackness A converse effect appears for a light strip on a blackened ground.—M. H A. **Newman**: Integral invariants of the affine field.—A **Young** and H. W. **Turnbull**: The linear invariants of ten quaternary quadrics.—G S. **Mahajani**: A contribution to the theory of ferromagnetism.—E. B. **Moullin**: On some resistance properties of a certain net-work containing inductances and capacities, and their analogies in a mechanical system. If the network is in acceptor resonance at a certain frequency when excited from a particular member, then it will also be in resonance when excited from any other member, but then the resonance may be either acceptor or rejector —J. C. **Burkill**: On Mellin's inversion formula.—Major P. A. **MacMahon**: The elliptic products of Jacobi and the theory of linear congruences.—R. **Hargreaves**: Geodetic and dynamical principles, a comparison and connexion.—J. R. **Oppenheimer**: On the quantum theory of vibration-rotation bands The dynamical problem of the diatomic molecule is solved on the new mechanics. The quantum numbers, chosen to give a normal state, are $n=\frac{1}{2}, \frac{3}{2}\ldots$; $m=-\frac{1}{2}, -\frac{3}{2}, -\frac{5}{2}\ldots, \frac{1}{2}, \frac{3}{2}, \frac{5}{2}\ldots$; $r=-m+\frac{1}{2}\ldots, +m-\frac{1}{2}$. The frequencies differ from the classical frequencies for half integral vibrational and rotational quantum numbers in having $m^2-\frac{1}{4}$ for m^2 in the coupling term. The weights of the m states are $2m$ The intensity of the central line of the band vanishes. The intensities of the lines are worked out to the second order in ν_{rot}/ν_{vib}—P. A. **Taylor** An approximation to the motion of two rotating electrical doublets in a plane —D. R **Hartree**: Some relations between the optical spectra of different atoms of the same electronic structure (ii) Aluminium-like and copper-like atoms. For penetrating orbits of the series electron, the quantum defect can be expressed as the sum of contributions from the groups of core orbits of different principal quantum number. Based on this, relations are obtained between the values of the quantum defect for corresponding terms of the spectra of an atom of a given element in different states of ionisation, and of different atoms in such states of ionisation that they have the same electronic structure.—J. P. **Gabbatt**: Note on the extension to higher space of a theorem of Wallace.—J B. S. **Haldane**: A mathematical theory of natural and artificial selection (Pt. iii.).

ROME

Pontifical Academy of Sciences (**Nuovi Lincei**), June —**Gemelli**: Perception of the position of the body in relation to the sensation of equilibrium of an aeroplane pilot. The importance of muscular, cartilaginous, and tactile sensations, in opposition to those of the semi-circular channels of the ear, is emphasised Anile, however, reaffirms the importance of such channels with reference to the equilibrium, and states that these studies necessitate consideration of the vast and complex relationships between the vestibular nerve and the nervous centres.—**Luigioni**: A case of trifid antenna in *Demetrias atricapillus*, a small coleopterous insect of the scarab family.—**Teofilato**: Motion of a weight in a medium with viscous resistance.—**Pagnini**: Hypotheses serving as foundation for the undulatory theory.—**Gianfranceschi**: De momento theoriae physicae circa quanta. The bases and the results of the quantum theory are examined and those of real value indicated.—**Scatizzi**: The demonstration of formal generality by means of differential equations of a typical case of the ideal problem.—**Colonnetti**: Experimental investigations on elastic co-actions. Results are given of the study of a rectilinear beam and of a ring subjected to the action of a source of heat which induces in them a state of co-action.—**Giorgi**: Unsolved questions in the fundamental theories of electromagnetism.—Isabella **Biasi**. The extension of Birichbet's theorem to the general typical case of impulsive function

SYDNEY.

Linnean Society of New South Wales, June 30.—R. J. **Tillyard**. Upper Permian insects of New South Wales (Pt. ii). The orders Mecoptera, Paramecoptera and Neuroptera. These fossils are from Belmont and Warner's Bay and belong to three closely allied holometabolous orders. The Mecoptera are represented by no less than two families, five genera and eighteen species, this being the largest fossil Mecopterous fauna yet discovered, though the Lower Permian of Kansas comes fairly close to it with six genera and fourteen species. This order is also the oldest of the three, as it can be traced back into the Upper Carboniferous. The most abundant genus is Permochorista Till, of which eleven species are described Fragments of the wings of this genus are the commonest fossils in these beds. The order Paramecoptera is not known outside these beds, and there are only two species; they are interesting as being the early ancestral types from which the orders Diptera, Trichoptera and Lepidoptera have evolved. The Neuroptera are represented by one family, four genera and eight species of the suborder Planipennia —A. P **Dodd**: New species of Australian Proctotrypoidea, with revisional notes. One new genus in the family Scelionidæ and ten new species in the families Scelionidæ, Belytidæ and Diapridæ are described.—G. H. **Hardy**: A new classification of Australian robberflies belonging to the subfamily Dasypogoninæ (Diptera, Asilidæ) Eighteen genera of the Dasypogoninæ are recognised and are divided into three tribes, Brachyrrhopalini (4 genera), Saropogonini (10) and Phellini (4).—May M. **Williams**: Contributions to the cytology and phylogeny of the siphonaceous Algæ. (2) Oogenesis and spermatogenesis in *Vaucheria geminata*. The young oogonia and antheridia are multinucleate, the ultimate uninucleate condition of the oogonium resulting from the degeneration of the supernumerary nuclei. These latter are regarded as being potential gameto-nuclei, and potential and functional gameto-nuclei are homologous There is no mitosis occurring in the oogonium or antheridium in connexion with the development of these organs. The Vaucheriaceæ are regarded as being derived from a Cladophora-type with gametangia liberating free gametes. They probably represent an end line of development.

Royal Society of New South Wales, July 7.—A. R. Penfold : The essential oils of *Leptospermum lanigerum*, Smith (Pt. 1). This Myrtaceous shrub is widely distributed, and is especially plentiful in the southern districts of New South Wales, where it follows the water courses. The chemical results obtained by an examination of material collected at Monga, near Braidwood, New South Wales, points to the separation of two extreme forms of this shrub. The type has silvery leaves, and yields 60-75 per cent. of aromadendrene and eudesmene, 16-20 per cent. d-a-pinene, with smaller quantities of citral, geraniol, geranylformate and cinnanamate, etc. The leaves of form A are bright green, and it yields 40-60 per cent. d-a-pinene, 40-45 per cent darwinol and its acetate, with smaller quantities of sesquiterpene and its alcohol.

Official Publications Received.

Proceedings of the Cambridge Philosophical Society. Vol. 23, Part 3, July. Pp. 191-335. (Cambridge : At the University Press.) 7s. 6d. net.

Museo Nacional de Historia Natural "Bernardino Rivadavia," Buenos Aires. Memoria Anual de 1924. Por M. Doello-Jurado. Pp. 118+44 plates. (Buenos Aires.)

The Rockefeller Foundation : a Review for 1925. By George E. Vincent. Pp. 59. (New York City.)

The Memoirs of the Imperial Marine Observatory, Kobe, Japan. Vol. 2, No 2. A Note on the Characteristic Movement of Spots, Faculæ and Flocculi of the Sun. By Rikita Sekiguti. Pp 83-110. (Kobe.)

Memoirs of the College of Science, Kyoto Imperial University. Series B. Vol. 1, No 3 : Notes on the Volcanic and Seismic Phenomena in the Volcanic District of Shimabara, with a Report on the Earthquake of December 8th, 1922, by Prof. Takuji Ogawa ; Notes on a Fossil Elephant from Sahamma, Tôtômi, by Prof. Jirô Makiyama. Pp. 201-264+plates 6-16 Vol 1, No. 4 Studies on the Surface Characters of Minerals. 1: Electro-chemical Behavior of the Crystal Surface of Pyrite. By Atsushi Matsubara. Pp. 235-332+plate 19. Vol. 2, No. 1 : On the Structure of the Anaphasic Chromosomes in the Somatic Mitosis in *Vicia Faba*, with special reference to the so-called Longitudinal Split of Chromosomes in the Telophase, by Yoshinari Kuwada ; A Study of the Mycorrhiza of *Abies firma*, S et Z, with special reference to its Mycorrhizal Fungus, *Cantharellus floccosus*, Schw., by Koki Masui ; On the renewed Growth of the Mycorrhizal Root, by Koki Masui. Pp 92+6 plates. Vol. 2, No 2: Contributions to the Knowledge of the Intestinal Secretion of Insects 1: Mid-Intestinal Secretion of Lepidoptera, with an Appendix : Behavior of Mitochondria in the Mid-Intestinal Epithelium of the Silk-worm *Bombyx mori*, L., by Osamu Shinoda ; Einige Beobachtungen uber die Ernahrungsbiologie der wilden Seidenraupe, *Dictyoploca japonica*, Moore, von Osamu Shinoda. Pp 93-128+plates 7-10. Vol. 2, No 3. Studies on the Surface Characters of Minerals ii. The Distribution of Tarnish Colours on the Crystal Surface of Pyrite, by Atsushi Matsubara ; Studies on the Surface Characters of Minerals iii a simple Method for the Determination of the Surface Stability of some Minerals, by Atsushi Matsubara ; Tertiary Fossils from North Kankyô-dô, Korea, by Prof. Jirô, Makiyama. Pp. 129-160+plates 11-13. (Kyoto.)

U S. Department of Agriculture. Farmers' Bulletin No 1489: The Green June Beetle Larva in Tobacco Plant Beds By K. B McKinney and Joe Milam Pp ii+6. (Washington, D.C. : Government Printing Office) 5 cents.

Proceedings of the Society for Psychical Research. Part 99, Vol. 36, July. Pp. 171-343. (London : Francis Edwards.) 7s 6d. net

Conseil Permanent International pour l'Exploration de la Mer. Bulletin Statistique des Pêches maritimes des Pays du Nord et de l'Ouest de l'Europe. Rédigé par D'Arcy Wentworth Thompson. Vol. 13, pour l'annee 1923 Pp. 113. (Copenhague : Andr. Fred Host et fils)

Carnegie Institution of Washington : Eugenics Record Office Bulletin No. 25 The Families whence High Intelligence Springs. By Grace Allen Pp 39 (Cold Spring Harbor, Long Island, N Y.)

Royal Botanic Gardens, Kew Picture Postcards. Set 13 : Stove and Greenhouse Plants. 6 cards in colour. Set 14 : Roses (Rosaceæ.) 6 cards in colour. Set 15 : Orchids (Orchidaceæ) 6 cards in colour. Set 16 : Decorative Plants. 6 cards in colour. (Kew : Royal Botanic Gardens.) 1s. per set

Mitteilungen der Naturforschenden Gesellschaft in Bern aus dem Jahre 1925. Pp. xxx+82. (Bern : K. J. Wyss Erben.)

Diary of Societies.

SATURDAY, AUGUST 28.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students' Section) (at Newcastle-upon-Tyne), at 3.—Capt W. Ridley : The Mineral Wealth of the British Empire.

CONGRESSES.

AUGUST 27 AND 28.

IRON AND STEEL INSTITUTE (Autumn Meeting) (at Stockholm).—F. Adcock The Effect of Nitrogen on Chromium and some Iron Chromium Alloy (Alloys of Iron Research, Part IV.).—J H. Andrew and H A Dickie A Physical Investigation into the Cause of Temper Brittleness —Prof C Benedicks, H. Backstrom, and P. Sederholm : Anomalies in Hea Conduction, with some Determinations of Thermal Conductivity i Iron and Carbon Steels.—Prof C. Benedicks and R. Sundberg Electrochemical Potentials of Carbon and Chromium Steels.—G. F. Comstock The Treatment of Steel with Ferro Carbon-Titanium —G. A Hankins D. Hanson, and Miss G. W. Ford The Mechanical Properties of Fou Heat-Treated Spring Steels.—Prof K. Honda : Is the Direct Change from Austenite to Troostite Possible?—A. Johansson and R. Von Seth. Th Carburisation and Decarburisation of Iron and Some Investigations o the Surface Decarburisation of Steel.—A. Johansson and A. Wahlberg The Development of the Swedish Iron and Steel Industry during th last thirty years —E Kinander : Notes on Jernkontoret.—A. Lundgren The Testing of Hardened Steel.—W Petersson : Notes on the Development of the Swedish Mining Industry during the last twenty-five years —G. Phragmen : The Constitution of the Iron-Silicon Alloys.

AUGUST 29 TO SEPTEMBER 1.

SOCIÉTÉ HELVÉTIQUE DES SCIENCES NATURELLES (at Fribourg).—I Sections devoted to Mathematics, Physics, Geophysics, Meteorolog and Astronomy, Chemistry, Geology, Mineralogy and Petrography General Botany, Special Botany and Geographical Botany, Zoology Entomology, Anthropology and Ethnology, Palæontology, Medica Biology, History of Medicine and Natural Science.

AUGUST 31 TO SEPTEMBER 8.

WORLD POWER CONFERENCE (at Basle), Technical Programme of Sections Meeting :

Utilisation of Water Power, and Inland Navigation.
Exchange of Electrical Energy between Countries.
The Economic Relation between Electrical Energy Produce Hydraulically and Electrical Energy Produced Thermally : Condition under which the two systems can work together with advantage.
Electricity in Agriculture.
Railway Electrification.

SEPTEMBER 1 TO 4.

INSTITUTE OF METALS (Autumn Meeting) (at Liege).

Wednesday, September 1, at 8.—Dr. W. Rosenhain : Ancient Industries an Modern Metallurgy (Autumn Lecture).

Thursday, September 2.—L. Boscheron : An Account of the Non-Ferrou Metals Industry in the Liége District.—Dr. A. G. C. Gwyer an H. W. L. Phillips : The Constitution and Structure of the Commercia Aluminium-Silicon Alloys With an Appendix upon The Properties o the Modified Aluminium-Silicon Alloys, by Dr. D. Stockdale and I Wilkinson.—J. D. Grogan : Some Mechanical Properties of Silicon Aluminium Alloys.—B. Otani Silumin and its Structure.—H. J Gough, S J Wright, and Dr. D. Hanson : Some Further Experiment on the Behaviour of Single Crystals of Aluminium under Reverse Torsional Stresses.—P. Chevenard : Thermal Anomalies of Certai Solid Solutions —W. T. Cook and W. R. D. Jones : Preliminar Experiments on the Copper-Magnesium Alloys.—Dr. K Honda : Comparison of Static and Dynamic Tensile and Notched-Bar Tests.

Friday, September 3.—Dr. C. J. Smithells, H. P. Rooksby, and W. E Pitkin : The Deformation of Tungsten Crystals.—A. Pinkerton an W. H. Tait : Season-Cracking in Arsenical Tubes —Dr C S. Smit and Prof. C. R Hayward : The Action of Hydrogen on Hot Soli Copper —F. W. Rowe : Bronze Worm-Gear Blanks produced by Centr fugal Casting.—Kathleen E Bingham : The Constitution and Ag Hardening of Some Ternary and Quaternary Alloys of Aluminiu containing Nickel —Capt. F. R. Barton : Development of the Use c Nickel in Coinage.—C H M. Jenkins : The Constitution and th Physical Properties of the Alloys of Cadmium and Zinc.—G. F Phillips : The Primitive Copper Industry of America. Part II

SEPTEMBER 6 TO 11.

AMERICAN CHEMICAL SOCIETY (at Philadelphia).—In eighteen Divisiona Gatherings, dealing with various branches of Pure and Applie Chemistry.

SEPTEMBER 12 TO 18.

INTERNATIONAL CONGRESS FOR APPLIED MECHANICS (at Federal Technic University, Zurich)—Lectures by Prof. P W. Bridgman, Prof. I Debye, Prof T. Levi-Civita, Prof. L. Prandtl, and Prof. G. I. Taylor.

SEPTEMBER 13 TO 17.

INTERNATIONAL CONGRESS OF PHILOSOPHY (at Harvard University Cambridge, Mass.).

SEPTEMBER 19 TO 26.

GERMAN SCIENTIFIC AND MEDICAL ASSOCIATION (at Dusseldorf).

SEPTEMBER 22 TO 24.

GERMAN RÖNTGEN SOCIETY (at Dusseldorf).—Discussions on X-ra Treatment of Inflammation, the Compton Effect, and Irradiation of th Ovary and Offspring.

SATURDAY, SEPTEMBER 4, 1926.

CONTENTS.

PAGE
The Social Implications of Biology 325
The Solid Foundation of Organic Evolution. By E. B. P. 329
Sunshine and Health 330
Vacuum Practice. By Dr. Norman R. Campbell . 331
Geography and Geology of Makalla. By A. B. T. 332
Our Bookshelf 333
Letters to the Editor:
  The Recurrence of Magnetic Storms.—Dr. C. Chree, F.R.S. 335
  Prof. Labbé's Production of 'Allomorphs' by the Action of increased Hydrogen Ion Concentration.—Robert Gurney 336
  Scattering of Electrons in Helium.—E. G. Dymond 336
  Intensity and Polarisation of Skylight at Sunrise and Sunset.—Dr. K. R. Ramanathan . . . 337
  Medical Entomology and the Tropical Field Worker.—Malcolm E. MacGregor 338
  Accurate Square Roots.—Prof. Frank Schlesinger 338
  The Polishing of Surfaces.—James M. Macaulay 339
  The Planetismal Hypothesis.—Prof. E. H. L. Schwarz 339
  Zoological Nomenclature: Suspension of *Sarcoptes*, type *passerinus*, in favour of *Sarcoptes*, type *scabiei*.—Dr. C. W. Stiles 339
The Optical Works of Sir Howard Grubb, Parsons and Company 340
The Mechanics of the Electric Field. By Sir J. J. Thomson, O.M., F.R.S. 342
Coal Ash and Clean Coal. By H. J. Hodsman .. 345
Obituary:
  Dr. C. W. Eliot 346
  Mr. W. Fawcett 347
News and Views 348
Research Items 352
Phytopathology and Private Enterprise. By L. . 355
A British Expedition to the Sepik River, New Guinea 356
The Pelagic Young of the Cod 356
The Haslemere Educational Museum . . . 357
University and Educational Intelligence . . . 357
Contemporary Birthdays 358
Societies and Academies 358
Official Publications Received 359
Diary of Societies and Congresses 360

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

The Social Implications of Biology.

At the recent meeting of the British Association at Oxford several of the sectional presidential addresses necessarily dealt with biological themes. But what was noteworthy was that certain of these addresses were devoted to attempts to answer various aspects of the question: "Taking for granted that the laws of biology and heredity have been in broad outline correctly ascertained, what lessons can be deduced therefrom for us in our present social environment?" Prof. Graham Kerr dealt with "Biology and the Training of the Citizen," Dr. Drever with the "Psychological Aspects of our Social System," Sir Josiah Stamp with "Inheritance as a Social Factor," and Sir Daniel Hall with the "Relation between Cultivated Area and Population." We propose to consider some of the conclusions to which these representatives of scientific work and thought have been led by their survey of biology.

Prof. Kerr rightly stresses the fact that the general truth of evolution is doubted by no intelligent educated man. However much biologists may differ from one another as to the nature and causes of variation, they are all agreed that one form of life has gradually grown out of another, and that there has been no interruption of the stream of life by the intervention of a creative fiat, however this stream may have started. As Prof. Kerr says, the facts of palæontology and embryology are decisive on this point, and also as he might justly have added, the facts of detailed systematic biology. With the growth of our great museums and the gradual collection of abundant material from all parts of the world, the insensible passage of the slightly marked and barely distinguishable local variety into the well-marked species has been clearly demonstrated, and the man who cannot see in this the proof of evolution is wilfully blind.

But Prof. Kerr plaintively asks, If this be so, why is it that so small a portion of school time is devoted to teaching the all-important truths of science to the young? Why in the twentieth century is our education still predominantly academic and literary? We are living beings, and biology deals with the laws of life and physical science with the workings of this wonderful Universe in which we find ourselves placed; surely it is the knowledge of these things that should constitute the greater part of the teaching which we receive when we are young. Why in a word do we not imitate these noble savages, the Indians of El Gran Chaco, amongst whom Prof. Kerr's early years as a biological researcher were passed, and who have left such an indelible impress on his memory? These people make their knowledge of biology—in a word the nature and habits of the animals which they hunt—the main theme of youthful education, whilst we stupidly burden the minds of our boys with the grammar of Greek and Latin, though scarcely any of them ever get far enough to read and enjoy classical literature.

Now reasoning of this kind appears to be at first sight unanswerable, but the matter is not so simple as it seems. To begin with, the 'academic and literary' education is given only to a comparatively small minority of our citizens: the pupils chiefly of our public schools. The vast majority receive only an elementary school education, which is intended just as truly as the education of El Gran Chaco Indians to fit citizens for their future environment. They learn something about the constitution and history of their own country, of its geography and place in the world, and of its traditional religious beliefs. They are also taught a number of things about the common domestic animals, and if they learn a good deal less than the Indian about wild animals, they are after all much less likely to meet them.

It is in their later years of school life, however, when children's minds have developed so that they could grasp such things, they might with advantage be taught a great deal more about the biological laws governing their own bodies. A great philanthropist and eminent man of business once complained to us that nowadays mothers trained in elementary schools could teach their daughters nothing about the care of babies. The traditional lore handed down from their own mothers had been forgotten, and he added the astounding statement that the lives of many babies were nowadays saved by the habit of giving them pickles! This crude and drastic introduction of acetic acid into the infantile stomach, to whatever local discomfort it might give rise, at any rate protected the baby against the deadly complaint of infantile diarrhœa by killing the putrefactive bacilli derived from the decomposing cow's milk on which it was fed.

Prof. Kerr thinks that an outline sketch of the laws of biology might also teach the alumnus of the elementary school that all life was necessarily striving and struggle, that men were born unequal, and that society could only progress if the best were selected. We think that on the whole he is right; but he is really knocking at a door which is already being opened; educational authorities are moving in the direction of increasing the amount of scientific teaching in elementary education. If, however, Prof. Kerr's knocking accelerates the opening we shall be the better pleased.

It seems to us, however, that the gravamen of Prof. Kerr's attack is directed against the literary education of the public schoolboy, for from the class to which he belongs are still drawn the bulk of our leaders, both in politics and in science. The leader amongst savages, Prof. Kerr avers, is chosen for his capacity of doing things, whilst under our system he is selected for his ability to talk. Now Prof. Kerr seems to forget that there are two elements in education; first, the giving of useful information, and secondly, and by far the most important, the training and development of the mind, the instrument by which this information is to be used. The question then arises, "How do the boys trained in public schools and in their extensions, our older universities, quit themselves in after life?"

The answer is not doubtful. Our political leaders, whatever their shortcomings, are on the whole the best in the world; and it is noteworthy that the exceptions to the rule have not been trained in public schools. Our colonial administrators are universally admired. Our Darwins, Lyells, Kelvins in most cases began their educations with a classical training. Michael Faraday was of course a great exception. Continental scientific men have in nearly every case also had a classical foundation for their education; this is certainly true of France and Germany. The one great country of which this is not true is the United States. Is Prof. Kerr prepared to maintain that our men of science cannot hold their own with those of the United States? If he is, we can only say that we do not agree with him, and in this we should be supported by the most thoughtful American opinion.

Space forbids our entering into a discussion as to how the classical training effects its object, but we would direct Prof. Kerr's attention to two things. First, that great naturalist, Dr. Bateson, whose untimely death we all deplore, admitted that he was a 'failure' so far as classics was concerned, yet he led a crusade in favour of the retention of compulsory Greek in Cambridge. Secondly, when about twenty-five years ago, classical training on account of its supposed inutility had been reduced to a minimum in American education, the consequences of this step were so flagrantly disastrous that a strong movement was begun to restore this teaching as an essential element in education. In general, it may be said that the English educational system is fundamentally good. Like all human things, however, it gradually becomes out of date, but the cure for this is careful modification and adaptation—such as is Nature's way in evolution—not uprooting and entire reconstruction as Prof. Kerr seems to suggest.

Dr. Drever deals with the evolution of punishment. He imagines that it began with anger and revenge, the natural reaction of the human animal to any action which incommoded him or caused him pain. But this stage is common to man and the lower animals. The history of man is the history of the evolution of society, and punishment is a social phenomenon. Dr. Drever hints that the next stage was the limitation of revenge by the instinct of the onlookers to see 'fair play.' This we think rather doubtful. Even the most rudimentary form of social life has to be held together by rules or 'tabus.' The infringement of one of the tabus was believed to involve danger to the tribe because of its offence to the supernatural powers, and the punishment of the offender was an endeavour to avert their anger; and this motive in modern dress, namely, the protection of society, remains the fundamental justification of punishment to-day. This, it is true, Dr. Drever recognises, but he argues that if punishment is really to act as a deterrent, the psychological state of the criminal should be examined. This is altogether too narrow a view. The main deterrent effect of punishment is the fear which it implants in the hearts of others lest they too suffer the same fate.

The safety of society is the primary matter; the all-important thing is that the influence of the criminal should be removed, whether by temporary or permanent segregation, in a word, imprisonment or by execution. This is indeed the modern way of eliminating the unfit. If, however, the criminal can be reformed and restored as a useful member of society, so much the better, but we think that Dr. Drever exaggerates when he says that in this respect our penal code is glaringly inefficient. He would have each criminal psychologically examined before being sentenced, in order to form an opinion as to his probable reaction to punishment, and so make the punishment fit the crime. We shudder to think what would become of our administration of law were proposals like this carried out, and how soon the wily criminal would learn to adjust his 'psychological state' to the mind of the investigator. The most hopeful class of criminals with which to experiment are the youthful beginners; and here, as a writer to the *Times* has pointed out, the "First Offenders Act" and our Borstal institutions have already done enormous good. In large measure, therefore, Dr. Drever's hopes have been realised in practice, though modifications of detail may no doubt be desirable.

Sir Josiah Stamp in his address entitled "Inheritance as a Social Factor" has subjected to a penetrating and illuminating analysis the modern socialistic views upon the inequality of the distribution of wealth. The title expresses the truth that men inherit from their parents not only their bodies but also their social environments. According to Sir Josiah, one of the most important elements in this environment is the inheritance of property. This is the main factor which explains why A and B start the race of life better equipped than C or D; and one of the commonest socialistic panaceas is the partial or total confiscation of property at death.

Sir Josiah Stamp points out that there is no *a priori* way of coming to a conclusion on this question. He quotes the utterances of certain enthusiastic members of the "Liberal Summer School," who in their efforts to compete with their socialist rivals for the support of the masses, have proclaimed "that the present inequality of wealth is an affront to social justice." He says that there is no scientific way of attaining a conception of "social justice"; it is merely an emotional ideal, and emotional ideals vary from person to person.

The scientific way of dealing with the subject is to ascertain so far as possible how such measures would work out in practice. Sir Josiah Stamp says that in the last 120 years the 'standard of life,' *i.e.* the relative amount of well-being, of the manual worker, has improved four times, and has increased most in England, where right of bequest has been freest from restriction. On one side there is urged what seems to us the irrefragable argument that the increase of wealth of a community is due entirely—at any rate in an old country like England—to the efforts of the abler and more far-seeing members of the community, in a word to private enterprise. It is not true that labour creates all wealth; labour without the organising direction of the capitalist is as barren of useful result as the waves of the sea. This wealth, in the form of wages and employment, is necessarily shared with the rest of the community who are so much the better off. Directly the primitive impulse to confiscation, or in plain words to plunder, is allowed to intrude, the spur to accumulation fails and capital disappears; and without capital our complicated industries could not be carried on, and large numbers of our working class would starve.

On the other hand, it is urged that the excessive rewards of a few capitalists (for the returns to most capitalists are very modest) excite envy in the mind of the working man, and make him inclined to do as little as possible for his wage. Sir Josiah Stamp, after some research, is convinced that the jealousy of the working man is not directed against inherited wealth, as such, but against wealth in general. Jealousy of one's neighbour is a very ancient human characteristic; else the Hebrew legislator would not have devoted one of the ten Commandments to its prohibition. But it appears to us that Sir Josiah's concession that something must be done to appease the envy of the manual worker so as to incite him to better work entirely overlooks one important consideration: it is that the manual labourer is a free Englishman, and, like every other freeman he is a merchant. His merchandise is his labour, which it is to his interest to dispose of at the highest price.

It is not a question of the labourer giving less or more according to his mood, but of his fulfilling his bargain. A grocer is not entitled to deliver thirteen or eleven eggs for a dozen according to whether he feels good tempered or bad tempered. In a word 'piece-work' is the one and only remedy for 'ca' canny' and under-production. The real cause for the relatively low wages of the English worker as compared with those of the American is the over-'reproduction' of the former. The wage is the reward for a certain product; the more mouths which have to be fed on this wage the worse off the individual will be.

In countries which have large untapped natural resources, revolutionary experiments may perhaps be indulged in without doing permanent irreparable damage, but in England it is a life-and-death matter to combat them. In a country with such a population that it is unable to feed more than two-fifths of them, our very existence depends on daring private enterprise, just as truly as did that of our Norse forefathers. As Mr. Walter Runcimann, who certainly will not be suspected of Toryism, once put it, "England lives on her business men." It must therefore be our constant endeavour to encourage private enterprise in every possible way, and especially by making its rewards secure, and the very worst manner of doing so would be by limiting the right of bequest.

The dependence of England for its food on foreign trade naturally leads us to the consideration of Sir Daniel Hall's address on the relation between cultivated area and population. Three years ago, at the Liverpool meeting of the British Association, Sir William Beveridge airily disposed of what he termed 'the Malthusian devil' by pointing out what large areas of the world in general and of the British Empire in particular were thinly peopled. His address was exploited by the leading socialist journal under the heading of "Malthusian Moonshine."

Sir Wm. Beveridge's conclusions were severely criticised at the time: and Sir Daniel Hall, speaking not only as a statistician but also as a distinguished biologist, substantially confirms all those criticisms. He points out that the possibility of increase of population is dependent on the increase of food supply, and that between 1850 and 1920 the numbers of the 'white race' increased from 200 to 700 millions. This increase in numbers was rendered possible by the addition of 500,000,000 acres of land to the world's farms: but no further reserves of such lands are to be found on the earth's surface. It is true that the product of those acres might be greatly increased by the adoption of more intensive farming, but intensive farming means greatly increased labour, and even now, despite very much higher wages, the product per man-power is much greater in the lightly farmed lands of Canada and Australia than in heavily farmed England. That the plant-breeder, by the production of better cropping varieties, might increase the yield without necessitating more labour, is conceded, but it will come as a shock to many to read Sir Daniel's opinion as to the narrow limits within which this improvement is to be expected. The main productivity of the plant, he avers, cannot be much increased; all that can be done is to alter the proportions between useful and useless products, such as grain and straw in wheat, sugar and starch in beet, and so on.

The return of the land in food-stuffs per acre is about twenty times greater for wheat than for beef. Further, a considerable portion of our cereal products are employed in producing beer and whisky. If we were all to become prohibitionists and vegetarians we could support a larger population on the same area; but we fully agree with Sir Daniel Hall when he says that the virile and enterprising races, such as have heretofore dominated the world's destinies, would never submit to such a pauperised mode of existence. On the other side of the ledger we have to take account of two grave facts: first, that the fertility of the virgin lands which produced such a great part of our supply is slowly but surely becoming exhausted; and secondly, that everywhere over the world, in Ontario no less than in England, there is the tendency for the rural population to drift into the towns. This tendency Sir Daniel attributes to the poorer rewards offered by agricultural labour as compared with industrial wages in towns. Greatly increased facilities of transportation, wide diffusion of news by wireless and other amenities of civilisation have certainly not diminished the tendency. It will eventually be checked in Sir Daniel Hall's opinion by the better organisation of agricultural workers, who will demand higher prices for the food which they produce. Certainly a cheerful prospect!

It seems to us that the imperative necessity of the limitation of the numbers of the human race in general and of the British Islands in particular is the lesson driven home in sledge-hammer blows by Sir Daniel's able address. If the principle be granted that every human being born in a civilised community may claim the right of full maintenance, whether at work or not, the obvious corollary is that society must be able to control its numbers or become bankrupt.

The Solid Foundation of Organic Evolution.

Evolution. By Prof. J. Graham Kerr. Pp. xii + 278 + 2 plates. (London: Macmillan and Co., Ltd., 1926.) 12*s.* net.

THE object of this book, as set forth in the preface, "is to provide a sketch in outline, approximately correct in its proportions and not overburdened with detail, of the evolutionary science of to-day." The author rightly claims that "a grasp of the main principles of biological science, and amongst these principles Evolution is one of the first, is an essential part of the intellectual equipment of the citizen of the modern state." The necessity was never greater than it is to-day. Although the proceedings in Tennessee last year would have been unthinkable in Great Britain, even amidst the fierce and embittered controversies of the early 'sixties, we often meet with the confident expression of opinions which are all the more injurious because less obviously absurd. Thus in the *Spectator*—on most subjects a sober and well-balanced journal—Mr. C. E. M. Joad wrote in the issue of February 20, 1926, on the causes of evolution: "There were two contemporary explanations in the field; that of Darwin and that of Lamarck. Darwin's was no explanation at all. He said, in effect, that he could not tell why variations occurred; all that he could affirm was that those which were suited to their environment survived." It might with equal force be maintained that the form of a house is not determined by an architect because he did not make the bricks, if I may thus condense an argument employed by Darwin in his correspondence with Asa Gray before the appearance of the "Origin of Species."

Quite apart from this old objection, raised long ago by distinguished controversialists, there is a tendency in these later years to depreciate natural selection, not indeed by contesting its truth but by maintaining that it is self-evident and obvious—a barren guide devoid of inspiration. In Prof. Graham Kerr's book we are provided with admirable and convincing answers to the mistaken opinions of those who maintain that evolution is a delusion, and of those others who admit evolution but deny or depreciate the value of natural selection as its cause. The author's answers are firmly based on a consideration of all the important aspects of the subject—embryology, palæontology, comparative anatomy, geographical distribution, heredity (cytological, statistical, and experimental), natural selection, adaptation, sexual selection, evolution in communities of cells and of individuals, evolution and man, the final chapter containing a summary and the brief discussion of certain general problems of evolution. The book is well and freely illustrated with 53 excellent text-figures and two beautiful coloured plates with well-chosen examples of mimicry in butterflies.

There is something deeply impressive, and to an open mind utterly convincing, in the convergence of so many and such widely different classes of evidence to one inevitable conclusion—the reality of organic evolution. It is not to be expected that the powerful and, in my opinion, irresistible arguments in favour of natural selection as the motive cause of evolution will meet with the same immediate acceptance as those which advocate evolution itself. The latter are driven home by the experience of every biologist; but in estimating the force of the case for natural selection, "the laboratory-trained zoologist lacking in field knowledge often shows a singular incapacity for understanding the importance of evolutionary factors which experience in the field, more especially tropical experience, drives home—such as, for example, the intensity of the struggle for existence or the adaptive significance of animal coloration" (p. 9). There is no doubt about the conclusions to which the author has been led by his own experience in South America. He writes on p. 272: "I adhere to the position of Darwin that the potency of natural selection is in actual fact enormous; I hold that the attempts that have been made to minimise its importance are to a great extent fallacious, invalidated in some cases by their author's want of experience and skill as field naturalists, and in others by the making of unwarrantable assumptions." Prof. Kerr is thus in no doubt about his foundations of belief.

A few slight changes in the excellent Chapter xi., on the "Coloration of Animals," might be advantageously introduced into the second edition, which is sure to be called for at an early date. Mombasa is not one of the localities where the females of *Papilio dardanus* resemble the males (p. 175). If space permitted it would be well to mention the Nairobi district, where ancestral forms of female occur, intermediate between the most primitive of the fully mimetic females and the male-like females of Madagascar and Abyssinia. Different forms of females have not been bred in the same batch of eggs in the Cape district, but in Natal; also in South-East Rhodesia, Southern Nigeria, Uganda, Tanganyika Territory, and of recent years on a very large scale by Dr. V. G. L. van Someren at Nairobi.

The section on "Aromatic Attractions" (p. 186) would be improved by a short account of the advance which has been made along lines originally laid down by Fritz Müller:—Lamborn's observations on male Danaine butterflies brushing the scent-patches on their hind wings and thus charging the anal tufts; Carpenter's, on the actual use of these tufts in courtship; Eltringham, on the minute structure of the scent-producing and scent-diffusing apparatus of these butterflies and of Phryganidæ.

Returning to Chapter xi., it would be an advantage in such a complicated and difficult subject as butterfly mimicry to adopt a uniform system of illustration, with the models to the left and mimics to the right, and to print "Models" or "Danaine Models," etc., as the case may be, at the head of one column, and "Mimics" at the head of the other. In Plate I. four of the models are to the left, but the fifth butterfly (Fig. 9) would be generally looked upon as a mimic. It appears, however, to be commoner than its model *Heliconius telesiphe* (Fig. 10), but both species are probably distasteful and the mimicry Müllerian. In Plate II. the Danaine models are to right and the mimetic females of *Papilio dardanus* to the left.

The author has been misled, as so many have been, by Bates's use of the word "Heliconidæ" in his classical memoir on butterfly mimicry in the *Transactions of the Linnean Society*. It is extremely difficult, wellnigh impossible, to correct effectually and for all time a mistaken impression conveyed by a great man in his greatest contribution to thought, embodied in a memoir which has been read and re-read unnumbered times and handed on to a widening circle by reprint in hundreds of volumes and journals. It is impossible on the present occasion to discuss this unfortunate result in any detail. It must suffice to explain that the chief models for mimicry among the tropical American butterflies are not the far-famed "Heliconidæ" at all, but a specialised group formerly united with the Danainæ but now placed in a separate sub-family—the Ithomiinæ. These are not only extensively mimicked by other butterflies but also by an important section of the Heliconines. An excellent example is figured by Prof. Graham Kerr on Plate I., Fig. 8, and its Ithomiine model in Fig. 7, but this relationship would scarcely be gathered from the author's words on p. 171, where Fig. 8 is referred to as a "typical example of the . . . Heliconiides." It is by no means typical of these, but only of that large section which mimics the Ithomiines. A far more typical example is represented in Fig. 10 of the same plate. Furthermore, the description of the Heliconiides on p. 171 refers to the Ithomiine and only to those species among the Heliconines which mimic them.

It is scarcely necessary to point out that this criticism, which equally applies to nearly every published account of butterfly mimicry, does not in any way affect the immense strength of the author's argument, and I wish in conclusion to emphasise again the excellence of the work and draw attention to the comfort of its clear type and entire freedom from misprints.

E. B. P.

Sunshine and Health.

Sunshine and Open Air: their Influence on Health, with Special Reference to the Alpine Climate. By Leonard Hill. Second edition. Pp. vii+132+8 plates. (London: Edward Arnold and Co., 1925.) 10*s*. 6*d*. net.

PROF. LEONARD HILL possesses to a marked degree the facility of presenting to his readers a graphic picture of the facts he desires to convey. The first few sentences of his admirable book, "Sunshine and Open Air," vividly and felicitously illustrate this power. "Going out before breakfast at 8 A.M., before the sun has risen over the mountains, one passes into a cold, dry, exhilarating atmosphere, cold enough to make one draw down a cap over one's tingling ears. The snow, crisp with some 10° of frost, crunches beneath the feet. The frosty snowfields glitter with light, and the distant snow peaks of the mountains, catching the sun, blush rosy red; the pines stretch upwards their black boughs drooping heavy with snow." We are transported at once to the scene he so graphically visualises. He writes not only as a scientist but as a poet; and when a few lines further on he says, "So one comes back with a good appetite for breakfast after an hour's climb," we almost feel the healthy hunger that morning walk over the enchanting snow-clad mountains has aroused, and plunge with added zest into a book readable from cover to cover, and replete with information and original observation.

The author considers the characteristics of the Alpine climate and on which of these its curative value is based, contrasting the outdoor English climate on one hand, and the indoor city conditions on the other, with these Alpine conditions. He finds no evidence of differences in atmospheric pressure ionisation of the air, or in chemical purity being of importance. The important factors are:

(1) Freedom of the air from pollution with infectious microbes, dust, and smoke which prevails in indoor city atmospheres.

(2) A high physiological saturation deficit; that is, a large difference between the water vapour in a cubic metre of air at atmospheric temperature and that held in the air when saturated at body temperature. On this depends the evaporation from skin and lung. The evaporation from the lung entails passage of blood and lymph through the respiratory membrane and a secretion which cleanses and immunises against infection. In crowded, warm rooms the physiological saturation deficit is lowered while microbic infection is increased, and with it the natural defensive cleansing

mechanism. The free evaporation from the skin is also of much importance to comfort and health.

(3) High drying power ensures dry clothes, houses, and soil; and these warmed with abundant sunshine prevent uncomfortable loss of body heat by radiation.

(4) Cool dry air stimulates the skin and exhilarates the feelings while keeping up the loss of body heat to an adequate level, maintaining appetite and good digestion.

(5) At night the cool air descending from the mountains prevents stuffy, warm conditions in the summer and gives an exhilarating change to the warm sunny day conditions. In winter the frosty cold air, with absence of wind, affords exhilarating conditions for sleeping in open-air balconies, the very antithesis of the stuffy, warm, stagnant, moist air of crowded city rooms which lowers the rate of cooling of the body and with this the respiratory metabolism. The absence of high wind prevents excessive cooling in the Alps.

(6) The sunshine, with its plentiful supply of ultra-violet light, acts beneficially on the skin and so on the general health.

The author discusses in detail the evaporative power of the air exerted on the body, the biological action of light, the cooling power of the air and its marked effect on the resting metabolism and heat production of the body.

In a volume so valuable and informative it is difficult to select special sections particularly deserving of mention, but in the concluding chapter is a section devoted to clothing which is of great practical interest. The author protests against excessive clothing, by which the natural vigour of the body is weakened. "It does no harm to go out and feel cold until warmed by exercise; the impulsion to vigorous exercise does good. It is only the old and feeble who require very warm clothing, those whose fire of life cannot be fanned up by vigorous exercise and exposure." Prof. Hill practises on himself his own preaching. He concludes his book by confessing: "The writer finds a light cellular shirt and pants and a woollen tweed suit ample for winter, and rarely wearing an overcoat, keeps himself warm and in good condition by walking on every possible occasion, covering to and fro from his place of work and in a walk before breakfast some five miles a day, and at week-ends having, whenever weather allows, a sunbath."

In a short appendix artificial light treatment is very briefly discussed.

"Sunshine and Open Air" is well worthy of careful study. The information it conveys cannot be too widely known and applied. Acquaintance with the facts described would do much to teach essential principles of sound hygiene and sensible care of the body. There is a lucidity and charm in this volume which adds greatly to its value. After perusal one cannot but wish that the author should be persuaded to issue an abridged edition suitable for the widest possible circulation amongst medical men, nurses, teachers, parents, and indeed all those who are concerned with and influence the management and upbringing of youth. Prof. Hill has rendered valuable service in producing a volume which may be commended in the highest terms as of great scientific and utilitarian merit.

Vacuum Practice.

Vacuum Practice. By L. Dunoyer. Translated by J. H. Smith. (International Text-Books of Exact Science.) Pp. x+228. (London: G. Bell and Sons, Ltd., 1926) *12s. 6d.* net.

IT must be very difficult to write a book on this subject, for it has to cover such a wide and varied range. There are two distinct aspects of the matter, theoretical and practical, both important and interesting. A complete exposition of the theories involved would require almost an entire text-book on physics, new and old; and most of them are still attended by considerable uncertainty. The practical side is no easier to treat; for practice is best taught by example and not by precept; and yet perhaps it is the more important. The principles—at least, of the theories—lie on the high road of academic physics and form a normal part of the training of every serious student; but the practice has developed in the factory rather than in the laboratory, and its literature consists of patent specifications rather than formal papers. In most of the university laboratories of Great Britain, the best designed and best executed piece of vacuum apparatus that they contain is the incandescent vacuum lamps (already almost obsolete) by which they are lit; and many a skilled experimenter with years of pure research behind him would be quite unable to produce such a common domestic article as a 'dull-emitter' valve. The reason lies partly in the lack of equipment from which all British universities suffer, but far more in the gulf between the followers of pure and applied science, which is only slowly being bridged.

No apology would therefore be needed (nor is any offered) for the appearance in English of a third book covering the same ground as those of Dushman and Newman, even if it possesses no merit that they lack. Actually in one respect M. Dunoyer's book is greatly superior to either. It is critical. Dushman dealt mainly with work in which he was so closely concerned that he is not in a position to criticise; Newman aimed chiefly at being encyclopædic. M. Dunoyer has passed all the work through his own mind, and offers his opinion freely. His presentment is therefore better, and his book more readable; he has been greatly assisted by a translator of complete competence and sufficient wisdom to risk slang, if only he may avoid Gallicisms.

If fault has to be found with M. Dunoyer—and how else can a reviewer display his omniscience?—it must be sought in his selection of material. He tells us that his principal object is the study of technique. But then would it not have been well to sacrifice some part of the theory of monomolecular absorption to a recipe for making 'activated' charcoal (for which every investigator has his pet method) or even to advice in constructing ovens for baking during absorption? Would not a few details of the commercial process of 'gettering' be worth as much as the somewhat nebulous theories that have been advanced to explain it? Why should Knudsen's theory of gas-flow at low pressure be carried beyond the point at which it has any practical application, while Gaede's theory of diffusion is left before it has indicated the effect of dimensions and temperature on the performance of the pump, or even the relation between speed and the nature of the gas pumped? Lastly, the simple theory of metal to glass constructions is quite as interesting and much more practical than many others for which space has been found.

We would not leave the impression, however, that M. Dunoyer has not lived up to his professions. He is most admirable when he is most practical. He is really helpful in the sordid matter of leaks; he knows all about waxes and cements, but realises their limitations; and, though he writes before the recent startling developments in this direction, is aware that metal to glass joints are not so difficult as the amateur believes. But even in these matters his outlook is not perhaps quite that of the professional expert. It is possible, and indeed easy, to be too ingenious in leak-hunting; in most circumstances a leak which cannot be found by simple means in a few minutes is best eliminated by reconstruction. The disadvantage of waxes is not their vapour-pressure, but their low melting-point; apparatus which involves them cannot be baked. If so much is said of the physical properties of these makeshifts, surely some attention should have been paid to the physical properties of the essential material, glass. In Great Britain, nearly all laboratory workers continue to handicap themselves by the employment of treacherous and generally unsuitable soda glass; they seem never to have heard of the lead and borosilicate glasses; a table of comparative thermal and electrical properties would do much to enlighten their ignorance.

There is only one matter, other than a choice of material, in which we differ seriously from M. Dunoyer. In his discussion of gauges, the account of the characteristics and limitations of the various types is excellent; but when he sums up in favour of a form of Knudsen gauge against the ionisation gauge, he misconceives the problem and might mislead a novice. A gauge is often used merely to indicate that a certain rough limit of pressure has been reached; for this purpose all that is needed is sensitivity, simplicity, and ease of attachment; in all these the ionisation gauge is vastly superior to the Knudsen. Sometimes only relative accuracy is required in the comparison of different quantities of the same gas; here again the dependence of the calibration of the ionisation gauge on the nature of the gas in immaterial. The Knudsen gauge is superior only if an absolute measure is required of mechanical pressure or of number of molecules per unit volume; the requirement is so rare and arises only in such elaborate researches that it should not be taken into account in offering a general recommendation.

NORMAN R. CAMPBELL.

Geography and Geology of Makalla.

Ministry of Finance, Egypt: Survey of Egypt, Geological Survey. The Geography and Geology of Makalla (South Arabia). By O. H. Little. With Two Appendices: (i.) Description of Fossils from South Arabia and British Somaliland, by Prof. G. Stefanini; (ii.) Note on some Terrestrial Mollusca from the Hinterland of Makalla, by P. Pallary. Pp. xi+250+36 plates. (Cairo: Government Publications Office, 1925.) 50 P.T.

THIS volume is the outcome of two expeditions led to Makalla at the request of the late enlightened ruler Sir Ghalib bin Awad bin Omer el-Kaitai, K.C.I.E., Sultan of Shehr and Makalla. Makalla is located on that little frequented coast-line of Arabia between Aden and Muscat. Under the impression that minerals of economic value existed in the territory he ruled, the Sultan requested the British Government to undertake an examination. A reconnaissance survey was made in May 1918, but so great are the difficulties of travel, and so lawless the tribes outside the immediate control of Makalla, that even under the protection of the Sultan's troops geological work is greatly hampered and every excursion is, in fact, an adventure.

The later and more detailed survey of Mr. Little confirmed the view that there were no minerals of economic value in the country even if the difficulties of access were surmountable. Exaggerated importance is attached by the Bedouins to any unusual rock or mineral, and the slightest attention from a European is sufficient to convince them that something of enormous value exists.

Every tribe claims the right of imposing tribute on travellers passing their territory, even if permission is granted, and camels must be hired in the country being traversed Any departure from recognised custom invites trouble, and the country is very convenient for ambushes. A virulent form of malaria prevails in the swampy regions along some of the nullahs and near the sea, and many of the expedition were incapacitated for long periods. The heat is very trying from May onwards, and even at night the air breathed resembles furnace gases at times. The tribes do not trust each other, and any unusual sound at night usually results in an outburst of wild firing from any strange party encamped in hostile country. One member of Mr. Little's party was, indeed, murdered shortly after he had left the main body.

The physiography of the region is extremely fascinating, as the interior is reached by traversing deep wadis which narrow down at times to cañons with precipitous sides, 1000 to 1500 ft. high. Men and animals trapped by a sudden flow of water due to rains in the interior can find no escape. At intervals these cañons are broken by steep falls, which make it necessary to climb out of the gorge by a zigzag track to reach a higher stretch. Immense boulders strew the path in these gorges and at times exceed 1000 cubic metres in size. Water disappears and appears in some at intervals where the valley floor is pervious or impervious.

Some of the roads, which traverse narrow spurs and ridges leading into the mountains of the interior, are so steep and so polished by the constant treading of the bare feet of men and camels that passage is exceedingly dangerous, and both animals and men occasionally lose their lives through falls of many hundreds of feet.

Sufficient fossils were found to distinguish the age of the sedimentary rocks. Beds of Pleistocene, Pliocene, Miocene, Oligocene, Eocene, Cretaceous, and Jurassic age were recognised. The Pliocene conglomerates appear to correlate with the Bakhtiari series of the Persian Gulf and the great calcareous conglomerates of Somaliland.

The Miocene beds are not well developed and are gypseous in character; they are thought to correspond with the Fars series of the Persian Gulf, and they resemble the Miocene gypsum series of Egypt. It is, however, the Eocene and Cretaceous beds which cause the most striking topography of the country. Imposing vertical scarps 1500 feet and more in height often border the side of the wadis and the edges of valleys The middle Eocene semi-crystalline limestones reach sometimes a thickness of nearly 1000 ft., and they overlie a series of massive variegated sandstones of Cretaceous age approximating another 1000 ft. in thickness. Where the Jurassic is absent these Cretaceous beds directly overlie the igneous basement rocks. Apart from occasional granites the igneous rocks are basic in character. Lignites are found in the Cretaceous sandstone series, while oil shales occur in the Jurassic rocks.

The only mineral deposits of any likely value are the lignites and oil shales, but neither are in sufficient bulk to warrant development to-day.

Two appendices with excellent illustrations describe the fossils of Southern Arabia and Somaliland; consequently the volume will prove valuable to all those studying the geology of that part of the world. The country and the customs of the inhabitants are admirably described, and many useful hints may be obtained by would-be travellers in these wild regions.

A. B. T.

Our Bookshelf.

Commission Internationale de l'Éclairage en succession à la Commission Internationale de Photométrie. Sixième session, Genève, Juillet 1924. Recueil des travaux et compte rendu des séances. Publié sous la direction du Bureau Central de la Commission, the National Physical Laboratory, Teddington, Angleterre. Pp. 432 + 19 planches. (Cambridge: At the University Press, 1926.) 15s. net.

THE initial portion of this comprehensive volume contains a list of the members of the International Illumination Commission, an account of the proceedings at the various meetings, and a summary of the chief decisions taken. The Commission recommends the initiation of researches on the incandescent black body as a primary standard of light, and adopts a series of values for the relative visibility factor for light of different wave-lengths. A series of terms and definitions for international adoption (in French) is also presented. In an appendix, recommendations on the lighting of schools and factories, presented by Mr. L. B. Marks, the chairman of the committee devoted to this subject, are reproduced. Values of illumination range from 0·2 to 50 lux (approximately 5 foot-candles) according to the purpose served by the light.

The remainder of the volume is devoted to papers read. These fall into several well-defined groups. Amongst those of a more purely scientific character may be mentioned researches on the primary standard of light, characteristics of tungsten lamps, notes on symbols and nomenclature, and heterochromatic photometry. A new feature is the inclusion of several papers dealing with educational propaganda in favour of good lighting, and illustrating methods of co-operation between supply undertakings, manufacturers, and the public in the United States. There are several papers dealing with the public lighting of Paris and with motor-headlight problems. Finally there is a group of papers by representatives of different countries dealing with industrial lighting. The various papers presented thus cover a wide ground, and it is evident that the work of the Commission is extending. The interchange of views between experts in different countries is helping towards the formulation of common principles of illumination, and it is to be noted that international committees are now engaged on a variety of problems.

The Historical Geography of Early Ireland. By Walter Fitzgerald. (*The Geographical Teacher* Supplement No. 1.) Pp. vii+100. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1926.) 5*s.* net (to Members of the Geographical Association, 4*s.* net).

THIS work is worthy of a better exterior. A closely printed pamphlet is apt to repel a reader, who would peruse with delight the same matter in an attractive book. Having said this, and having added a word of censure on the poor scratchy drawings of gold ornaments (p. 70), we proceed to the pleasant task of commendation. Mr. Fitzgerald has undertaken, and has done well, a work long overdue; although the way was prepared by the late Prof. Cole's short but notable "Ireland the Outpost." In the past the history and antiquities of Ireland on one hand, and her geology and geography on the other, have received attention; Mr. Fitzgerald shows the inter-relation of the two sets of facts. The first half of the book is occupied with geography, and is illustrated with many valuable maps; the second half is archæological and historical, and is likewise illustrated with maps of the distribution of types of implements, roadways, colonisation-areas, the routes of early Irish enterprise on the Continent, etc.

We sincerely hope that the author will expand his work into a 'full-dress' book, and we venture in anticipation to offer a friendly hint or two. 'Gaeillon' (p. 63) should be *Gaileoin*: 'Ushnagh' should be *Uisneach*. The Cat-stone is not on this hill, but on the slope of the hill next to it; and it is not a dolmen, but a large erratic boulder (the author has been misled by Borlase's imposing but unsatisfactory "Dolmens of Ireland," which should be used with discretion). And let him be cautious about taking literally the legends of the Tuatha Dé Danann; the complex stratification of these strange tales must be worked out much more critically than has yet been done, before they can be safely utilised in a study such as this.

R. A. S. MACALISTER.

Coal: Ways to Reconstruction. Being a Sequel to "The Coal Crisis and the Future." By Members of Leplay House. Pp. vi+58. (London: Leplay House Press, 1926.) 2*s.*

THIS volume consists of a number of articles by various contributors, and, as is stated in the preface, the studies are both complementary and divergent. The main thesis, however, is that reconstruction in the coal industry is to be effected by means of regional planning. The application of the surveys is to be based on the co-ordination of the recommendations of the several experts, while the corresponding theory of the "transition from the confused empiricism of current business and politics to an ordered advance" is to be supplied by the sociologist. Prof. Geddes contributes an interesting summary of the methods of regional planning, and advocates regional surveys of the coal districts as a preliminary to the solution of the problem. Then follow articles by Prof. Desch and Prof. Hay, who both emphasise the importance of better methods of coal utilisation. The former deplores the present wasteful methods, while the latter holds that there is more hope for the industry in improved systems of coal consumption than in reorganisation of the mines.

Prof. Hay's thoughtful survey, which can be commended to those interested in the problem, stresses the importance of a greater production per man-shift, the development of markets, and the stabilisation of prices. At the same time he pleads for more understanding among the various parties, consumer, owner, and miner. An abstract of a previous volume is given by Mr. Sandeman, while Mr. Victor Branford contributes a theoretical exposition illustrating the application of sociological principles.

Superpower: its Genesis and Future. By William Spencer Murray. Pp. ix+237. (New York: McGraw-Hill Book Co. Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 15*s.* net.

THE term 'superpower' is used to indicate a "greater unity of effort and broader co-ordination in (electrical) power production and utilisation." The author was chairman of a committee authorised by Congress to study the possibilities of superpower in the Boston-Washington zone. This committee began its activities in July 1920 and twelve months later presented its report (*Professional Paper* 123, U.S. Geological Survey).

The present book is to some extent an amplification of that report. It contains many interesting reflections and personal touches which will make it good leisure-time reading to those who have read the original report. A wide survey of the problem is made and a considerable portion of the book is devoted to finance, but the difficulties involved in standardisation of frequency and the stereotyping of generation and distribution methods in an age of rapid progress do not appear to have been dwelt upon sufficiently.

W. T. D.

A Bibliography of Indian Geology. Part IV. *Palæontological Index.* Compiled by T. H. D. LaTouche. Pp. iv+vii+414. (Calcutta: Government of India Central Publication Branch, 1926.) 7.4 rupees; 11*s.* 6*d.*

SINCE his retirement from the Geological Survey of India, Mr. T. H. D. LaTouche has devoted his leisure time to the great task of compiling a bibliography of Indian geology. Part I. A gives a list of authors' names in alphabetical order with the titles of their papers arranged chronologically; Part I. B is an index of minerals; Part II. an index of localities; Part III. an index of subjects. Part IV., which has just been issued, gives an alphabetical list of the species of Indian fossils, followed by references to the works in which each species is described. This index will be indispensable to palæontologists whether they are dealing with the fossils of India or of other countries.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Recurrence of Magnetic Storms.

IN recent communications to the French Academy of Sciences Prof. H. Deslandres (see NATURE, vol. 118, p 71), the distinguished director of the Meudon Observatory, has described a tendency in magnetic storms to follow one another at intervals $iT/6$, where i is integral, T being the rotation period shown by sunspots It is now, I think, generally agreed that there is a tendency to a repetition in magnetic conditions, whether disturbed or quiet, in what is described for brevity as the 27-day interval. Investigations (*Phil. Trans.* A, vol. 212, p 75, and A, vol. 213, p. 245) which I made in 1912 and 1913 showed a tendency to recurrence in intervals which were multiples of T, but in none shorter. Supposing in accordance with modern ideas, as seems to have been first suggested by Kr. Birkeland, that magnetic storms are due to the discharge of ions from the sun, if such discharge, whether from sunspots or other approximately fixed limited areas, went on for a long time, a repetition of disturbance according to the solar rotation period is exactly what we should expect. But repetition at intervals submultiples of T would suggest a different explanation, namely, that the sun as a whole acts somewhat like an intermittent geyser. The subject seemed so important both to magneticians and astronomers that I have further considered it.

Some things fairly patent to magneticians may be less so to others A magnetic storm is not definable with the same precision as a solar eclipse It is true that an eclipse commences at different times at different parts of the earth, whereas the S C. (sudden commencement) of a magnetic storm may, for all we know, be absolutely simultaneous all over the earth. But many storms have no S.C.'s, and, when S.C.'s occur, highly disturbed conditions may not follow for some hours. Thus, in general, the time when a storm begins at a particular station, and still more the time when it ends, cannot be specified exactly. Again, there seems to be at all stations a marked diurnal variation in disturbance, and this renders it extremely difficult to estimate to the fraction of a day the interval between successive storms.

The accompanying table gives some of the results which I have obtained. The results all ultimately depend on daily character figures assigned on the international scheme 0 (quiet), 1 (moderately disturbed), and 2 (highly disturbed), and they further depend on the selection of five highly disturbed days a month. Take, for example, the 11-year data distinguished by the letter A. The entry in column n is the mean character figure from the 5 × 12 × 11, or 660, selected disturbed days, the entry in column $n+1$ the mean character figure from the 660 days immediately following these selected days, and so on. In the case of A and B, the 5 days selected for each month were the days of largest horizontal force range at Kew. A includes the whole eleven years 1890 to 1900, while B represents only three of these years, 1891, 1895, and 1896, selected for a special reason. In the case of A and B the daily character figures depended entirely on the estimate of disturbance at Kew. In the case of C and D the selected days were the days of largest international character figure, and use was made of the daily international character figures which range from 0·0 to 2·0. C includes six years, 1906 to 1911, and D five years, 1920 to 1924.

If, to take a round figure, we suppose 27·0 days to be the solar rotation period, M. Deslandres' conclusions would suggest maxima answering to days $n+4\cdot5$, $n+9$, $n+13\cdot5$, $n+18$, $n+22\cdot5$, $n+27$, and $n+31\cdot5$. As disturbance is seldom limited to a few hours, we should expect to find maxima in the table in columns $n+9$, $n+18$, and $n+27$, and to perhaps a minor extent in columns $n+4$, $n+5$, $n+13$, $n+14$, $n+22$, $n+23$, $n+31$, and $n+32$. High disturbance is seldom confined to single (Greenwich) days. It is not unusual for it to extend to 3 or 4 consecutive days, and sometimes even to 6 or 7 This explains why outstandingly high mean values are not confined to column n, but extend to at least columns $n-2$ and $n+2$. The existence of high mean values for the five columns $n-2$ to $n+2$ entails values somewhat below the all-day means (given in the first column) in the majority of the other columns. Individual years give usually somewhat irregular results, and minor irregularities appear even in 11-year data. But it will probably be admitted that in addition to the primary disturbance pulse extending from column $n-2$ to columns $n+3$ or $n+4$, A shows clearly only one secondary pulse, extending from column $n+25$ to column $n+30$, or possibly $n+31$. The maximum appears in column $n+27$, with column $n+28$ not far behind The three years included in B are given separately because they rather suggest a minor peak value in column $n+14$. But as the B results form a part of the A results, this is presumably purely accidental. Again, the D results may suggest a small secondary peak centring about column $n+17$, but there is no suggestion of this in the C results The full 27-day interval is shown particularly clearly in D, which includes the latest international data available. No entry from column $n+3$ to column $n+24$ exceeds 0·58, the all-day mean, while the entry in column $n+27$ exceeds this by 0·25. Magnetic disturbance is the rule rather than the exception, and in the absence of any exact definition of a magnetic storm it is specially necessary to study the phenomena with an unprejudiced mind. The method employed here ensures impartiality. The table does not seem to me to suggest any real recurrence interval

	Mean	$n-3$	$n-2$	$n-1$	n.	$n+1$.	$n+2$.	$n+3$	$n+4$	$n+5$
A	0·70	0·64	0·77	1·05	1·51	1·11	0·86	0·77	0·70	0·66
B	0·84	0·77	0·94	1·22	1·73	1·32	1·06	0·96	0·87	0·76
C	0·66	0·57	0·67	0·95	1·32	1·02	0·77	0·66	0·65	0·63
D	0·58	0·53	0·63	0·90	1·30	0·94	0·69	0·55	0·47	0·47

	$n+6$	$n+7$	$n+8$	$n+9$	$n+10$	$n+11$	$n+12$	$n+13$	$n+14$	$n+15$
A	0·62	0·63	0·64	0·62	0·61	0·63	0·63	0·63	0·64	0·63
B	0·68	0·73	0·74	0·73	0·70	0·75	0·75	0·81	0·84	0·80
C	0·63	0·65	0·64	0·62	0·59	0·59	0·59	0·60	0·59	0·57
D	0·48	0·53	0·52	0·54	0·53	0·53	0·55	0·54	0·54	0·57

	$n+16$.	$n+17$	$n+18$	$n+19$	$n+20$	$n+21$	$n+22$	$n+23$	$n+24$	$n+25$.
A	0·63	0·63	0·61	0·61	0·62	0·64	0·64	0·63	0·65	0·71
B	0·82	0·78	0·70	0·74	0·77	0·74	0·78	0·76	0·84	0·87
C	0·60	0·61	0·62	0·63	0·63	0·63	0·63	0·62	0·62	0·65
D	0·57	0·58	0·58	0·58	0·53	0·52	0·48	0·49	0·52	0·59

	$n+26$	$n+27$	$n+28$	$n+29$	$n+30$	$n+31$	$n+32$.	$n+33$	$n+34$	$n+35$.
A	0·83	0·94	0·92	0·84	0·79	0·72	0·70	0·67	0·64	0·61
B	0·98	1·13	1·15	1·02	0·94	0·82	0·79	0·73	0·72	0·66
C	0·75	0·84	0·81	0·75	0·70	.	..	.	..	
D	0·74	0·83	0·76	0·67	0·60	0·54	0·52	0·51	0·54	0·55

shorter than 27 days, but any one can judge for himself.

Obviously, if two or more solar areas are highly active simultaneously, for a time which includes several rotation periods, we may have several pairs of (unconnected) storms separated by approximately constant time intervals, which might happen to be approximately sub-multiples of 27 days.

C. CHREE.

75 Church Road, Richmond, Surrey,
July 29.

Prof. Labbé's Production of 'Allomorphs' by the Action of Increased Hydrogen Ion Concentration.

PROF. LABBÉ, in a series of recent papers (*C.R. Acad. Sci.*, Paris, 1924, t. 178, p. 132, 594; t. 179, p. 928; 1924, *Arch. Zool. Exp.*, t. 62, p. 401), has communicated the results of observations made on the Salines of Croisic, and the conclusions he draws therefrom as to the nature and stability of species would, if substantiated, seriously shake the foundations of systematic zoology. For example, he asserts that, from the eggs of a parent form *Canthocamptus minutus* O.F.M. exposed in the ovisac to the influence of a high P_H, he has obtained a mixed progeny consisting of:

(*a*) *C. minutus* (typical).
(*b*) 'Allomorph' *Mesochra* (*Wolterstorffia*) *blanchardi* Rich.
(*c*) 'Allomorph' *Canthocamptus lucidulus* Rehb.
(*d*) 'Allomorph' *Mesochra salina* n. sp.

From these and other results Labbé draws very far-reaching conclusions which will, no doubt, receive serious consideration from all concerned with biochemical investigations; and it is possible that many will accept the premisses on which the conclusions rest without the close critical study which is the province of the systematist. For this reason the following remarks may be justified. I will take only the example given above of *C. minutus* and its 'Allomorphs.'

(1) 'Allomorph' *C. lucidulus* Rehb. In the first place one may observe that *C. lucidulus* is a common *fresh*-water species; secondly, the descriptions and figures given (*Arch. Zool. Exp.*, 62) are sufficient to show that the specimens described did not remotely resemble *C. lucidulus*. The antenna figured (Fig. 17) is unlike that of any Harpacticid of which I can find a description, since in all 8-jointed antennæ[1] the æsthete or "organ of Leydig" is borne by the fourth joint, which is followed by four more small joints; whereas in Labbé's figure it is borne on the fifth, and followed by two joints only. The fifth legs of both male and female (Figs. 28 and 29) are not only totally unlike those of *C. lucidulus* but have no parallel among Harpacticids. I can only call to mind two examples of a fifth leg having a two-jointed exopod—*Misophria pallida* and the male of *Microthalestris forficula*. It is conceivable that Labbé's figures are inaccurate drawings of swimming legs of immature individuals; but they are quite certainly not those of the fifth leg of *C. lucidulus*. Lastly, the operculum of his allomorph is, as he admits himself, quite different from that of *C. lucidulus*.

(2) 'Allomorph' *Mesochra blanchardi* Rich. Fig. 31 of the fifth foot bears some resemblance to that of *M. blanchardi*, but those of the antennæ, the furca and the first leg do not. The antennæ, if correctly drawn, can only be interpreted as monstrosities.

(3) 'Allomorph' *M. salina* n. sp. Here there is no question of alleged identity with a known species, but Labbé states that it differs from *M. blanchardi* only in the structure of the fifth legs. Curiously enough Fig. 32, which is said to represent the fifth leg, is so nearly like the *first* leg of *M. blanchardi* that (apart from a discrepancy in the proportional length of the joints) it might represent that limb, while Fig. 26 of the first leg represents an appendage described in the text as the fifth, but quite unparalleled among known Harpacticids.

Similar criticisms might be directed upon the 'Allomorphs' *Eurytemora affinis* and *E. lacustris*, while the remarks concerning *Artemia salina* are open to serious objection.

The experimental methods are so briefly described that any one acquainted with the difficulties of breeding Copepods without accidental introduction of the Nauplii of other species cannot fail to be sceptical of the results. Prof. Labbé's statement that the parents died on being placed in the new medium, but that their eggs were successfully hatched, leads one to doubt very much if the larvæ observed actually came from those eggs. In the brackish water such as fills the Salines at Croisic in winter, a number of Harpacticids may be expected to occur—*e.g.* species of Amphiascus and Nitocra—and it seems quite probable that the unsuspected presence of such species may have vitiated the results.

Having regard to the importance of the questions at issue it is essential that the foundation of fact should be impregnably secure, and it is to be hoped that, before Prof. Labbé's conclusions are accepted, he will be required to produce not only a detailed account of his experiments, but also accurate figures of his 'Allomorphs.'

I do not find anything at present in his writings which "fera malheureusement le désespoir des morphologistes classificateurs."

ROBERT GURNEY.

Stalham,
Norwich.

Scattering of Electrons in Helium.

THE energetic relations in collisions between electrons and gas molecules have been made the study of a very large group of workers, all of whose results show the essentially unmechanical nature of the processes involved. Our picture of the nature of such a collision must remain incomplete, however, until the angular relationships of the electron and molecular paths are also known.

Such information as we already possess of the scattering of electrons is in the highest degree unexpected. The work of Ramsauer has shown that slow electrons in the rare gases possess free paths much longer than would be anticipated on the kinetic theory, while that of Davisson and Kunsman (*Physical Review*, **22**, 242, 1923), on the scattering in metal films is also of revolutionary character. Quite recently Langmuir (*Physical Review*, **27**, 806, 1926) has shown that inelastic collisions in several gases lead to very small angles of scattering. Elsasser (*Die Naturwissenschaften*, 13, 711, 1925) has put forward an explanation of these results on the basis of the theory of de Broglie, in which a moving particle is associated with a 'phase wave,' the interference of which governs the scattering.

In the course of an investigation of the energy distribution of electrons after a collision with a gas molecule, it was found possible to study at the same time the angular distribution of scattering.

---

[1] Labbé's figure shows seven joints only, though all species of the genus have eight. The legend of the figure is "Canthocamptus minutus O.F.M. ♀ Antenne antérieure gauche de l' 'allomorphe'" and presumably is intended to represent that of "Allomorphe Canthocamptus lucidulus Rehb."

Electrons from a tungsten filament were restricted by two slits to a narrow beam and traversed the gas under investigation, which was helium at a pressure of 0·03 mm. A beam of scattered electrons could be selected by two slits and afterwards bent in a magnetic field to determine the velocity distribution. Fast pumps maintained a low pressure in this region. The filament and first two slits could be rotated, so that the scattering angle could be varied from 0° to 90°.

The results for the scattering of electrons, which have suffered inelastic encounters and have lost 20 volts energy, are shown for two initial velocities, $V_1 = 100$ and $V_1 = 400$ volts, in Figs. 1 and 2. For $V_1 = 100$, there are two maxima, the principal one at 5° agreeing with the observation of Langmuir, and another, much broader, at about 60°. For $V_1 = 50$, the principal maximum broadens and moves to 20°. At higher initial velocities this maximum moves to smaller angles and for $V_1 = 200$, is at less than 2·5°, the smallest angle at which measurements could be made. At the higher velocities a very remarkable third maximum appears at 30°, which is much sharper than the other two. It is found first at 200 volts and increases in importance to 400 volts, which was the highest point at which measurements could be taken. The position of this peak was found to be independent of the velocity. This type of scattering is limited to the inelastic collisions, as is shown in Fig. 3, which shows the distribution of 400 volt electrons which have lost no energy, and is very similar to that of 100 volt electrons that have lost 20 volts energy (Fig. 1).

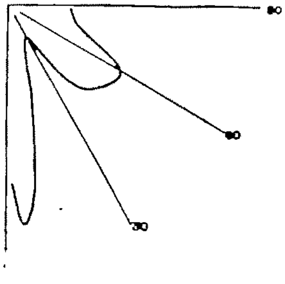


FIG. 1.—Scattering of electrons losing 20 volts energy, initial velocity, $V_1 = 100$.

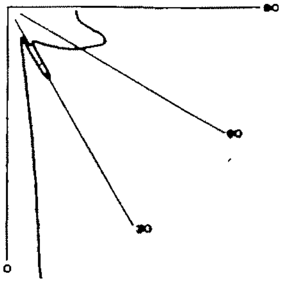


FIG. 2.—Scattering of electrons losing 20 volts energy, initial velocity, $V_1 = 400$.

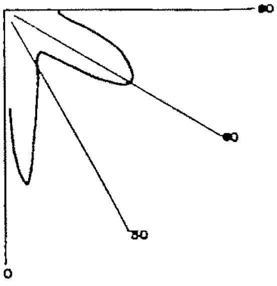


FIG. 3.—Scattering of electrons losing no energy, initial velocity, $V_1 = 400$.

The occurrence of these maxima is strongly suggestive of an interference pattern, as suggested by Elsasser, but the fact that the position of the sharp maximum at 30° is independent of the velocity does not agree with his explanation.

It is hoped to extend this work to higher velocities and to the case where collision leads to ionisation and not excitation of the atom.

E. G. DYMOND.

Palmer Physical Laboratory,
Princeton University,
Princeton, New Jersey,
June 18.

Intensity and Polarisation of Skylight at Sunrise and Sunset.

IT is now well-established that the illumination of the clear day-sky at high-level stations is almost entirely due to molecular scattering by the atmosphere. The remarkable changes in the character of sky-illumination which take place when the sun approaches and gets below the horizon have been the subjects of study of a number of investigators and in recent years, particularly of Profs. Dorno[1] and Gruner.[2] Some of the phenomena, as for example, the changes of colour and polarisation of skylight and the appearance of the earth-shadow, occur in the clearest of weathers and at such high-level stations that their origin cannot be attributed to anything other than molecular scattering. Gruner has, indeed, shown that the observed changes of colour of skylight when the sun is near the horizon can be explained by scattering by a pure atmosphere.

The writer has recently calculated the intensities of sky illumination due to molecular scattering when the sun is on the horizon at a place 2 km. above sea-level for the wave-lengths 0·45 μ, 0·55 μ, and 0·65 μ by a method somewhat different from that of Gruner, and as some of the results obtained are new, they may be of general interest. The light from the sky when the sun is on the horizon has a much smaller proportion of the shorter waves than the normal daylight sky. In the zenith, where the relative proportion of the short waves is the largest, the ratio of blue (0·45 μ) to red is only 1·3 while, according to the inverse fourth-power law, it would be 4·3. As we move from the zenith to the horizon, the proportion of blue decreases still more, the ratio becoming 0·48 at a zenith distance of 80° in a direction perpendicular to the sun's rays, and 0·45 at the same zenith distance on the side opposite to the sun. The calculated absolute values of intensity are also of the same order of quantities as the values observed by Dorno at Davos (1·6 km. above sea-level), but there is a tendency for the observed values to be larger in the quadrant of the sky containing the sun.

The way in which different layers of the atmosphere contribute to the illumination is also interesting. The proportions of the total light of wave-lengths 0·45 μ and 0·65 μ coming from different layers of the zenith sky are as follow:

Height.	Wave-length.	
	0·45 μ	0·65 μ
2-10 km. . . .	8 per cent.	38 per cent.
10-20 „ . . .	47 „	44 „
20-30 „ . . .	33 „	15 „
30-50 „ . . .	12 „	4 „

The single kilometre layers from which the maximum percentages come are 17 to 18 km. for the shorter wave and 9·5 to 10·5 km. for the longer.

In the calculations mentioned above, only primary scattering has been taken into account. But observation shows that complete neglect of self-illumination is not justifiable. For example, even in the clearest weather during the winter months at Simla (1·9 km. above sea-level), when the light from the zenith sky is analysed by a double-image prism and nicol, the weaker component is found to be richer in blue than the stronger, due, no doubt, to the self-illumination being greater for the shorter waves.

The effect of self-illumination may be expected to be a minimum, if confining our attention to the longer waves, we observe in a direction perpendicular to the sun's rays but at a zenith distance of 70° to 80°, where the absolute intensity of the primarily scattered longer waves is greater and the greater part of the radiation comes from a comparatively thinner layer nearer the surface of the earth Observations at Simla show that the polarisation for the red in these directions often reaches values so high as 30 per cent, which may be compared with 91 6 per cent, the value of the polarisation of the light transversely scattered by pure air. K R RAMANATHAN

---

[1] C. Dorno, "Himmelshelligkeit, Himmelspolarisation und Sonnenintensität in Davos, 1911 bis 1918," *Veröffent. des Preussischen Meteor. Instituts, Abhandlungen*, Bd. 6, 1919.

[2] P. Gruner, "Beiträge zur Physik der freien Atmosphäre," Bd. 8, pp. 1 and 120 (1919).

Colaba, Bombay, June 25.

Medical Entomology and the Tropical Field Worker.

WITH a wider enlightenment on matters of public health among all communities, east and west in the tropics and sub-tropics, nowadays the medical officer of health finds a more insistent demand on his attention to problems connected with medical entomology.

Before proceeding to his tropical or sub-tropical appointment the medical officer of health has doubtless had a training in medical entomology, and often has acquired an active interest in this important subject, so much so, that if his destination is to some locality, let us say, where malaria is rife, he takes up his appointment with an enthusiastic intention of improving conditions. To those of us who have seen the arrival of many a medical officer of health in the tropics that is but the beginning of the story The remainder is less satisfactory, and sadly uniform in most instances on arrival he can give a fairly excellent account of the systematic divisions of the Anophelini, and a poorer—often a decidedly bad account—of the Culicini, and can readily distinguish an anopheline from a culicine larva (when it is in the laboratory, or microscopically mounted) So he arms himself with a few tubes, and then usually wonders where on earth he can find the species of his locality. At the back of his mind is the recollection that 'old tin-cans, broken bottles, gutters, and water-tanks' have been mentioned as being dangerous mosquito-breeding places, and a search is therefore diligently made in these situations. His efforts are rewarded, maybe, by the capture of what ninety-nine times out of a hundred are culicine larvæ—which he distinguishes by the presence of the siphon Ere long the capture of 'Culexes' becomes less exciting, and he possibly seeks in the foulest pond in the district for the more interesting anopheline larvæ By great good luck he may find one or two, and with a feeling of just pride orders the abolition of that breeding-place; while some clearer, but, in reality, more pestilential pond in which he found no larvæ, yet where there are actually thousands, continues to breed its pests

In the end, supported only by a meagre knowledge of the systematic divisions of the Culicidæ, upon the capture of a few larvæ which all look horribly alike and cannot be identified as anything particular, and perplexed by the unaccountable numbers of mosquitoes which continue to swarm, enthusiasm speedily dies with the feeling that "this mosquito business is a subject only for the expert"

The reason for all this is obvious: we might as well expect to produce competent surgeons by a training devoted to descriptions and the examination of excised pathological exhibits. At present, astonishing as it is, instruction in medical entomology follows an absurdly parallel course academic teaching and laboratory exhibitions (decidedly essential as they are) are almost the sum total of what instruction in medical entomology constitutes The bionomics, the remarkable habits of some species, the practical methods of demonstrating the breeding-places in Nature, the varied methods of collection, the practical application of control measures in the field; all these matters of paramount importance in the training and successful work of the sanitarian receive no more attention than can be given in lectures Consequently, once the sanitarian finds himself in the field, he discovers immediately that for all he has learnt he has no idea how to proceed

I have merely taken the case of mosquitoes as an example The same thing is true of the 'field' aspects of all other insect-enemies, and it is indeed time that the essential importance of proper field instruction should be taken into account so as to ensure that the men whom we send out from our schools are not so completely stranded when they meet the problems as Nature herself presents them To avoid misapprehension, I should perhaps add that the Wellcome Field Laboratory is *not* a teaching centre where such practical instruction as that referred to can be obtained MALCOLM E MACGREGOR.

Wellcome Field Laboratory,
Wisley, Surrey

Accurate Square Roots.

IN NATURE for June 19, Mr John Wishart directs attention to certain inaccuracies of one unit in the last printed place in Barlow's Tables of the square roots of numbers. Such errors are very common in these tables, applying to approximately ten per cent. of all the square roots, and they also apply, apparently even more frequently, to the cube roots The reciprocals in the same tables are much more accurate, but even these are occasionally in error by a unit of the last printed place

Mr Wishart says that "there are some who have need of all the figures that existing tables give them, who sometimes wish, indeed, that more were available" I gather from this and from other hints in his letter that he may not be acquainted with the very useful collection · Hulsse's edition of Vega's Tables, published by Weidmann at Leipzig, 1849 On pages 476 to 575 are there given the square roots of all integers up to 10,000. They therefore have the same extent as Barlow's Tables but they give the roots to twelve decimals, five more than Barlow The same table gives cube roots to seven decimals just as Barlow does, but they are carefully rounded off to the correct digit

The best table of reciprocals is that by Oakes (published by Layton, London), which gives them to seven significant figures for all integers up to 100,000, care was taken to make the last printed digit correct Hulsse's and Oakes' tables together should replace Barlow's where great accuracy is needed. But Barlow's tables, as Mr Wishart intimates, are very convenient indeed whenever an error of one part in 100,000,000 is not important, and this is almost always the case.

The following method for deriving or testing square roots to many places may be of interest Let N be the number the root of which we wish to extract, and let a and b be two nearly equal numbers such that

$$ab = \mathrm{N}.$$

We have then

$$\sqrt{\mathrm{N}} = \sqrt{ab} = \frac{1}{2}\sqrt{(a+b)^2 - (a-b)^2}$$
$$= \frac{a+b}{2} - \frac{(a-b)^2}{4\,(a+b)} + \quad \cdot\cdot$$

If, therefore, b differs from a by one part in 10^7 say, $\frac{1}{2}(a+b)$ will differ from $\sqrt{\mathrm{N}}$ by only about one part in 10^{15}. With an eight-bank computing machine we can readily find values for a and b that do not differ by more than one part in 10^7 and will usually differ by much less than this. Their arithmetical mean will therefore be the square root of N with an error of, at most, one part in 10^{15}. If still more digits are required, eight additional ones can be obtained in a few minutes by computing the term in $(a-b)^2$ above.

The same method can be used to extract square roots to three significant figures by mere inspection, and this degree of accuracy is sufficient in many computations, including solutions by least-squares. Thus, for example, the square root of 8·46 is seen to be not far from 3; dividing by 3 we get 2·82; the mean between this and 3 is 2·91, which differs from the square root of 8·46 by only 0·0014.

FRANK SCHLESINGER.

Yale University Observatory, July 12.

The Polishing of Surfaces.

THE manner in which an optical polish is produced on glass and metal surfaces has been considered by the late Lord Rayleigh ("Polish," Collected Papers, vol. 4, p. 542, "Interference Bands," vol 4, p. 54). The amorphous layer theory of the late Sir George Beilby is well known The article by Dr. J. W French on "The Working of Optical Parts" ("Dictionary of Applied Physics," vol. 4) summarises and extends these considerations. Reference may also be made to a paper by M. M. Fichter, a notice of which appeared in NATURE, August 2, 1924, p 173.

The object of this present note is to suggest that, in the process of polishing, surface layers are really melted by the communication of heat vibrations to them. Consider a single surface layer of glass molecules of area 1 sq cm. If glass consisted wholly of silica there would be approximately 9×10^{14} molecules per unit area, each of mass 9×10^{-23} gram Taking the specific heat of glass as 0·16, initial temperature 20° C., melting-point 1100° C., and assuming a latent heat of fusion 100 calories per gram, the heat required to melt a single layer of molecules of 1 sq. cm. area would be 900 ergs

Now Beilby gives a pressure of 4 lb. per sq. inch (280 grams per sq. cm) as sufficient to produce surface flow with rouge polishing. Taking a coefficient of 0·3, the work done against friction when this force is overcome through 1 cm. is 83,000 ergs.

As one stroke of a polisher will polish only a small proportion of the 1 sq. cm area considered, there will be available in the ordinary polishing procedure frictional energy of amount many hundreds of times that required to melt one layer of glass molecules.

At first sight it might be thought that any great rise in the temperature of the surface molecules would be prevented by the loss of heat due to conduction, etc. But this is to suppose that conduction would take place across plane interfaces. Is it not more reasonable to consider the heat as being produced at *points* of contact? If these were mathematical points, then no matter how small the rate of production of heat at a point, the temperature at the point would be infinite (the expression for the steady temperature v at distance r from a point in an infinite solid where heat is being supplied at the rate of q calories per sec., is $v = q/4\pi rk$, where k is the thermal conductivity of the material).

That the temperature attained by a surface depends essentially on the manner in which the heat is applied, is illustrated by the fact that a bunsen flame (of high temperature) may be played on a block tin surface without melting it, while a small globule of molten lead (only 100° C. above the melting-point of tin), if dropped on to a tin surface, will melt the tin below.

As an analogy to the manner in which high temperature vibrations may be set up locally, in polishing a surface, reference may be made to the setting of a Kundt's tube into vibration by slowly stroking it by hand, or a violin string by the slow stroke of the bow.

JAMES M MACAULAY.

Natural Philosophy Dept.,
The Royal Technical College,
Glasgow, C.1, August 4.

The Planetismal Hypothesis.

As there is a rising tide adverse to the planetismal hypothesis, may I record the following observation in its favour? Looking at the moon with a 9½-inch reflector, I saw details of the structure of the great south wall of the crater Hommel; the circular fault is perfectly fresh, and the rock exposed is a giant conglomerate, the boulders several hundred yards in diameter, with cavernous spaces between. In moments of perfect pellucidity, my instrument is quite capable of defining objects half a mile in diameter. My observation confirms Pickering's at Arequipa, when he was looking at the fault-scarp of the Sinus Iridium, in the opposite quadrant.

On the earth, iron is being taken from the surface rocks by weathering; it is washed down in solution into the rivers, but does not reach the sea. It goes downwards, and where there is a precipitant, it replaces limestone, forming deposits of iron-ore; where there is nothing to stop it, it must proceed towards the centre of the earth. Reversing the process, it follows that this iron would have made the crust of the earth an ultra-basic material in the early history of our planet, or in other words, it would have been similar to what we now find on the moon, where there has been no water to obscure matters. The lower specific gravity of the moon would be accounted for by the boulders making an arch and girder formation, with spaces between.

E. H. L. SCHWARZ.

Rhodes University College,
Grahamstown, July 9.

Zoological Nomenclature: Suspension of *Sarcoptes*, type *passerinus*, in favour of *Sarcoptes*, type *scabiei*.

THE secretary of the International Commission on Zoological Nomenclature has the honour to invite attention of the zoological profession to the fact that application has been made to the Commission to suspend the rules in the case of *Sarcoptes* Latr., 1804, tsd. (Latr., 1810) *passerinus*, and to place *Sarcoptes*, 1804, in the Official List of Generic Names with *S. scabiei* as type.

The argument states that the application of the rules to this 'transfer' case will result in greater confusion than uniformity, involving generic, subfamily, and family names, and designations of diseases in human and comparative medicine. The suspension requested will result in validating internationally accepted (though erroneous) nomenclature in consistent use for more than a century in zoology, and in human and comparative medicine.

The secretary is familiar with the premises, and in his report to the Commission will state that he considers this a typical case in which suspension is justified. He will, however, delay announcement of final vote until about October 1, 1927, in order to give ample opportunity to interested persons to express their views for or against the suspension.

C. W. STILES,
Secretary to Commission.

Hygienic Laboratory, Washington, D.C.,
August 3.

The Optical Works of Sir Howard Grubb, Parsons and Company.

A FEW years ago it was very difficult to obtain a large object glass for an astronomical telescope. The optician would only promise a glass conditionally on his being able to procure suitable discs. For example, the director of the Johannesburg Observatory placed a contract for a 26-inch refractor in 1909, and four years later, in 1913, he reported that "it is hoped that glass discs will be obtained shortly." Large discs of optical glass are required only rarely, and their manufacture is a delicate operation requiring special plant; consequently very few people make them.

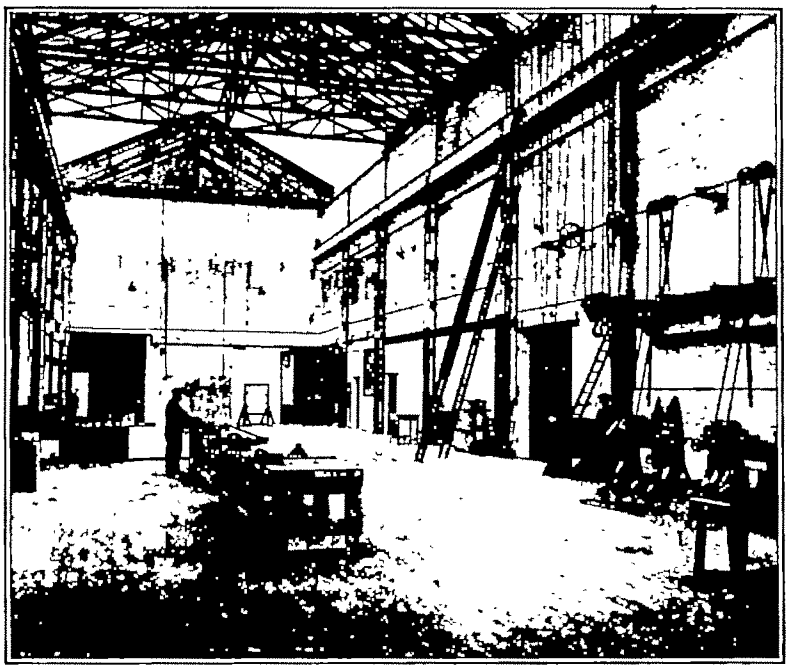


Fig 1 —Erecting bay showing sliding roof partly open.

British astronomers were greatly pleased when the manufacture of large discs of optical glass was taken up by Sir Charles Parsons, who acquired the business of the Derby Crown Glass Works from Messrs. Wood Brothers, in 1921. Sir Charles Parsons has an hereditary interest in astronomy and the manufacture of large astronomical telescopes, as his father, the Earl of Rosse, built the famous six-foot reflecting telescope at Birr Castle, Parsonstown, King's County, Ireland. This early interest doubtless influenced him in taking up the manufacture of astronomical instruments from beginning to end—the manufacture of glass, the grinding and figuring of lenses and mirrors and the mechanical parts of telescopes. Near the beginning of 1925 he acquired the old-established business of Sir Howard Grubb. This famous firm was founded by Thomas Grubb a hundred years ago, and developed by the optical and mechanical skill of Sir Howard Grubb, under whose direction many fine telescopes, refractors, and reflectors have been produced. In 1918 the works were moved from Dublin to St. Albans in connexion with the manufacture of periscopes for the Navy, instruments which have been a standard product of the firm since the date of the first British submarine.

New works were set up in 1926 at Walker Gate, Newcastle, in close proximity to the well-known works of Messrs. C. A. Parsons and Co., Ltd., makers of steam turbines, electrical machinery, and searchlight mirrors. Close association with large engineering works is a great asset for makers of astronomical instruments. For small telescopes comparatively small plant is required, but for large ones the resources of engineering works with machines of the necessary size and accuracy are essential In such accessories as large domes and rising floors, which are necessary with big instruments, large machinery is also required. For all heavy machine work the large machine shops of the Heaton works of Messrs. C. A. Parsons and Co. will be used. Nor must the great advantage be overlooked of the interchange of ideas among the staff, made possible by close association with the larger world of engineering.

An internal view of the principal bay of the new optical works is shown in Fig. 1. An important feature of this building is the provision for sliding off a large portion of the glass roof by carrying it on a supporting gantry moved by electrically operated motors. The shop possesses a five-ton electric travelling crane; one end of the bay is fitted up as a machine and fitting shop, and the other is used for the erection of instruments. Means of testing large instruments in course of construction by actual observation of stars are thus provided. Generally this is a matter of difficulty at optical works, but however well the laboratory tests may be satisfied, the purchaser of a telescope, as well as the maker, wishes to see how the instrument performs the end for which it is intended, before it is taken away from the works and erected in a possibly distant observatory.

Fig 2 —Insulated tunnel for the horizontal testing of mirrors and objectives.

In the transfer of the optical works from St. Albans to Newcastle the essential personnel as regards both staff and workmen was retained. One establishment is in complete continuity with the other, and it may well be that some of the improvements in the fitting up have been suggested by the previous long experience of the firm of Sir Howard Grubb. The means for testing large mirrors and objectives in the course of construction have been carefully planned. While in position on the polishing machine they can be conveyed by an electrical lift to the bottom of a shaft belonging to the optical testing room. Much labour and time is thus saved in the course of polishing a large mirror or objective which will be tested many times. Fig. 2 shows the horizontal testing tunnel This is 100 feet in length, and gives the means of testing mirrors and objectives in a room of constant temperatures and free from disturbing effects of air currents The rough polishing shop is shown in Fig 3.

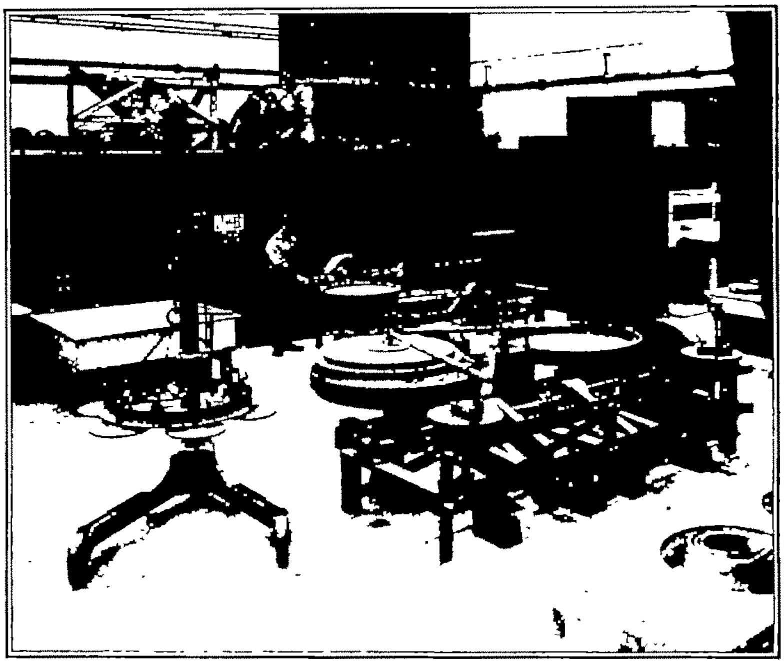


FIG 3.—Optical roughing shop

Among the instruments already constructed by the firm are a seven-metre solar spectrograph for the Pulkovo Observatory and a 40-inch reflecting telescope for the Observatory of Simeis in Southern Russia. In the annual report of the Observatory, published in the *Vierteljahrschrift*, and quoted in NATURE of July 17, p. 97, an account is given of the mounting and testing of the mirror The departure of the mirror from paraboloidal state is found to be of the order of one-tenth of a wavelength, showing the mirror to be of very perfect figure. A description of the telescope, and of its mounting and control, was given in NATURE of April 12, 1924.

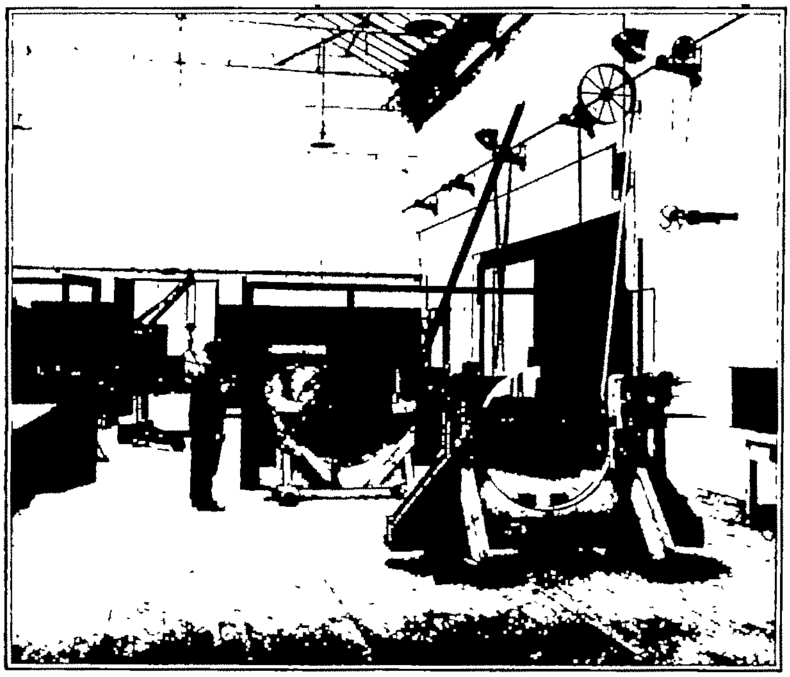


FIG 4.—Optical discs for 41-in objective.
These discs were manufactured by The Parsons Optical Glass Company at Derby.

At the present time, Sir Howard Grubb, Parsons and Co are engaged on the ambitious task of constructing a refracting telescope with an object glass of 41 inches diameter. When completed, this telescope, which is also intended for the Simeis Observatory, will have a slightly larger aperture than that of the Yerkes Observatory. The focal length will, however, not be so long, as the instrument is designed for photographic rather than visual work. The discs have already been made at the Crown Derby works, and Fig 4 shows them in the optical testing shop in Newcastle. Some time ago it was reported by a news agency that the discs had failed to satisfy the optical tests specified, but, as was announced in NATURE of June 19, p 868, the statement was entirely erroneous. The progress of this large telescope will be watched with great interest and in confidence that a very fine instrument will be constructed.

The Mechanics of the Electric Field.[1]

By Sir J. J. THOMSON, O.M., F.R.S.

THE subject which I have selected for the Kelvin Lecture is one that from the very beginning of his scientific career was never long absent from Lord Kelvin's thoughts. It is one, too, which researches only dawning towards the close of his life have put into quite a new aspect. These researches have given us very definite information as to the structure of the atom; they have taught us that the atom is made up of electrons and positively electrified particles of known masses; they have told us the number of electrons and positive particles present in each atom; they have, in fact, given us a definite specification of the electrical state of the atom. With this in our possession it would seem as if we ought to be able to deduce the properties of the atom, by calculating by means of the laws of electromagnetism the behaviour of this definite electrical system. We find, however, if we do this, that the properties of our mathematical atom are in some respects in contradiction to those of the real atom. It is of course a gigantic extrapolation to pass from any system which we can test by direct experiment, and for which the laws of electromagnetism have been verified, to systems like the atoms, where the times and distances involved are of an entirely different order of magnitude. The extrapolation fails, but the point is that if the usual interpretation of these laws is the right one it ought not to fail.

I propose to discuss the question whether the equations of classical electrodynamics or, for the matter of that, classical dynamics are as fundamental as they have been thought to be; whether, instead of giving us a complete representation of the field of force, they do no more than give us the relations between the average value of the quantities used to define the field. That, in fact, they express statistical and not particle dynamics.

Let us consider some of the consequences of supposing that electric force consists of separate impulses separated by finite times. I must point out that this conception involves the existence in the universe of a structure beyond that represented by electrons and positive particles; if there were no structure of this kind, we could not account for the intervals which elapse between the impulses. This structure must be far finer in texture than the electrons; thus, on this view, the electron does not represent the last word in minuteness and there are still smaller entities awaiting discovery by the physicists.

For heuristic purposes, *i.e.* for the purpose of making our meaning clear, and without committing ourselves to the reality of this particular structure, we may liken it to a sub-atomic and sub-electronic gas the particles of which are much finer than the electrons. It is in these particles that the energy and momentum of the electric field are stored. We may regard these particles as concentrated round the electric charges, each charge carrying with it an atmosphere of these particles. The particles are crowded together near the centre of the charge, but get more and more widely separated as the distance from the centre increases. To distinguish between the positive and negative charges, we may suppose that the particles rotate round the charges and that the rotation as viewed from the centre of the charge is in one direction for the positive and in the opposite direction for the negative charge.

The particles bombard intermittently the charges round which they are congregated. If there were only one charge in the field the particles would be symmetrically distributed around it and the bombardment would not, on the average, make it move in one direction rather than in another; but when two or more charges are near together the symmetry of the distribution of the particles is disturbed and the bombardment results in the charges acquiring momentum.

Let us now consider in some detail the way in which the effects produced by intermittent forces differ from those due to continuous ones. We may represent the intermittent force analytically by saying that the chance of a body on which this force is acting receiving in time δt an increment of momentum is $\delta t/D$, where T is the average time between two increments and is a measure of the fineness of the time structure of the electric field. Let I be the increment of momentum given at each impact; then the expectation of the increase in momentum in time δt is $(I/T)\delta t$. If the force had been continuous and equal to F, the increase in momentum would have been equal to $F\delta t$ and have had a definite value. On the intermittent view, instead of a certainty we have an expectation: sometimes the results will exceed expectations, sometimes they will fall below them; but on the average, when there are a great many increments, *i.e.* when δt is large compared with T, they will differ but little from the expectation, so that the increase of momentum will be $(I/T)\delta t$, or the same as the body would receive from a continuous force $F = I/T$. Thus for effects lasting for times long compared with T, the results will be very nearly the same whether the forces are continuous or discontinuous; but for shorter times they will be very different.

We may illustrate the difference between a continuous and an intermittent force by considering a simple case. Take that of an electron projected horizontally and exposed to the influence of a vertical force for a time t. Whether the force be continuous or intermittent the horizontal velocity will remain constant and the horizontal distance travelled is not affected by the intermittence of the force. When the force is continuous and constant there is only one orbit, the parabola. If the force is intermittent there will be an infinite number of possible orbits. In fact any polygon is a possible orbit, provided the rth side makes an angle with the horizontal such that $\tan \theta r = kr$, where k is a constant. Thus a horizontal straight line is a possible orbit, because there is just a chance that the electron may escape a collision for the time t.

There is an infinite number of two-sided orbits where the electron makes one collision in the time t. At the end of these orbits all the electrons have the same kinetic energy, but they will not all have suffered the same vertical fall, *i.e.* they will not all have the same potential energy, this is an illustration that the conservation of energy in the ordinary sense does not hold for these intermittent forces. To get the same increase in kinetic energy as they would under the action of a continuous force, some of the electrons under the intermittent force would have lost less, others more, "potential energy" than they would under the continuous force.

---

[1] From the Seventeenth Kelvin Lecture, delivered before the Institution of Electrical Engineers on April 22

Again, there is an infinite number of 3-, 4-, 5-sided orbits; there is no limit to the number of sides, and the greater the number of sides the greater the kinetic energy acquired by the electron describing the orbit All these are possible orbits, but some of them are very improbable. We can calculate the probability of any type of orbit. We have already seen that the most probable number of sides for the orbit is t/T; this makes the final momentum have the same value and direction as it would under the continuous force. But even when the number of sides is given, the individual sides may have very different lengths. We can show that the most probable orbits are those where the impacts are equally spaced over the journey. Again, the most probable orbit is the one that approximates most closely to that described under a continuous force. It is, however, only when t/T is a very large number that the chance of orbits departing widely from this becomes inconsiderable.

I have already pointed out that the principle of the conservation of energy in its usual form does not apply when the forces are discontinuous. This is because the energy is stored in the particles which constitute the electric field, and the distribution of these particles and their energy may change, even though the electrons and positive particles do not move; an electron may take energy from these particles or give up energy to them without suffering any change in its potential energy.

Take, for example, the case of an electron starting from an infinite distance from a positive particle, falling close to the particle and then receding from it until it is again at an infinite distance away. The potential energy is the same at the beginning and end, so that if the principle of the conservation of energy holds, the kinetic energy at the end must also be the same as at the beginning. If we suppose that the mass of the positive particle is infinite compared with that of the electron, so that it absorbs no kinetic energy, the velocity of the electron at the end of the journey must be the same as that at the beginning.

This need not, however, be the case if the force is discontinuous, for when the electron is falling from aphelion to perihelion the increase in its kinetic energy depends upon the number of increments of momentum it receives during its journey from aphelion, and when it goes away from perihelion to aphelion its loss of energy depends upon the number of increments of momentum it receives on the return journey. Now, according to the intermittent theory of the force, these numbers are not fixed but are a matter of chance, so that there is a finite probability that the electron on its journey from aphelion to perihelion may receive more than a normal number of increments, whilst on the return journey it would receive less. If this were so, the electron would receive more energy in its approach than it would lose on its return, so that it would have gained by the journey kinetic energy without losing potential.

The chance of losing more energy on its return than it gained on the approach is just as great as in the case we have considered, so that some electrons may lose kinetic energy by the journey without gaining potential energy. The fact that it is possible for an electron to gain energy in this way has, I think, an important application to the question of the spontaneous dissociation of atomic systems.

Let us take the case of an electron describing an elongated orbit about a positive centre, and suppose that in going from aphelion to perihelion it receives more than the normal number of increments of momentum; when it gets to perihelion it will have more than the normal amount of kinetic energy. Suppose that the increments in the return journey are not more than normal, then on reaching aphelion again the electron will have more kinetic energy than when it started. If this increase in energy exceeds a certain amount, *i.e.* if it is so great that when the electron approaches the place from which it started it has sufficient energy to carry it against the attraction of the positive centre from this place to an infinite distance, the electron will break away and separate from the positive centre.

In this way the discontinuous character of the force may give rise to a spontaneous dissociation of the system—spontaneous in the sense that it is a consequence of the character of the forces acting between the members of the system, and does not depend upon collisions with other molecules or electrons or on the influence of radiation.

An example of this spontaneous dissociation is afforded by the negative ions in gases; these have two phases, one being the electron, the other a complex of the electron and one or more molecules. The first phase is continually passing into the second by the combination of electrons with molecules, and the second into the first by the dissociation of the complex. The rate of this dissociation is independent of the pressure of the gas, and there is no evidence that it is affected by radiation. Similar considerations show that when the force is intermittent an electron moving past a positively electrified particle may acquire or lose energy by the collision, even though the mass of the particle is infinitely greater than that of an electron, when if the force were continuous there would be no transference of energy to or from the electron. Thus it might be possible for an electron projected with less than the energy required to ionise a gas to acquire by collisions with positive particles enough energy for this purpose.

Let us now consider more in detail other characteristics due to the intermittence of the electric force; these will naturally occur only when the phenomena involve times short enough to be comparable with the time interval of the electric field. This time interval, we may say in passing, is not constant but varies with the strength of the electric field, diminishing as the strength of the field increases. Now suppose the electric field acts on an element of volume which contains a very large number of systems, be they electrons, atoms, or anything else which can be effected by electric force; and suppose the time t the force acts is small compared with T the time interval of the force. We can easily show that the momentum received by the whole system will be the same as if the force had been continuous and equal to I/T. This will be true whatever the time may be during which the force acts. The distribution of momentum will, however, be very different in the two cases, when the time of action is small compared with T.

The difference between the continuous and the intermittent force is accentuated when the forces are reversed after short intervals. If the field is intermittent and t is small compared with T, only a small fraction of the systems will have received any energy. When the field is reversed, the chance that any of the few systems previously excited will receive negative momentum and so lose energy is exceedingly small, and the great majority of systems which receive energy in the second interval will not have received any in the first. Thus the systems absorb practically as much energy from the electric field in the second interval as they did in the first. Under the continuous field, instead of absorbing energy, in the second period they gave up all they had got in the first.

Thus the intermittence of the field may lead to a great increase in the absorption of energy from alternating fields by systems exposed to the action of the field. The question of the transmission of waves of electric force when the period of the wave is shorter than the time interval of the electric force, is therefore one that introduces considerations quite different from those of electrical waves of longer period, and requires special treatment.

In the first place, the equations of the electric field do not, if we take the view of the intermittence of force, represent relations between physical quantities which have an existence at any particular time; they have respect rather to the relations between certain statistical quantities, averages taken over a time which is long compared with the time interval of the electric field; for these equations represent relations between electric and magnetic forces. From the point of view of the intermittent theory, electric and magnetic forces do not represent anything that is happening at any particular instant, but an average taken over a time which is long compared with the time interval of the electric field. Thus these equations are meaningless when the times available are not long enough to allow this average to have a definite value. They would not apply, for example, to the case of electrical waves if the period of the waves were less than the time interval of the electric field.

The consideration of what would happen to electrical oscillations the period of which is shorter than the time interval of the electric field, is a matter of great interest and importance. The time interval T of the electric force is connected with F, the intensity of the force by the relation $F=I/T$, where I is the momentum communicated at each impulse, so that as the intensity of the electric field diminishes I/T diminishes also. Now, whatever view we may take of the origin of the impulses which produce the force, whether, for example, we regard them as due to collisions with a swarm of very minute particles or in any other way, we should expect the interval between the collisions to increase as the field gets weaker. The time interval would be a function of the intensity of the field and would be longer for weak fields than for strong. Now consider an electron oscillating with a definite period T_0. Close to the electrons the electric field may be very intense, and its time interval may be short compared with T_0, the period of the oscillations. In such a region as this the classical theory would apply and electrical waves would travel through it, starting from the source of the oscillations. But as the distance from the source increases, the electrical field gets weaker and the time interval continually increases until when a certain distance is reached the time interval becomes comparable with T_0. When this region is reached it seems clear that the waves must stop, as Maxwell's equations from which the wave motion is deduced do not hold.

We have seen too that when T_0, the interval between the reversals of the electric force, is small enough to be comparable with the time interval, the absorption of the energy of the electric field is far greater than when T_0 is long compared with the time interval. We should not therefore expect these waves to travel farther away from the source than the place where the time interval of the electric field is equal to the period of the oscillations. For oscillations of very long period the critical place would be one where the time interval is long, *i.e.* where the field is very weak, and thus may be at a very great distance from the source; whilst for oscillations of very short period the critical place would be one where the time interval is short, *i.e.* where the force is very intense, and thus, *ceteris paribus*, much closer to the source of oscillations than for the slow vibrations.

As an illustration we may take one often used by Lord Kelvin. This is the case of a tightly stretched long string loaded at equal intervals with equal masses. This system has many periods. If P is the fastest of these, $P=\pi\sqrt{(lm/T)}$, where T is the tension in the string, m the mass of one of the particles loading the string, and l the distance between two adjacent particles. If one end of the string is agitated harmonically with a period p, waves will travel freely along the stretched string as long as P is less than p. If, however, the string is made more sluggish by increasing the mass of the particles or otherwise, so that p becomes less than P, the string will no longer transmit the waves, and the energy, instead of travelling along the string, will be localised close to the extremity which is agitated. The model would resemble the electrical case more closely if, instead of spacing the particles at equal intervals, the distance between two adjacent particles increased with the distance from one end A of the string; the value of P would increase with the distance from this end. If the end A were agitated harmonically with a period greater than the value of P close to A, but less than the value of P at some distance from A, the waves would travel along the string until they reached the place where P was equal to the period of agitation. Here they would be reflected back and the farther parts of the string would be free from agitation.

To return to the case of the vibrating electron: we see that though it may send out electrical waves, these waves, after travelling through a distance which depends on the period of the vibrations and also upon their amplitude, will reach a region through which they cannot penetrate, and will be reflected back. Thus the energy emitted by the radiator will not travel out into space but will be reflected back and again absorbed by the radiator, and thus there will be no escape of energy.

If the oscillations were due to an electron describing a circular orbit, the reflected waves when they struck the electron and gave up their energy to it would, in general, deflect it and cause it to describe a different orbit. Thus the motion of the electron would not be steady There may, however, be some orbits where the distance of the boundary at which the reflection takes place from the orbit is such that the reflected waves are in such a phase when they reach the electron that they just compensate for the changes in the motion of the electron produced by the emission of the radiation. For such orbits the uniform circular motion might be a steady state. It is evident that certain conditions have to be fulfilled for this to happen, so that it is only orbits with particular periods which possess this property. Since the application of a strong electric force would diminish the time-constant of the field, these orbits would be displaced by electric force. We may illustrate this point by the case of a piston vibrating at one end of an organ pipe which is closed at the other. In general, the waves reflected from the closed end will influence the motion of the piston, but they will not do so if the period of the piston is such that a loop of the vibrations of the pipe coincides with the position of the piston.

Let us apply similar considerations to light waves. Assuming that light is an electrical effect, we see at once that there can be no unlimited propagation of spherical electrical waves diverging from a source such as is contemplated in the usual conception of the electromagnetic theory of light; for on this view energy in the light is distributed continuously through space, and the energy per unit volume diminishes indefinitely as the light travels farther and farther away from the source. Now we have seen that the condition for the propagation of a periodic disturbance is that the period of the disturbance should be greater than the time interval of the electric field; this interval increases, however, as the energy in the light diminishes, so that when the energy falls below a certain value, which is small for long-period vibrations and large for short-period ones, any further propagation is impossible. Thus the intermittence of electrical force demands a corpuscular theory of light, *i.e.* a theory where the energy is done up in bundles which do not alter in size as they travel through space The bundle may consist of a periodic distribution of electric force, like a piece cut out of what on the classical theory represents a beam of light. This piece is prevented from spreading because the energy density at its boundary has the critical value, and this boundary acts, on our view, like a reflecting surface and sends back any disturbance which tries to get outside it.

I picture these units as consisting of two parts: a central core in the form of an anchor ring, the plane of the ring being at right angles to the direction in which the unit is travelling This ring is the seat of an intense electric field, and the circumference of the ring is equal to the wave-length of the light. This ring corresponds to the quantum of the light. This ring vibrates and emits electrical waves which, after travelling to a certain distance from the centre, get to the limit where the time interval of their electric field is equal to the period of the light. This forms the boundary of the unit, and the space occupied by the waves and the energy in them remain unaltered as the unit travels through space. On this view, light has a dual structure consisting of electrical waves with a quantum as the core. The electrical waves give rise to interference effects, the quanta to the photo-electric ones.

On the view that the force is intermittent the electric field must have a structure, and as electrons and positive particles are the centres of intense electric fields, they are probably much more complex than the usual conception of them, and must be regarded as centres of complex systems associated with an electron or a positive particle. If we compare the atom with its electrons to a solar system, we may compare an electron or a positive particle to the centre of a nebula and regard the electron as surrounded by an atmosphere of small particles.

This atmosphere can be distorted by the presence in its neighbourhood of other electrons or positive particles with their atmospheres, and will assume a shape appropriate to its surroundings. Thus the atmosphere round an electron far from other charges would be symmetrical and, if it were distorted, would vibrate about the symmetrical shape. Thus we could have vibrations associated with single electrons or single positively charged particles, even though the electron or particle were itself at rest; for example, without becoming neutralised by the absorption of an electron, a positively electrified hydrogen atom might be able to give out radiation. The possibility of vibrations of an electric field apart from any movement of the charges in the field has not, I think, been sufficiently realised.

These considerations suggest that just as matter is made up of molecules, and molecules are made up of electrons and positive particles, this is not the end of the story; there are still other worlds to conquer, the worlds which build up the electrons and positive particles.

Coal Ash and Clean Coal.[1]

IT is the normal view that the incombustible part of coal is not only a useless but even objectionable diluent. At times in the past, chemists, familiar with the theory of contact catalysis of gas reactions, have speculated that the ash constituents might well play an active rôle in the processes of carbonisation and combustion. None have been more prominent than Dr. Lessing, but his opinions met with no great support. The reactions in question seemed too complex, and no experimental confirmation had been adduced. Even Dr. Lessing himself waited until 1924 before disclosing evidence that inorganic substances altered the course of carbonisation. Since then, however, the subject has aroused greater interest. It is possible now for

---

[1] Cantor Lectures by Dr R. Lessing before the Royal Society of Arts, Nov. 23, 30, and Dec. 7, 1925.

Dr. Lessing's ideas to receive independent support. Processes have even been patented for modifying the results of coal carbonisation by means of control of the ash constituents.

In the Fuel Department of the University of Leeds, where the process of gasification of coal has been under experimental study for some years, it was soon observed that the inorganic constituents could not be ignored. They might be incombustible but were not necessarily inert. It was the availability in the West Yorkshire area of seams of coal almost free from ash which made it possible, by the controlled addition of inorganic matter, to investigate the influence of individual compounds on carbonisation. The results exceeded expectations, and it was shown by C. B. Marson and J. W. Cobb that the character of the coke produced was beneficially and extensively modified by the addition of certain substances, especially oxide of iron and sodium carbonate. Certain other oxides examined were apparently inert. Since the publication last year of this paper, further experience has only strengthened their conclusions. There is good ground for hope that a valuable control over the carbonisation process may be secured by means of the ash constituents. Indeed, it is no exaggeration to say that there is to-day no prospect in the distillation of coal more alluring than that offered by this method. Obviously, then, the subject is of great practical interest, especially in connexion with the production of smokeless fuel. It may well be that too much attention has been paid to the possibilities of varying temperatures of carbonisation, and too little to the variation of the character and quantity of the incombustible constituents. This oversight is, however, in the way of being remedied.

It is, however, a condition precedent to the most effective use of this new method of control, that the raw material, coal, shall be adequately clean to begin with. Any coke or smokeless fuel product will have to compete for popular favour with good household coal, which may in the best cases be even so low in ash as 2 per cent. It is, unfortunately for those who set out to provide smokeless fuel, only too true that the housewife is apt to think more of dirt on the hearth than of smoke leaving the chimney-pot If the carbonised product is to contain added inorganic matter, as well as the ash originally present, it is obviously essential that the raw coal must be very clean, for the ash content of the coke produced from it will necessarily be higher. Nothing is more important to the popularisation of smokeless fuel than the supply of clean coal. The stigma which rests on coke as a fuel is largely due to a reputation for 'dirtiness,' and the smokeless fuel problem can never be regarded as solved until a product is obtained which will find favour in the drawing-room of the most fastidious householder.

It is, however, essentially a problem for the mining industry, and its solution would give a powerful fillip to the popularisation of carbonised fuel for domestic purposes. The problem implies the identification of seams of coal which lends itself to cleaning, the improvement of cleaning technique, and the installation of plant necessary to turn out a fuel of the desired standard. The consumer would have to pay more for the product, but it would be necessary and possible to demonstrate that he was not a loser. Time, study, and capital would be required to carry these ideas into effect. It is then the more depressing to see the mining industry dissipating energy and resources of all kinds in a barren struggle instead of wrestling with its own more fruitful problems.

Dr. Lessing believes that these objects will be attained, that the carbonising industries "will feel constrained to insist for their raw material on coal containing only a fraction of the proportion of mineral matter which is customary to-day," and "that the provision of such a commodity will be technically possible and commercially profitable, and that it will be of economic advantage both to supplier and user."

The three lectures are, however, not confined to the importance of ash to coal carbonisation. They also traverse the chemistry of coal ash and its origin, the technique of coal cleaning, the economic aspects, and present a valuable survey of the whole subject.

H. J. HODSMAN.

Obituary.

DR. C. W. ELIOT.

AT a luncheon recently given by King's College, London, for the delegates to the Congress of the Universities of the Empire, Principal Barker introduced President Lowell as "the most distinguished permanent academic officer in the English-speaking world." The phrase was happily taken, and its substantive truth dates from Charles William Eliot, whose death on August 22, fuller of honours even than of years, removes the last survivor of the three captains who bridged the incredible gap between the primal 'college' and the contemporary university; the others were Angell (Michigan) and Gilman (Johns Hopkins). They mediated a change wherein sober fact nigh outruns imaginative fiction. Eliot, the most conspicuous, foresaw the unbelievable, and it came true.

Circumstances must conspire with men to produce significant results. Accordingly, Eliot was fortunately born (1834) from the soundest New England stock, and educated at the best New England institutions. After graduation at Harvard in 1853 he taught mathematics and chemistry in the College and the Medical School for a decade; resided two years in Europe (1863–65), observing the universities shrewdly; returned to occupy the chair of chemistry in the Massachusetts Institute of Technology, where he pioneered for four years. In 1869, after keen opposition, still the subject of piquant legend, he was elected president of Harvard, and launched upon a unique incumbency of forty years He found the College (1636) with Medical (1782), Divinity (1816), and Law (1817) Schools of a narrow type; he left the foremost American university with a transformed College and a score of other departments.

As the Harvard inscription bears, the New England College was founded "to advance learning and perpetuate it to posterity, dreading to leave an illiterate ministry to the churches"; or, as the Yale charter runs, "fitting youth for public employment, both in church and civil society." In other words, vocation, and one vocation mainly, took precedence over the advancement of knowledge. Moreover, although Agassiz used a Charles River shed for a laboratory so early as 1848, acquaintance with the natural sciences was usually confined to little physics and less astronomy. Further, the human sciences, as now understood, enjoyed no independent recognition. While striking persons were to be found on the staffs, they were seldom specialists—Mark Hopkins (Williams) taught all subjects to all undergraduates in their final year ! Modifying the clerical and bellelettrist tradition, Eliot, though but thirty-five years of age, set himself to create a new order; in addition, he proceeded to reform the meagre curricula and otiose methods of the professional schools. He agreed with his brilliant colleague Barrett Wendell that "the use of heresy is to vitalise creed." Inevitably, he drew much fire; a rare combination of courage, candour, penetration, patience, above all, aplomb, enabled him to make very rough places plain. Under his leadership Harvard rose to unchallenged primacy in twenty-five years, and the example of her chief began to affect academic policies from coast to coast. Blunders were perpetrated in his name and, being human, he added his personal quota. But in sum and substance he won universal recognition as a national asset.

Eliot's remarkable dignity of address and statement came to him by right of heritage. Democratic puritanism, bred of self-understanding, flowered in a peculiar aristocracy, secure in appeal to sense of duty. Eliot was its most conspicuous example. For, elevated far above sordid affairs, his qualities were means to spiritual ends; thus he could confront the American people as a vocal public conscience. He said his say with none to gainsay on grounds of petty interest. He blandly exposed illusions and dangerous symptoms, protesting against the mediocrity of efficient technique as a peril incident to universal education; telling his countrymen that, after all, they must apply for guidance to the select minority who know; insisting upon the equality of every subject open to sober investigation.

Hence, although the United States had passed to another phase during the period of his retirement, he could still speak forthright to the very end. He contributed to science in particular by affording ample facility and genial stimulus to inquiry. His was an exceptional life, because he rose greatly to a great opportunity. Attempting to sum it in a phrase, one might perhaps venture to say that he furnished a striking illustration of that peculiarity of American culture which most baffles other nations—"the parts are greater than the whole." R. M. WENLEY.

MR. W. FAWCETT.

WILLIAM FAWCETT, who died suddenly at his residence at Blackheath on August 14, in his seventy-sixth year, was originally a schoolmaster and graduated B.Sc. at the University of London. In 1880 he was appointed assistant in the Botanical Department of the British Museum, shortly before the collections were transferred to South Kensington. In 1881 he became a fellow of the Linnean Society, from which he withdrew in 1915, but rejoined in 1923.

On December 29, 1886, Mr. Fawcett sailed to take up his appointment as director of Public Gardens and Plantations, Jamaica, a post he retained after the amalgamation in 1903 of the Botanical Department with the Department of Agriculture until his retirement in March 1908. He edited the *Bulletin of the Botanical Department*, Jamaica, from April 1887 until 1902, and the *Bulletin of the Department of Agriculture* from 1903 until his departure in March 1908, when a new series of the latter was commenced by the Hon. H. H. Cousins, the present director. A note on this department was published in the *Kew Bulletin*, 1906, p. 68. In addition to notes in these journals, he published in 1893 "A Provisional List of the Indigenous and Naturalised Flowering Plants of Jamaica," and in the same year "An Index to Economic Products of the Vegetable Kingdom in Jamaica." He also delivered lectures, one of which, an "Introduction to the Classification of Plants," was published at Kingston in 1889. "Historical Notes on Economic Plants in Jamaica" appeared in vol. 6 of the *Bulletin of the Department of Agriculture*, and dealt largely with cigar and tobacco production. After returning to England he commenced, in collaboration with Dr. A. B. Rendle, a flora of Jamaica, the first volume of which, on Orchidaceæ, including text-figures, was published in 1910, and vol. 5 in July 1926; vol. 2 has yet to appear. Most of the work for this was done at the British Museum, but Mr. Fawcett frequently visited Kew to consult the collections there, his last visit being so recent as July 29 last.

As the titles of some of the above-mentioned papers show, Mr. Fawcett was keen on developing the applied side of botany, and in 1913 published a book entitled "The Banana: Its Cultivation, Distribution and Commercial Uses." During his residence in Jamaica he rendered valuable service in developing the vegetable resources of the island, in association with Sir Daniel Morris, the commissioner of the Imperial Agricultural Department of the British West Indies, after the threatened failure of the sugar crop. To Mr. Fawcett was also due the inception of the Imperial Exhibition in Jamaica in 1891. C. H. W.

WE regret to announce the following deaths:

Dr J George Adami, F.R.S., Vice-Chancellor of the University of Liverpool, on August 29, at sixty-four years of age.

Dr. R. D. Carman, president of the American Roentgen Ray Society and chief of the section of radiology of the Mayo Clinic, known for his work on the radiology of the digestive tract, on June 17, aged fifty-one years.

Mr Charles A. Coffin, founder and former president of the General Electric Company, who was responsible for the organisation of the research laboratory at Schenectady, on July 14, aged eighty-one years

Dr. Willis T. Lee, sometime professor of geology and biology in the University of Denver, and geologist since 1902 of the United States Geological Survey, who studied the stratigraphy of the south-western States with particular reference to ground water and coal investigations, on June 17, aged sixty-one years.

Mr. Frank M. Woodruff, for many years curator of the Academy of Sciences and Museum of Natural History in Lincoln Park, Chicago, and secretary of the ornithological section of the Chicago Academy of Sciences, on July 21, aged fifty-nine years.

News and Views.

THE German Dye Trust, the actual title of which is the Interessengemeinschaft Farbenindustrie Aktiengesellschaft, has long been in the limelight as the largest and most powerful combination of its kind. Only last year its constituent companies entered into a form of union that is indistinguishable from an amalgamation, and their combined capital was increased to 646 million marks (say, 32,300,000*l.*); now it is announced that the capital is to be raised to the enormous figure of 1100 million marks (55,000,000*l.*). It is well known in chemical circles that dyestuff-manufacture now represents only a very small part of the activities of the I.G. Before 1914, Germany supplied 75-80 per cent. of the world's requirements in dyes; to-day its export trade is relatively very small, and except for a marked revival in exports of zinc oxide and 'lithopone,' it is continually diminishing, whilst importations are steadily increasing. In the opinion of many German industrialists, the practical monopoly enjoyed before the War is unlikely ever to be regained. Manufacture of dyestuffs and pharmaceutical products has now become of inferior importance to that of fertilisers, such as synthetic ammonium compounds and urea, and these materials are responsible for most of the profits made. Nothing is more astonishing than the development of the nitrogen-fixation industry, and the long-threatened competition between it and the Chilean nitrate industry has materialised, to the great discomfiture of the latter. The most fundamental factor in the nitrogen-fixation industry is the cost of hydrogen, and every effort is being made to reduce this cost by extending its uses. This accounts for the interest which the I.G. is taking in the hydrogenation of coal and peat, and in the artificial production of light motor-fuels.

THE ramifications of the German Dye Trust are too intricate and deep-seated to be divined by those outside the inner ring; and they are probably very numerous, if one may take a line from the activities of some of our own large chemical undertakings, the interests of which are known to extend far beyond the sphere of industrial chemistry. A letter from the Frankfurt correspondent of the *Times*, printed in its issue for August 27, throws a little light upon the ever-extending interests of the I.G. and upon the uses to which the new capital may conceivably be put. It may be taken as fairly certain that a good proportion of it is earmarked for developing and extending the nitrogen plants and for financing the rapidly increasing trade in nitrogenous products. The fact that compound fertilisers are in chief demand to-day in Germany, necessitates abundant supplies of phosphates and potash, and it is confidently asserted that the I.G. is contemplating some arrangement with the powerful Potash Syndicate. By absorbing the important Köln-Rottweil explosives company, the Dye Trust has obtained a dominant position in the German artificial-silk industry. That industry has already come to terms with certain foreign producers—including, it is stated, Messrs. Courtaulds—and rumour now says that an understanding with French and Italian manufacturers is in prospect. The Dye Trust, through one of its subsidiaries, is the largest producer of raw films in Europe; co-operation or fusion with its two chief competitors, the Eastman Kodak Co. and Pathé Frères, is said to be maturing. Rumour is also busy with the industrial exploitation of the Bergius process, although its commercial success is by no means assured. The board of the I.G. has officially announced its intention to erect a large plant "for the liquefaction of coal," but it has not stated which process is to be adopted. In many quarters it is believed that the statement refers to the manufacture of light motor-fuel by a process other than the Bergius, and that it is this other process which is the subject of negotiations with British, Dutch, and American petroleum companies.

ALL who are interested in bibliography and in scientific organisations, particularly from the international point of view, will welcome the appearance of the first issue of the *Bulletin for Scientific Relations*, dated July 1926, which has just been published by the International Institute of Intellectual Co-operation of the League of Nations (price per annum, 24 francs, France; 2 dollars for other countries). Written mainly in French, partly in English, the journal deals with many phases of scientific activity, including the results of inquiries initiated by the Institute itself. In the first section, which is devoted to bibliography, general and special, and to libraries and research centres, nothing strikes one more than the interest which Russia is showing in these matters. Soviet Russia is stated to possess 28 libraries containing 50,000 volumes or more, and in these are located more than 16 million volumes, the public library in Leningrad alone containing 4,134,000—the largest library in the world. Moscow has 140 scientific libraries, about 100 of which have been established since 1917, and in May 1925 a bibliographical library containing more than 10,000 volumes was opened to the public. The library of the University of Amsterdam has been enriched by a gift of 10,000 French scientific books. Berlin possesses an information bureau for books and monographs that informs scientific workers where any desired book may be found, as well as a Government central office for scientific information, which co-ordinates bibliographies relating to natural science and procures either original or photostatic copies of the publications mentioned therein. Athens can now boast of a new library, housed in a fine building presented by the Carnegie Institute, and named "Bibliothèque gennadienne," after Gennadios, a former Greek minister in London, whose gift of books to the Greek Government is located in the library.

UNDER the heading "International Scientific Organization," the *Bulletin for Scientific Relations* records that in answer to a *questionnaire* sent out by the International Union of Academies concerning an international language, nine academies replied that they would prefer a living language to an artificial one; Italy asked for Latin, and Japan for Esperanto. This section contains a long report from the International Bureau of Meteorology, also references to the establishment of microbiological institutes at Moscow and Buenos Ayres, and to the projected opening of a branch of the Pasteur Institute at Montreal. Uuder "National Scientific Organizations" mention is made of the proposal to remove the anthropological, prehistoric, and ethnographic collections from the Museum of History at Vienna, and to use them for the nucleus of a new "Kulturhistorisches Museum." A Kaiser-Wilhelm Institute for silicate chemistry has recently been founded in Berlin, with Prof. W. Eitel as director. In France a Petroleum Institute has been opened at Strasbourg. In Greece the Academy of Athens has been founded and inaugurated in a building which was intended for this purpose forty years ago The Academy has three classes of members: pure and applied sciences, literature and fine arts, and moral and political sciences, the number of members in them being restricted to 25, 20, and 15 respectively. In Germany an institute for Chinese students studying in the University of Frankfort was opened at the end of last year.

MR ERNEST MACKAY'S summary of the results of the Oxford University and Field Museum Expedition to Kish during the past season, in the *Times* of August 25, affords striking evidence of the importance of this site for the early history of civilisation in Mesopotamia. No less than three considerable buildings have been brought to light this year. Of these, one, a temple of Nebuchadnezzar, with walls standing 18 feet high, which is one of the best preserved in Mesopotamia, has another large building of the period of Hammurabi (2100 B C) beneath it, and possibly earlier buildings at a still lower level. A ziggurat of Sargonic date (2752 B.C.) is of unusually large proportions, while another building adjoining the Nebuchadnezzar temple is constructed of mud bricks of a size which points to the age of Dungi (2250 B.C.). The discovery of the greatest significance, if the interpretation offered be correct, comes from Jemdet Nasr, a mound on which were discovered fragments of painted pottery, both monochrome and polychrome, and the inscribed signs emerging from the pictographic state, to which attention was directed at the time of their discovery in their relation to the evolution of writing from pictographic signs to the later cuneiform writing. The excavation of this mound showed that it belonged entirely to one period (*circ.* 4000–3500 B.C.), but a building discovered there proved to be built, not of the characteristic plano-convex bricks hitherto thought to be the earliest in date in Babylonia, but of a well-made rectangular brick, differing in size and shape from the later rectangular brick which ousted the plano-convex brick. It is thought, therefore, that the latter—an obviously inferior type—must have been introduced by a race of invaders and have entirely superseded the earlier form in Northern and Southern Sumeria, as there is no evidence that the two types were ever in use at the same time.

THE August number of the *Review* issued by the British Brown-Boveri Co. gives an excellent illustration of the trend of electrical development. We learn that Messrs Brown-Boveri, the famous Swiss firm, is constructing for the New York Edison Co. a turbo-alternator set of 160,000 kilowatt capacity suitable for continuous running. As only a few stations in Great Britain have an output so large as this, it will be seen that it is a bold undertaking. The high steam pressure part, 265 lb. per sq. in., is to drive an alternator of 75,000 kilowatts at 1800 revolutions per minute, whilst the low pressure part drives an alternator of 85,000 kilowatts at 1200 revolutions per minute. This will be the world's largest turbine.

ANOTHER direction in which the Brown-Boveri Co is specialising is in the manufacture of automatically controlled sub-stations. The importance of these stations in railway work has been long recognised. They are more expensive to build than hand-controlled stations, but the great saving in wages almost invariably makes their adoption advisable. There is no need to consider problems relating to the housing of the staff, and so the most economical site can be chosen In a recently constructed sub-station for a Swiss railway they have installed a 300-kilowatt rectifier set which converts 8000 volts alternating pressure into 800 volts direct pressure. There is in addition a 300-kilowatt rotary converter for performing the same function. A time switch in the morning sets the rectifier into operation. If a long period of overload occurs a thermal relay operates and the rotary converter operates in parallel with the rectifier. If for any reason the converter failed to act and the rectifier was excessively overloaded, safety devices would act and an alarum would be sounded. In the event of a sudden serious disturbance, the relay tests whether the cause is permanent or not. It operates three times at intervals of ten seconds, and if the disturbance persists it shuts down the whole set. Even when the load is only one-third of the full load, the efficiency of the conversion at the sub-station is 92·5 per cent.

WE have received from Mr. Arthur MacDonald of Washington, D.C., a statement of proposals which he has put before the United States Senate advocating the extension of anthropological studies in certain directions. Among other matters he stresses the importance of the study of man after death, especially in the case of those who have been prominent in the political and scientific world. It is interesting to note that since the beginning of the last century the brains of quite a large number of prominent Americans, including Abraham Lincoln, Lewis Aggasiz, and Walt Whitman, have been studied after death. Mr. Macdonald has also opened up a new line of inquiry in studying the political activities of American senators. In the sixty-second Congress, which lasted over three sessions, he found that the attendance was better in the first and third sessions than in the second, while Progressive Republicans showed a higher percentage of voting than Conservative Republicans. Business men attended quorum calls more and "yea and nay" calls less than professional men, but professional men averaged higher than business men in their frequency of remarks on the

Senate floor. Curiously enough, success in both public and private legislation varied inversely with education; that is, the better educated the senator, the less his success in legislative activity. Mr. MacDonald maintains that continuous study on these lines and a comparison with similar studies of legislatures in other countries should prove valuable, and probably lead to modifications of legislative procedure. It must be confessed that the utility of these studies is not immediately apparent. Abstract studies on statistical lines of political activities, such as frequency of voting in division, introduction of legislation, public and private, and the like, can have little scientific value when considered *in vacuo* and apart from attendant conditions which, from the nature of the case, it is almost impossible to ascertain.

PROF. A. F. C. POLLARD has prepared a Subject Index to volumes 1-25 of the *Transactions of the Optical Society* on the lines set out in his manual on the Decimal Bibliographical Classification of the Brussels Institut International de Bibliographie recently published by the Optical Society. It is printed on one side of the paper only, so as to be suitable for gumming to the ordinary 5 in. × 3 in. catalogue cards. A paper appears under each subject with which it deals, and to each subject is assigned a number, as in the original Dewey decimal system of 1876. This number appears at the right-hand top corner. At the left on the line below is the name of the author. Next below is the date in the order 1923.05.24 and the descriptive title. On the next line the reference in the order-title of publication, volume, year, pages. The manual explains the system of notation, which from 535 = Light gives 535·5 = Polarisation, 535·54 = Chromatic Polarisation, and 535·543 = Colours of thin Plates, and with (02) for Treatises gives 535(02) = Treatises on Light. The system was adopted at Brussels in 1899, but was not used in the International Catalogue of Scientific Literature, where Light had the range 2990–4470 assigned to it. As a system it appears both concise and comprehensive, but it has not yet been accepted as international, although it has been in existence more than a quarter of a century.

PROF. POLLARD's Subject Index introduces an innovation into the method of indexing individual scientific journals, and it will be interesting to see with what favour the scheme is received and how far the movement will extend to other learned societies and journals and lead to some uniform and standard method of indexing. For, although the Dewey system has been adopted extensively in the libraries of Great Britain for their book classification, the Brussels scheme for indexing periodicals has not so far found much practical application. A few, notably French journals, habitually arrange their monthly abstracts of current literature in this order, and some, including certainly one English, even label the original articles in each issue with the appropriate Brussels notation, but none as yet, we believe, has extended the system to annual or consolidated indexes.

IN the June issue of *Medical Life* (vol. 33, p. 261), Prof. Tenney L. Davis has a short note on Boerhaave's attitude toward alchemy. A remarkable feature of the "Elementa chemiae," a book which did much to establish its author's reputation, is that it does not discuss the phlogiston doctrine of Stahl, and Prof. Davis interprets this silence to mean that Boerhaave thought the doctrine unimportant. Boerhaave, in short, was interested in facts, and was always ready to weigh and consider. This trait made him extremely tolerant and sympathetic in his treatment of the alchemists, whose habits of wide experimentation and careful observation did not, however, prevent him from doubting "whether these skilful persons, after they had discovered so many extraordinary things by naked observations, might not by a too great quickness of apprehension anticipate, and relate things for facts, which they conclude might be done; or even must of necessity have been done, if they had persisted in the pursuit. . . Credulity is hurtful, so is incredulity: the business, therefore, of a wise man is to try all things, hold fast what is approv'd, never limit the power of God, nor assign bounds to nature."

SOME American museums are accustomed to publish reports of the explorations and travels on which members of the staff have been engaged, while reserving the scientific results for more weighty publications. This has the advantage of encouraging the traveller to observe and note facts subsidiary to his main object, and of preserving a record of details interesting in themselves but not important enough to warrant a formal paper. Thus the Yearbook of the Academy of Natural Sciences of Philadelphia for 1925 contains well-written and well-illustrated accounts of such journeys. Francis W. Pennell describes "Botanical Travel in Peru and Chile," his main objective being the Scrophularaceæ of the central and southern Andes. Witmer Stone writes on "Past and Present Bird Life of the Southern New Jersey Coast," and publishes some good photographs of terns and skimmers. Samuel G. Gordon reports on a mineralogical expedition to Bolivia and Chile, but manages to introduce photographs of glaciers and mountain lakes.

ANOTHER such volume is "Explorations and Field-work of the Smithsonian Institution in 1925." This contains an account of Dr. Hrdlička's seven months' journey to some of the chief palæo-anthropological sites in the world. The photographs of the locality from which the Pithecanthropus remains were obtained, of the finder of the Rhodesian skull, and of the quarry that yielded Australopithecus, are of particular interest. Dr C. D. Walcott's geological explorations in the Canadian Rockies, Dr. Bassler's field-work in Tennessee geology, and Mr. C. W. Gilmore's collecting fossil foot-prints in Arizona are among the numerous articles that show the value to the museum of detailing members of the staff for field-work. There are twenty-six such reports in this volume, ranging from field-work in astrophysics by Dr. C G. Abbot, to experimental breeding of the mollusc Cerion at the Tortugas, by Dr. Paul Bartsch.

THE thirty-eighth Congress and Health Exhibition of the Royal Sanitary Institute will, at the invitation of the Town Council, be held at Hastings on July 11-16, 1927. The Right Hon. Sir William Joynson-Hicks, Bart., Home Secretary, has consented to act as president of the Congress.

THE eighth International Congress of Psychology will be held at Groningen, Holland, on September 6-11. Sections will be formed for the discussion of eidetic imagery, psychogalvanic reflex, higher psychic processes, animal psychology, psychopathology, and applied psychology. Papers will be read by the following British psychologists: Mr. F. C. Bartlett (Cambridge), Dr. Wynn Jones (Leeds), Dr. Thouless (Manchester), Dr. Aveling, Dr. Ernest Jones, Dr. C. S. Myers, and Prof. Spearman (London). Altogether nearly a hundred papers will be read.

THE issue of *The Fight against Disease*, the journal of the Research Defence Society, for July, contains an obituary notice with an excellent plate of the late Mr. Stephen Paget, who died in May. He was the founder of the Society and of its journal. Dr. J. A. Murray's address at the annual meeting of the Society on "The Experimental Attack on Cancer" is also printed; it gives a good summary of the subject, and tells just how far we have advanced in the knowledge of cancer by experimental methods.

THE Department of Glass Technology of the University of Sheffield has recently published vol. 8, 1925, of its experimental researches and reports, consisting of papers collected from the *Journal of the Society of Glass Technology*, the *Journal of the Royal Society of Arts*, and the handbook to the annual meeting of the Society of Chemical Industry, Leeds, May 1925. Most of the papers describe the work which has been carried out by Prof. W. E. S. Turner, Dr S English, and Mr. A. Cousen on the physical properties and the chemical constitution of various glasses. In addition, the publication contains articles on the glass industry and the modern production of sheet glass.

MESSRS. Isenthal and Co., Ltd., inform us that their address now is Ducon Works, Victoria Road, North Acton, W.3, where all communications and inquiries should be sent. The change of address has been necessitated by the expansion of the business, chiefly in connexion with the manufacture of overhead high-tension switchgear, protection apparatus, automatic voltage regulators, etc, all of which now demand more spacious premises than it has hitherto been found possible to devote to them. The manufacture of resistances and the development of some important new lines will also benefit by the greater facilities now at Messrs. Isenthal's disposal.

UNDER the direction of Prof. Doello-Jurado, the Museo Nacional de Historia Natural of Buenos Aires has resumed its custom of distributing a fairly comprehensive "Memoria Anual." That for 1924 (dated 1925) has just been received. It records the celebration of the centenary of the Museum on December 31, 1923, gives an account of the activities of the staff and of the chief accessions, illustrated by 44 half-tone plates, and discusses the proposed new building. Among numerous expeditions, the most noteworthy was that to South Georgia to obtain examples of cetaceans, pinnipedes, and birds. Chief stress, however, is laid on the renewal of collections in vertebrate palæontology. Rich though the museum is in this department, the older material is not always furnished with those precise details of horizon and locality now esteemed indispensable. Among the fossils collected are crania of Scelidodon, bones of Promacrauchenia and Protohydrochœrus from Monte Hermoso, skull and bones of Lestodon and other mammals from the later deposits of Playa de Barco. Apparently the enforcement of the law forbidding the export of palæontological, archæological, and anthropological material before it has been passed by a commission, has proved a difficult and laborious task. It resulted, however, in the retention for the Museum of a fine mandibular ramus of Pyrotherium and a few other desiderata from the collection made by Dr. Elmer S. Riggs for the Field Museum, Chicago.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A European science master at the Agricultural School at Moor Plantation, Ibadan, Nigeria—qualified to teach mathematics, chemistry, physics, and botany to about Junior Local standard—The Secretary, C.A. (N.), Board of Education, Whitehall, S.W.1. Scottish candidates should apply to the Secretary, Scottish Education Department, S.E.D. (N), Whitehall, S W.1 (September 27). A professor of economics in the University of New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (September 30). A head of the Department of Chemistry of the Witwatersrand Technical Institute—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C.2 (September 30). A museum assistant at the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (October 4). A whole-time research worker at the Calcutta School of Tropical Medicine for the investigation of hookworm disease from the point of view of its effect on the health on labour forces—The Director, School of Tropical Medicine and Hygiene, Calcutta (November 30). A laboratory assistant for the Veterinary Research Division of the Agricultural Department of the Government of Kenya—The Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (quoting M/14661). A visiting lecturer on engineering quantities and estimates at the Borough Polytechnic Institute—The Principal of the Institute, Borough Road, S.E.1. A director of the National Institute of Poultry Husbandry—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

Research Items.

PRE-HISPANIC JEWELRY IN COLOMBIA.—Among the contributions to the session at The Hague of the thirty-first International Congress of Americanists which have recently been published is a description by Dr. Paul Rivet of two collections of pre-hispanic jewelry in gold and gold and copper—one of Chibcha manufacture, the other Antioquian. Although they represent two entirely distinct industries, they have a common technique which is identical on general lines and is also related to the technique of the gold ware of Chiriqui, Panama. The Colombian gold industry was carried by the Chibcha far beyond the bounds of Colombia, and the whole of Ecuador and the Peruvian coastal areas appear to have come under its influence. In the same region an entirely different industry, originating on the Peruvian-Bolivian plateau, has been superimposed. Unlike the Chibcha industry, which is confined to gold and gold-copper, this superimposed industry works in copper, gold, tin, silver, exceptionally lead, and the alloys of these metals. The Chibcha industry, notwithstanding its high development, is probably not indigenous. It may be derived from the industry in an alloy of copper and gold, which the Spaniards found on their arrival among the inhabitants of the Antilles and the area north of the Amazon-Venezuela and the Guianas. This alloy is identical with that of Colombia, and the industry may have been introduced into that area by a Carib invasion. The centre of its origin lay possibly in the hinterland of the Guianas, the legendary site of El Dorado, and may have given rise to that tradition. The antiquity of the Carib invasion must be considerable, as the Chibcha technique appears on the Peruvian coast so early as the proto-Chimu period of Uhle.

VITAL STATISTICS OF SOUTHERN INDIA.—A study of the vital statistics of southern India, by Major A. J. H. Russell, which appears in the *Scientific Monthly* for July, brings out some interesting points bearing upon the question of the conservation and promotion of the population. Of a population of 41,002,696 (1921), the Hindus form 89·48 per cent., Mohammedans 6·95 per cent., and native Christians 3·2 per cent.; other classes 0·04 per cent. A study of the population curve since the census was initiated in 1871, shows that southern India has very nearly reached an asymptotic population under present conditions. Indeed it has been necessary to import food stuffs during the last few years and, in spite of serious famine years and epidemics, the population is still too large for the methods of cultivation employed. The registered birth-rate is 30·0 per 1000, but there is reason to believe that the birth-rate is really so high as 42·5 per 1000. In Madras City, where registration is more accurate, in 1922 it was so high as 41·2, and of 215 towns, 13 registered a rate of 40 to 50. The registered death-rate for the same period was only 21 per 1000, but actually it was probably 33 to 36 per 1000. In Madras City it was 43·1 per 1000. Infantile mortality was very high, although there has been a distinct downward tendency. In several of the largest towns this was so high as 311·6 to 352·8 per 1000, as against the English rate of 80 per 1000. Nearly 50 per cent. occur within the first month. This is attributed largely to the Hindu employment of 'barber' midwives, and it is significant that in the towns, 13·7 mothers die for 1000 births, the rate for the whole presidency probably being much higher.

ROGER BACON AND GUNPOWDER.—In a recent issue of *Archivio di storia della scienza* (vol. 7, 1926, p. 34), Adolf Clément of Copenhagen offers a new and convincing solution of the famous cipher in Bacon's "Epistola de secretis operibus artis et naturae et de nullitate magiae." The passage in question, which it is only right to say has been regarded as of doubtful authenticity, reads: "Item pondus totum 30. Sed tamen salis petrae LURU VOPO VIR CAN UTRIET sulphuris; et sic facies tonitruum et coruscationem, si scias artificium." Lieut.-Colonel H. W. L. Hime interpreted the words in cipher by omitting *et* and rearranging the remaining letters into R. VII. PART. V. NOV. CORUL. V., which he translated "take seven parts (of saltpetre), 5 of young hazelwood (charcoal) and 5 (of sulphur)." Hime's solution (for a detailed account of which see "Roger Bacon Memorial Essays," Oxford, 1914, chap. xii.) has, however, been severely criticised by Lynn Thorndike, and is far less convincing than Clément's. Clément points out that the letters of the words in cipher can be rearranged into "pulveri carvonu tritov," the letters *s*, *m*, and a syllable *rum* at the end of *tritov* instead of *v*, apparently being lacking. It must, however, be remembered, he says, that the cipher was written at an epoch when abbreviations were in common use, and the three final letters of the words as rearranged are really signs of abbreviation, namely, *i* for ī, *i.e.* *is*; *v* for ũ, signifying *um*; and *v*, in *tritov*, for ꝝ, *i.e.* *rum*. The sentence would then read: Sed tamen salis petrae, pulveris carvonum tritorum, sulphuris, etc.

ARABIC ASTRONOMY.—In a recent number of the *Sitzungsberichte der physikalisch-medizinischen Sozietät zu Erlangen* (Band 58, 1926, pp. 33-88) O. Schirmer continues the Erlangen tradition of the study of Islamic science. Inspired by Prof. Wiedemann, Schirmer has investigated some problems of Arabic astronomy, the most interesting being concerned with Arabic determinations of the inclination of the ecliptic. Two pages of figures of these determinations are given, chiefly, as might be expected, for Bagdad, Damascus, etc., though one was made at Toledo by Al-Zarqali. Al-Chugendi's description of his determination at Ray (near Teheran) in 994, for which he obtained the figures 23° 32′ 21″, is very clear. Prof. Wiedemann provides an appendix in which he translates the introduction of an astronomical work by Al-Nasawi; this contains a good deal of noteworthy historical information referring, *inter alia*, to the Aristotle of Islam, Avicenna.

TABULA SMARAGDINA.—Prof. Julius Ruska, of Heidelberg, whose work on the history of chemistry in Islam is well known, has recently published an exhaustive study of the "Emerald Table" of Hermes ("Tabula Smaragdina," Carl Winter's Universitatsbuchhandlung, 1926). He deals first with the ancient Hermetic literature, and discusses the conception of the god Thoth among the Egyptians. Passing in review Scott's "Hermetica," he rightly remarks that in sweeping aside all the alchemical books ascribed to Hermes as masses of rubbish, Scott was acting in a high-handed fashion, since "weder der Inhalt noch die Geschichte des ganzen Literaturkomplexes, der unter des Hermes Trismegistos Namen geht, gibt uns ein Recht auf solche grundsätzliche Scheidung und ungleiche Bewertung." A detailed study follows of Hermes and Hermetic literature among the Syrians, Arabs, and Persians, and Prof. Ruska shows that the attribution of the "Tabula" to Greek sources is probably not justified. He gives the Arabic text as found in a work of Jâbir ibn Ḥayyân, and also as it occurs in a collectaneous

MS. in a private library in Germany. He does not give credence to Jâbir's statement that he found the text of the "Table" in a work of Apollonius of Tyana, remarking that all we can be sure of is that by Jâbir's time (eighth century A.D.) a magical, astrological, and alchemical literature ascribed to Apollonius had grown up, but how much of it was genuine, or even from Greek sources at all, it is impossible to say. Prof. Ruska then deals with the "Emerald Table" in its Latin dress, exhibiting a wide and deep knowledge of medieval alchemical literature, but remaining interesting in spite of erudition—or perhaps because of it. The commentary of that enigmatical person Hortulanus is considered, and references to the "Tabula" and other Hermetic writings in Albertus Magnus, Arnold de Villanova, Trithemius, Paracelsus, and others are described. With one or two exceptions, such as the omission of any mention of the work on the "Table" published by Steele and Fulton, the book is extraordinarily complete, and contains everything that is of importance on the subject with which it deals.

HERRING AND PLANKTON.—The correlation of abundant plankton food with large catches of herring, if it can be successfully proved, should point to a means of great value for enabling fishermen to shoot their nets in areas most likely to be profitable, when the herring are actively feeding. In this connexion, Mr. R. E. Savage ("The Plankton of a Herring Ground." Min. Agric. Fish. Fishery Invest. Series 2, Vol. 9, No. 1, 1926) records the results of a cruise of the fisheries research vessel to study the plankton in the North Sea, in July 1922, off the mouth of the Tyne, where the herring fishery was very poor at the time. The catches of plankton on the fishing grounds, which consisted mainly of copepods, chiefly *Temora longicornis*, are stated to have been poor; while the region in which the plankton was most abundant did not coincide with the centre of the area in which the herring boats were fishing, but was some 20 miles south-east of it. Interesting observations are given on the vertical distribution of the different plankton organisms, together with a comparison of the distributions shown by day and by night collecting. It was found, by a series of hauls at each 5 fathom depth, that the deeper layers were generally richer in plankton animals as a whole in the daytime, and that the poverty of the surface layers extended to a depth of at least 10 fathoms.

VERTEBRATE DEVELOPMENT.—Volume 17 of the Carnegie Institution's Contributions to Embryology contains a paper on the origin of the rete ovarii and rete testis by Dr. K. M. Wilson, a description of the vessels of the sow's ovary by Miss D. H. Anderson, a physiological study of cortical motor areas in kittens and adult cats by Messrs. L. H. Weed and O. R. Langworthy, and a paper on the relations between the onset of decerebrate rigidity and the time of myelinisation of tracts in the brain and spinal cord of young animals by Dr. Langworthy. Dr. Wilson's most important conclusion is that the rete cords arise from deeply lying undifferentiated cells in the early sex gland and so indirectly from the cœlomic epithelium; thus they do not have a Wolffian origin. Miss Anderson's paper deals with the cyclic changes in the blood-vessels and lymphatics of the ovaries, and shows that both of these form double wreaths around the follicle, the capillaries growing inwards at ovulation and the lymphatics following two days later when the corpus luteum is becoming organised. Messrs. Weed and Langworthy determined the responses to electrical stimulation of the cerebral cortex in cats of all ages from birth, and found that in the newly-born ones movements of the contralateral fore-leg only were obtained, but in older ones not only these but also movements of the hind leg and of the facial-masticatory muscles were observed. The areas made out for the young kitten corresponded topographically to the same areas in the adult. In the paper by Dr. Langworthy, strong experimental evidence is presented of a correlation between the myelinization of the rubro-spinal tract and the occurrence of decerebrate rigidity. All the memoirs are illustrated by plates.

A DINOCEPHALIAN FROM SOUTH AFRICA.—Prof. W. K. Gregory has published in the *Bulletin of the American Museum of Natural History* (Vol. 61, article 3) a very detailed account, illustrated by 21 plates and 29 text figures, of *Moschops capensis*, a dinocephalian reptile. This study is based on very complete material, some seven or eight skeletons being represented, and, as a result, Prof. Gregory is able not only to describe the osteology but also to discuss the relations of this animal, its probable food and habits, and to make a restoration of it as it appeared when alive. Moschops, a semi-aquatic animal, had advanced from the primitive reptilian condition in that its body was raised well off the ground. In the author's opinion it was derived from some Pelycosaurian ancestor.

JAPANESE EXTINCT MAMMALS.—Prof. Matsumoto describes in *Science Reports of the Tôhoku Imperial University*, Vol. 10, No. 1, various extinct mammals discovered in Japan, many of them being described for the first time. The paper is in three sections, the first dealing with Proboscidea. The chief interest of this account is the description of a new species of the genus Hemimastodon. This genus was first described by Dr. Pilgrim from Baluchistan from rather scanty material, and its existence was doubted by some authorities. Matsumoto's further evidence goes to support Pilgrim's determination of the genus as being a connecting link between the genus Phiomia (Palaeomastodon in part) and the later mastodons. Altogether fourteen species of Proboscidea are listed as occurring in Japan. The second section describes two pinnipeds, one an extinct form *Eumetopias watasei*, the other a specimen of *Odobaenus obesus*, the walrus, possibly of Pleistocene age. The third section deals with four new species of fossil cetaceans.

HYDROGRAPHY OF THE IRISH SEA.—An account of hydrographic observations made in the Irish Sea between Holyhead and Dublin, by Mr. R. J. Daniel in 1925, is published in the annual report of the Lancashire Sea-Fisheries Laboratory (Liverpool University Press). In this area the water is of practically the same temperature and salinity from surface to bottom, which greatly facilitates the survey of these two physical conditions which are being carried out regularly every month. A slow drift of ocean water passing north through the Irish Channel, strongest in some months and weakest in others, has been known for some time, our knowledge being based on inferences drawn from changes in salinity of the water. Mr. Daniel's observations at regular intervals of one month may be expected to give a record of the fluctuations in this drift of water from year to year. A point of interest, recorded in this report, is the considerable differences in surface salinity readings at near-by stations which occur sometimes, and the small differences, at each station, between the surface and deeper samples.

Bottom Currents in the North Sea.—Under the title "The Water Movements in the Southern North Sea, Part 2, The Bottom Currents," Mr. J. N. Carruthers publishes an account of an extensive experiment conducted by the Ministry of Agriculture and Fisheries, by means of 'bottom trailers,' of which some ten thousand were set free from a number of selected positions throughout a year (Fishery Investigations Series 2, Vol 9, No. 3, London: H.M Stationery Office, 1926). This ingenious method of observing the drift of the water close to the bottom, by means of bottles so weighted that they remain lightly poised upon their tails of wire, which are about two feet long, was devised by Dr. G. P. Bidder more than twenty years ago, and has been used successfully in several areas of the sea around the coast of Britain. The bottles trip along lightly with any horizontal movement of the water and escape the danger of becoming arrested by mud and rough ground to a much greater extent than any body resting directly on the bottom, until such time as they are caught in the trawl of a fishing vessel or go ashore on the coast. The number of days each has been out and the distance travelled gives an indication of the currents experienced in the course of its wanderings. An idea of the intensity of the trawl fishing in the southern part of the North Sea is given by the fact that 24 per cent of the trailers put out were recaptured by trawlers. Besides these a number were found on the coast, particularly in the case of those liberated from the Sandettie, Galloper and Outer Dowsing Light vessels, from the positions of which there is an onshore set of the deep water. The results of this extensive experiment show that current of bottom water flows in to the North Sea from the English Channel, spreads out fan-wise towards the East Anglia and Dutch shores and proceeds north-easterly. A current also flows south-east off the coast of Scotland and north-east England until it reaches the latitude of Flamborough Head, when it turns easterly and finally north-easterly, forming a counter clockwise swirl system in the vicinity of the South Dogger Light vessel. Water from the two currents mingle and proceed north towards the Danish coast. The speed of the residual drift or current at each of the chosen positions approximates to a mile a day.

A Current Meter for Deep Water.—Much ingenuity has been exercised in the design of meters for measuring currents in the sea during recent years, and considerable headway has been made with a difficult practical problem. The apparatus devised by Prof. V. W. Ekman more than twenty years ago has been used extensively and is probably the best known type. In *Publication de Circonstance* No. 91 (June 1926) of the Conseil International pour l'Exploration de la Mer, he describes "a new repeating current meter" which is a development of the original model for use in deep water. The aim has been to provide an instrument to be used in several hundred fathoms from a vessel riding to a single anchor, which does not provide a fixed point of suspension for the meter owing to the veering of the ship. With this instrument a number of 'messenger weights' are slid down the wire to which the meter is attached, one after another at noted times, and the meter registers the direction of the current at the moment when each 'messenger' hits it, together with the distance the current has travelled between successive hits.

The Compressibility of Rocks.—To test the rival hypotheses that beneath the earth's outer shell the material consists of peridotite or basaltic glass, L. H. Adams and R. E Gibson, of the Geophysical Laboratory of Washington, have made direct measurements of the compressibilities of dunite and tachylyte (*Proc. Nat. Acad. Sci.*, May 1926). The results show that at a pressure of 17,000 megabars, corresponding to a depth of 60 km., the velocity of longitudinal earthquake waves in dunite would be 8·4 km. per sec In basaltic glass the corresponding velocity would be 6·45 km. per sec., and in gabbro from 6·9 km. to 7·3 km. per sec. The actual velocity of such waves at a depth of 60 km. is about 8 km. per sec. It is concluded that this gives a very definite indication "that at depths greater than 60 km. we have a material more basic than gabbro and approaching dunite in composition." The new measurements show quite conclusively that Daly's conception of a substratum of basaltic glass meets with no support, but neither can the author's deduction be completely justified. Eclogite would probably satisfy the evidence equally as well as peridotite. It is to be hoped that similar work on this high-pressure facies of basalt may soon be carried out.

Radiation without Quanta.—The Montreal *Mercury* has issued as a pamphlet of 28 pages the two addresses given in April by Prof. L. V. King to the Physical Society of McGill University on the properties of a rotating electron in translatory motion. If the shortening of the axis of the electron in the direction of translation is taken into account, the equations of motion of the electron are shown to give a precessional motion of frequency ν which is connected with the translational velocity v by an equation of the form $h\nu = \frac{1}{2}mv^2$, where m is the mass of the electron when at rest and h is a constant for all electrons. Thus the quantity h of the quantum theory is introduced by classical dynamics as a property of the rotating electron. The extension of the idea to spinning protons and to atoms leads to the series formulæ for the hydrogen and helium spectra and to the *S*, *P*, *D*, and *F* series for other elements with the correct value for the Rydberg constant. The fine structure of lines, the Zeeman and Stark effects are explained as due to perturbations of orbits brought about by external fields. The radiation formula in terms of temperature and wave-length follow from a Maxwellian distribution of electron velocities.

Coal Carbonisation Tests.—The Department of Scientific and Industrial Research has issued a Fuel Research Technical Paper, No. 15, on the Carbonisation of Durham 'Holmside' Coal in Continuous Vertical Retorts (London, H.M. Stationery Office, 1926). The continuous vertical retort has gained its popularity largely because it lends itself to the production of the lower-grade gas which is usually distributed to-day. The tests recorded were made at the Fuel Research Station, Greenwich, at the request of the South Metropolitan Gas Company, which distributes a coal gas of calorific value somewhat greater than is customary in England, and it is of considerable interest to ascertain how far the continuous vertical retort can be applied to the production, from a typical Durham coal, of gas of the quality used in South London. It was found that the settings required certain modifications both in construction and operation, after which it was possible to produce the carbonisation results desired. The tests were extended to study the effect of steaming the charge, so as to obtain results comparable with those previously obtained on other coals.

Phytopathology and Private Enterprise.

IN most of the European countries, as is the case in England, the insect pests and fungus diseases of agricultural plants are dealt with by one phytopathological service, and in spite of the opposition to such a practice in America this union has been found to work satisfactorily, for if at times one branch may seem to be profiting at the expense of the other, the two have so much in common that it is probably the most logical system to adopt. As we in Great Britain are more or less interested in what is happening in the corresponding service on the continent, it may perhaps be opportune to give an account of the National French Phytopathological Congress held at Lyons on June 28-30, which we had the pleasure of attending through the kindness of the promoters, the P.L.M. Railway.

The meetings, on account of the heavy programme, began at the somewhat early hour—for an Englishman—of 8.30 A.M. and continued until after 6 P.M. M. Mangin, the director of the Natural History Museum, Paris, acted as president, and M. Boret, the ex-Minister of Agriculture, and several other deputies honoured the Congress with their presence. Some five hundred persons accepted invitations, and most of the surrounding countries were represented. The subjects discussed comprised papers on various entomological and mycological problems, the disinfection of the soil, the value of colloids in spraying, the relation of birds and field-mice to agriculture, and proposals for the establishment of regional committees to assist in the war against what may be termed shortly the enemies of plants. In view of the large quantities of certain chemicals employed in this fight—on an average 50,000 tons of copper sulphate are used, for example, in a year, and about one-third of that is imported—and the consequent increase in price which such a demand creates, the need for finding fresh insecticides and fungicides was also discussed, while motions were passed dealing with the necessity of obtaining nicotine plentifully and readily and the need for some sort of guarantee of purity in those chemical preparations used by the grower. The latter question, it may be said in passing, has been receiving of late some consideration in this country. The exhibits of the various research stations—Paris, St Genis-Laval, Montargis, Mentone, etc.—and of various firms, notably those of Vermorel and Truffaut, were very fine, while a practical demonstration of spraying apparatus at Ampuis completed the work of the Congress.

Hitherto it has been left to a government to maintain a phytopathological service, either directly or indirectly, though there are notable examples of the enterprise of private associations in establishing and running laboratories for the study of diseases of the particular crops in which they are interested. Amongst these the Hawaiian Sugar Planters' Association, the Colonial Sugar Refining Company, the Assam Tea Planters' Association, and the recently founded Ceylon Tea Planters' Research Institute may be mentioned, while on a smaller scale we have seen the establishment of works' laboratories by several private firms in Great Britain for the study of certain problems affecting their businesses, but this is a side of which people are in the main ignorant, and indeed there is little reason why they should be enlightened. The fostering of the agricultural industry by the P.L.M. Railway in the area covered by their system dates fairly far back. It has to be remembered that in northern France the carrying trade of the railways consists largely of coal, wheat, and beet, but in mid and southern France the railway derives most of its revenue from flowers, fruit, and vegetables. In 1877, when Phylloxera threatened to wipe out the wine industry, the P.L.M. Railway recognised that its revenue was closely bound up in the prosperity of the vineyards and did its utmost to assist in the stamping out of this dread disease. The service instituted then served as a nucleus out of which has grown the present magnificent organisation, which as it exists to-day is almost entirely of post-war origin. It is quite distinct from the service maintained by the state, but in actual practice it works in conjunction with and is really supplementary to it.

That disease may seriously affect the returns of an industry we all know, though it is difficult to obtain definite figures. M. Raybaud, the chief inspector to the company, estimates the injury caused by insects and fungi throughout the globe at 10 milliards of francs per annum, of which one milliard's worth is done in France. That the former figure is probably a very fair estimate the following data collected haphazardly from literature and reduced to a par value will show; the estimates are for limited areas in most cases and for prices prevailing before or during the War. The Hessian Fly is said to cost the U.S.A. 20,000,000*l*. every year; in the State of Washington the Codling Moth injures apples to the tune of 800,000*l*., and in another State 400,000*l*; *Conotrachelus nenuphar*, one of the British "scheduled" pests, injures peaches worth 400,000*l*. in Georgia; leaf injury by insects to tobacco in Sumatra on 80 estates amounts to 750,000*l*.; Helopeltis causes about 200,000*l* loss every year in the Dutch East Indies, *Phytalus smithi* 33,400*l*. to sugar-cane in Barbados, and figures are not available for the loss it causes in Mauritius, where it is a much more serious pest, *Bruchus pisorum* causes damage of more than 200,000*l*. in one province of Canada alone; *Thrips tabaci*, to those crops it attacks in the U.S.A., 600,000*l*., Frit-fly in Britain in 1912 damaged 12,126,198 bushels of wheat which, if we allow 1*l*. per quarter, is equivalent to more than 1,515,000*l*, the Brown and Gold Tail Moths have cost Pennsylvania and the neighbouring States 6,000,000*l* loss annually; *Prosagrotis orthogonia* caused injury valued at 600,000*l*. in Montana in 1920; *Cylas formicarius*, where it is established in the U.S.A., causes a loss of about 1,500,000*l*.; *Sitotroga cerealella* in Pennsylvania alone 200,000*l*.; one scale insect (*Saissetia oleae*) takes an annual toll of 400,000*l*. from the Californian Citrus industry; and if we include grain pests, Ohio loses 200,000*l*, Alabama from 800,000*l*. to 2,000,000*l*., while *Calandra oryzae* alone caused a loss of about 2,000,000*l* in the U.S.A. in 1918, but this was a particularly bad year. Damage on the grand scale is seen in the case of the Cotton Boll Weevil, which costs the cotton growers of the U.S.A. 35,000,000*l*. in lint and 5,000,000*l*. in seed, and the Pink Boll Worm, which is said to cause a loss of 10,000,000*l*. in Egypt. Then we have the more general estimates of 20,000,000*l*. for the injury to the forest and shade trees of the U.S.A., 1,000,000*l*. to the agricultural products of British Guiana, 1,350,000*l*. to the maize industry in South Africa, 25,000,000*l*. annual loss to the field crops in Canada, and a similar amount in Germany. A mycologist would probably be able to supply as astounding figures for the losses caused by fungi.

Satisfied as to the need, therefore, of keeping a watchful eye on the diseases of plants, the P.L.M. Railway maintains a central agricultural service bureau which carries on a progressive educative policy amongst the growers in the region covered by its lines, providing them with the latest literature on every subject which may be of interest to them, arranges conferences and demonstrations at convenient centres to which large attendances are assured through free travelling facilities, visits to other countries to study the conditions prevailing there, and also provides free carriage on their system for chemicals and spraying apparatus. The conferences are not confined to university professors and researchers in phytopathology, but the chemist and physicist, the manufacturer and the engineer take their place beside the practical man. Lively discussions result from such a gathering of experts, and not unusually the grower is able to hold his own. We were particularly struck by the keenness of the grower in everything pertaining to spraying, and whatever may be the opinion prevailing in Great Britain as to its value, there can be no doubt that the French agriculturalist is a firm adherent to the practice.

The phytopathological is but one side of the work carried out by the P.L.M. Railway. Since 1912 it has founded 138 experimental nurseries for the training of the peasants, and also many school gardens, subsidised largely the research station at St. Genis-Laval and the Insectary at Mentone, experimented with many varieties of strawberries, established a nursery for growing cypress for hedging, and distributed hundreds of thousands of plants free, fruit trees, vines, black currants, asparagus, artichokes, tomatoes, and osiers being the chief, but potatoes and winter vegetables have also received their share of attention. In addition pisciculture, viticulture, and sericulture owe much to the liberality and the encouragement of the Company. A huge organisation and a well-filled purse have always been behind these movements. What is the result to the Company? In 1910 it carried 190,000 tons of fruit and vegetables, in 1925 this had grown to 488,850 tons, so that the results of its labours are reflected in the balance-sheet at the end of the year in such a way as to encourage the Company to continue in the work which they are doing with such conspicuous success.

L.

A British Expedition to the Sepik River, New Guinea.

AN expedition has been planned and is now being organised by Mr. V. A. C. Findlay, the object of which is to penetrate to the central mountain chain of New Guinea and locate the head-waters of the Sepik River. There is at present a theory that a large lake lies between the Victor Emmanuel Range to the north and the Müller Range to the south, which feeds both the Sepik and the Fly Rivers. In 1891 Sir William MacGregor reached a point on the Fly River in the territory of Papua at lat. 8° 11′ S., long. 141° 54′ E., and of recent years a number of explorations of the head-waters of the Fly River have been carried out by officers in the Papuan service. In 1913–14 Dr. Behrman's expedition proceeded up the Sepik River in what is now mandated territory and the advance party reached lat. 8° 11′ S., long. 141° 36′ E. in the Victor Emmanuel Range, but failed to attain the objective of the expedition, the source of the river. A survey was made up to the point reached by the advance party.

The object of the present expedition will be not only to locate the source of the Sepik, but also to cross and survey the country lying between the head-waters of this river and those of the Fly. Geological, anthropological, zoological, and botanical observations will be made on the way, and if the objective is attained, should lead to results of great importance, as the higher and hitherto unexplored parts of the central mountain chain should produce much new and valuable material in each of these branches of science.

The expedition will proceed by launch to the highest possible point on the Sepik, where a base will be formed. From this the main party will proceed into the hills. Should they succeed in reaching the Fly, they will return down this river, the base party returning down the Sepik independently. The base party will be in communication with the authorities at Rabal by radio, and the main party will keep in touch with the base by means of a small transmitting set. A kinematograph outfit will also be carried.

The personnel of the expedition so far as arranged at present consists of Mr. V. A. C. Findlay, leader and agricultural and topographical surveyor; Mrs. Findlay, engineer, radio operator and photographer; Mr. A. J. Hill, engineer and radio operator; Mr. K. H. Henderson, zoological and botanical collector; Mr. W. S. Malcolm, anthropologist; and Mr. C. T. Teychenné, geological surveyor.

The expedition has received the approval of the Royal Geographical Society, the Royal Anthropological Institute, and the Committee for Anthropology of the University of Oxford. The expedition is being organised under the direction of a council of which Lord St. John of Bletso is president, and Mr. Henry Balfour, The Hon. Mr. H. A. Casson, and Dr. A. F. R. Wollaston, are members. At the recent meeting of the British Association at Oxford a committee was appointed to co-operate in the work of organisation. The estimated cost of the expedition is 6000*l*., and contingently on that amount being raised, the expedition will leave England in the autumn of 1927.

The Pelagic Young of the Cod.[1]

MR. MICHAEL GRAHAM and Mr. J. N. Carruthers have attempted to correlate the known distribution of the pelagic young of the cod with the theoretical distribution deduced from three factors—market statistics, wind records, and experiments with drift-bottles. The theoretical part is undertaken by Mr. Carruthers, the practical part, dealing with the actual catches of the young fishes, by Mr. Graham. In addition Mr. H. H. Goodchild investigated the food of the fry from the same samples. Three questions are involved in the present paper: First, to what extent the drift affects the pelagic fry in the North Sea; secondly, what is the distribution of the fry; and thirdly, what is the food of the young in the pelagic stage? To answer these questions the market statistics were used to ascertain the spawning-grounds and times, the methods being justified by previous work of one of the authors in 1924. A system of cruises was undertaken to fish for the larvæ and post-larvæ from these spawning-grounds outwards; experiments with drift-bottles were made and wind statistics consulted. The ascertained distribution was then compared with the theoretical distribution, and the results were found to be so much in agreement that the authors seem to be justified in their conclusion that the pelagic young of the cod are to a large extent carried by currents

---

[1] "The Distribution of Pelagic Stages of the Cod in the North Sea in 1924 in Relation to the System of Currents," by Michael Graham and J. N. Carruthers. With a section on "The Food of Pelagic Young Cod" by H. H. Goodchild, Fisheries Laboratory, Lowestoft. Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, vol. 8, No. 6, 1925. London: H.M.S.O.

The method of fishing was by taking oblique hauls with Petersen's young fish-trawl, at first as close to the bottom as possible for ten minutes; then to shorten the warp to half the length used in fishing near the bottom, and tow for a further ten minutes; finally, to tow for ten minutes at the surface. It was not intended to investigate the distribution by depth but to obtain representative hauls from near the bottom to the surface. Thus the fishes from all three depths were mixed together in the sample. In the drift-bottle experiments those at the surface only were taken into account. Information as to the vertical distribution of the pelagic young and the vertical extent of the drift would be extremely interesting.

More than a thousand of these pelagic stages were investigated for food; the result, as was entirely to be expected, showing that from the time when it begins to feed the young cod's main food is copepods. Copepods are pre-eminently the food of the larva and post-larva at least up to the time of its settling down to demersal life. Mr. Goodchild finds that diatoms are practically of no importance as food, which also is not surprising, judging from our knowledge of the food of other baby gadoids. The presence of the few specimens he mentions is in all probability accidental

The Haslemere Educational Museum.

NEW buildings for the Haslemere Educational Museum, founded a generation ago by the late Sir Jonathan Hutchinson, were inaugurated and opened to the public on August 27. He was an original and powerful influence in many ways; in his hobby of making and directing a museum he became a popular benefactor to the beautiful Surrey district where he had his home, and in the development of which into one of the best known areas for scenery, residence and holiday in the radius of fifty miles from London. The Museum, which was formed and arranged with the educational aim predominant of making every exhibit tell its tale to the average person who came to look at it, has until recently been the property of the Hutchinson family. They have now handed it over to a trust under a scheme by which the collection is placed in new buildings, a maintenance endowment fund is being formed, and the committee becomes representative of local and other institutions, which ensure it being widely popular and therefore educational to many.

The scheme owes much in inception and carrying out to the chairman, Dr. Arnold Lyndon, who presided at the ceremony on August 27, when Earl Midleton formally opened the buildings, and Dr F. A. Bather, keeper of the Department of Geology in the British Museum, unveiled a memorial tablet to the late Sir Jonathan Hutchinson. A large and distinguished company assembled in the beautiful grounds behind the roomy old mansion in the High Street, which with large additions has been most happily transformed into an admirable Museum. These grounds, with the spacious verandah and lecture hall, make the Museum well suited for education gatherings, whether for instruction of classes or by special demonstrations, etc, or (what may be well looked for) to visits from scientific societies, field clubs, and perhaps summer schools and conferences.

An additional interest is added by the fine collection of so-called Peant Arts, the property for some years of the Peasant Arts Guild, having been donated to the Museum and arranged in a special section. From an anthropological and ethnographical point of view, as well as from that of art and handicraft, this collection is important; there is no other in Great Britain made and arranged on the lines familiar to those who have visited Scandinavia and various continental cities where there are folk-museums. This Peasant Arts Section is entirely sympathetic to the aims and ideas of the late Sir Jonathan Hutchinson; a number of objects which he had collected have come into fitting spaces in this new phase. A great deal is due to Mr E. W. Swanton, whom Sir Jonathan many years ago appointed as the curator of his Museum, and who, with the aid of Mrs. Swanton, has become a real educational influence in Surrey. This is recognised by the annual grant of the County Council (as Education Authority) to the Museum. Mr. Swanton is a many-sided man, as was the original founder of the Museum, and he may be trusted to carry the Museum on in the fine tradition which it has established

University and Educational Intelligence.

A USEFUL guide-book to the universities of Germany has been published by the Akademische Auskunftsamt an der Universitat Berlin. This has been compiled by Prof. Karl Remme, Director of the Central Office for Foreign Students in Prussia. It is an attractive volume of 290 pages, profusely illustrated and well arranged, and will be most useful to students proposing to visit Germany. It comprises an historical introduction, a general description of the higher educational system, statistical summaries, and chapters devoted to facilities available for foreign students, the distribution of subjects of study as between the different institutions, conditions for obtaining degrees and diplomas, and very readable descriptions of the university towns

RESEARCH in progress at the University of Minnesota, July 1924–July 1925, is described in a three-hundred-page pamphlet issued by the University's Graduate School It contains the titles of about a thousand papers published or in the press and short abstracts of a large proportion of them. In addition it contains brief notes on the subjects and purposes of researches, the methods and materials used, and the results so far as available, in cases in which publication of papers has not been decided on. The index is not very satisfactory, names of researchers and classification headings of subjects of research being mixed in one series. If universities would co-operate in the production of annual lists of titles of subjects of research in progress, such lists could scarcely fail to be of considerable utility.

THE National University of Ireland's Calendar for 1926 exemplifies the tendency of such annuals to become unwieldy It contains more than 900 pages, chiefly lists of graduates and university honours. A list of published works and theses submitted for doctorate degrees from 1911 onwards contains about 200 titles and is followed by a footnote requesting professors, lecturers, and graduates to forward to the registrar "full details of publications and research work carried out by them." Of the six travelling studentships, each 200*l.* per annum for two years, announced for competition in 1925, only one was awarded, namely, in pathology. The subjects notified for travelling fellowships to be offered for competition in 1927 are: mathematical science, Irish together with English or French or German, philosophy, one of the three sciences, botany, zoology and geology, and anatomy.

Contemporary Birthdays.

September 4, 1845. Sir Thomas Barlow, Bart., K.C.V.O., F.R.S.
September 6, 1870. Prof. Frederick G Donnan, C.B.E., F.R.S.
September 6, 1876. Prof. J. J. R. MacLeod, F.R.S
September 7, 1877. Sir John Cadman, K.C.M.G.
September 9, 1867. Mr. Robert Ludwig Mond.
September 10, 1859. Prof J. Norman Collie, F.R.S.
September 11, 1877. Dr. J. H Jeans, Sec. R.S.

Sir THOMAS BARLOW, to whom congratulations are due on the anniversary of his eighty-first birthday, is Physician Extraordinary to H.M. the King President of the Royal College of Physicians, 1910–15, he was also president of the International Medical Congress of 1913.

Prof. DONNAN, occupant of the chair of general chemistry in the University of London, was educated at Queen's University, Belfast, and at Leipzig and Berlin. From 1904 until 1913 he was professor (the first to be elected) of physical chemistry in the Muspratt Laboratory of the University of Liverpool. Prof Donnan is a Longstaff medallist of the Chemical Society.

Prof. MACLEOD, Nobel laureate in physiology and medicine in 1923 (jointly with Dr. F. G. Banting), was born at Cluny, Perthshire. He was educated at the Grammar School of Aberdeen and the University there. Six and twenty years ago he was demonstrator in physiology, and afterwards lecturer in bio-chemistry, at the London Hospital, and for a time he was working with Dr. Leonard Hill on the physiological effects produced on animals by compressed air. From 1901 until 1903 he was Mackinnon research student under the Royal Society, taking up afterwards the chair of physiology in the Western Reserve University, Cleveland, Ohio. In 1918 he was elected to a similar post in the University of Toronto. The Nobel prize was awarded for the discovery of insulin.

Sir JOHN CADMAN was born at Silverdale, Staffordshire. He was educated at the High School, Newcastle-under-Lyme, and Armstrong College. Formerly a mining engineer and colliery manager, he established a practical acquaintance with all branches of the mining industry. Sir John is professor of mining and petroleum technology in the University of Birmingham, and technical adviser to the Anglo-Persian Oil Company. He is an Officer of the Legion of Honour.

Mr. ROBERT L. MOND was born at Farnworth, Lancashire, and educated at Cheltenham and Peterhouse, Cambridge. He is honorary secretary of the Davy-Faraday Laboratory. In recent years Mr Mond has rendered signal service as a student of Egyptology and conductor of excavations.

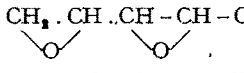
Dr. NORMAN COLLIE has been, since 1902, professor of organic chemistry in the University of London. A past president of the Alpine Club, he is an ardent mountaineer.

Dr. JEANS, one of the secretaries of the Royal Society, was educated at Merchant Taylors' School and Trinity College, Cambridge. Second wrangler in 1898, he was Smith's prizeman in 1900, and sometime Isaac Newton student. From 1905 until 1909 he was professor of applied mathematics in the University of Princeton. In 1919 the Royal Society allotted him a Royal medal for researches in applied mathematics, in 1922 the Royal Astronomical Society awarded him its medal for his contributions to the theories of cosmogony.

Societies and Academies.

PARIS.

Academy of Sciences, July 12.—Charles **Moureu**, Charles **Dufraisse**, and C. L **Butler**: Rubrene peroxide: new experiments. Rubrene peroxide, when dissociated by rise of temperature, emits light In an earlier note it was shown that light was essential to the combination of oxygen with rubrene —Miécislas **Biernacki**: The theorem of Lucas and its generalisations.—J. **Neyman**: A property of the law of probability which obeys the coefficient of variation.—Jules **Drach**: The integration of partial differential equations of the second order and the explicit use of the characteristic variables of Ampère.—**Decros, Rebuffet**, and J. **Villey**: An electrometric recording dynamometer.—N. **Gunther**: The movement of a liquid filling a domain with multiple connexion which is displaced —Ernest **Esclangon**: The asymmetry of sidereal space and the phenomenon of tides. —Marcel **Laporte**: The measurement of the mobility of ions in gases —R. **Forrer**: The structure of the atomic magnet. Its normal position with respect to the network and residual magnetisation.—A. **Bogros**: The resonance of lithium vapour. The resonance line of the alkali metals is known to be the first doublet of the principal series Direct experimental proof of this has been given for sodium and cæsium (Wood): the author now gives experiments proving it for lithium —J. **Heyrovský** and B. **Souček**: The electrolytic potential of iron amalgam. From measurement of the electrolytic potentials of iron amalgam, it is concluded that this amalgam should be metastable and decompose spontaneously, with liberation of energy, into a mixture of solid iron and mercury —J. **Consigny**: The stopping power of some metals for α rays —A. **Hamy**: The absorption of iodine by precipitated magnesia. Studies in the amount of iodine absorbed as a function of time, concentrations of iodine and of potassium iodide.—J. **Dumont**: The separation of the finer particles and colloidal constituents of the soil by centrifugation. The solid matter remaining in a clay suspension in water after standing for a day can be separated into two portions by a high velocity centrifuge, the portion remaining in suspension being considered as a true colloid.—Marcel **Bouis**: The synthesis of allene hydrocarbons In an earlier communication a method was given for preparing ethylallene starting from vinylethyl carbinol It is now shown that the method is generally applicable, the vinylalkyl carbinol, $CH_2:CH.CH(OH).R$, leading to the allene $R.CH=C=CH_2$—Charles **Prévost**: A new erythrite. The glycols (*cis* and *trans*) $CH_2OH.CH:CH.CH(OH).CH_3$ were converted into the ether oxides



$$CH_2.CH..CH-CH-CH_3$$

Only from the *trans* glycol was sufficient ether oxide obtained to convert by hydration with water into the corresponding erythrite.—E. **Rothé**: The nature of the maxima inscribed in seismograms —Albert **Baldit**: The periods of constancy of temperature at a station of medium altitude.—J **Beauverie**. The modes of degenerescence of the chloroplasts, particularly in parasitism.—Mlle. H. **Popovici**: Contribution to the cytological study of the laticifers.—A. L. **Guyot**: Some parasitic fungi of the roots of Phanerogams.—A. **Rizzolo** and A B. **Chouchard**: The quantitative study of the action of morphine on the cerebral cortex.—G. A. **Nadson** and N **Meisl**: The mechanism of the action of chloroform on the protoplasm, the nucleus and the chondriome of the cells of *Allium cepa*. The chondriome is the most sensitive to the action of chloroform; later, modifications are seen in the protoplasm, and last of all in the nucleus. The general character of the modifications produced by chloroform in the living substance is analogous with that of the changes provoked by X-rays.—Emile **André** and Henri **Canal**: Contribution to the study of the oils of marine animals. Researches on the oil of *Todarus sagittatus*.—Robert **Weill**. The problem of the cleptocnids. The nematocysts of *Hermæa bifida*.—André **Lwoff** and Mlle. Nadia **Roukhelman**: The variations of some forms of nitrogen in a pure culture of infusoria. From the point of view of the chemical transformations of the culture medium, and more especially from the point of view of the excretion of nitrogen in the form of ammonia and amides, *Glaucoma piriformis* (and perhaps all Infusoria) resemble bacteria.—A. **Vandel**: Triploidia and parthenogenesis in the isopod *Trichoniscus* (*Spiloniscus*) *provisorius*.—M. **Lemoigne** and P. L. **Dopter**: The nitrogen losses caused by soil bacteria in pure cultures.—M **Javillier** and H. **Alliare**: The existence of a nucleic phosphorus index of tissues.

July 19.—H. **Deslandres**: The law of distribution of terrestrial magnetic storms, and the corresponding law of distribution of the active regions of the sun. These are due to corpuscular radiation, which is subject to considerable periodic change.—G. **Bigourdan**: A means of improving the lunar co-ordinates deduced from the occultations of stars. The errors due to the irregularities of the edge of the moon's surface may cause an error of $1''$, whereas the error of observation gives the lunar longitude to about $0''\cdot1$. The application of lunar photographs is suggested as a means of reducing the error caused by the surface irregularities.—Charles **Moureu** and Adolphe **Lepape**: The determination of krypton and xenon in atmospheric air. An application of the spectrophotometric method previously described. The results (by volume) are: krypton, 1×10^{-6}, and xenon, 9×10^{-8}. These are about twenty times those obtained by Ramsay in 1903, but nearly identical with the figures obtained by Ramsay and Travers in 1900.—Charles **Richet** and P **Lassablière**: The protective effects of chloralose in chloroform anæsthesia. From experiments on dogs it is shown that the administration of chloralose (which must be free from parachloralose) by the mouth prevents cardiac syncope by the action of chloroform.—Rolin **Wavre**: The reduction of domains by a substitution with *m* complex variables, and the existence of a single invariant point.—Luigi **Fantappié**: A class of analytical functionals.—H. **Mineur**: Waves of discontinuity of the second order in an Einstein universe.—Henri **Bénard**: The limit of the laminar regime and the turbulent regime, revealed by the appearance of clear alternating vortices.—Farid **Boulad Bey**: The calculation of a continuous beam of any form when given vertical elastic deformations.—Da **Costa Lobo**: Correlation between the solar prominences and the filaments. The agitation of the surface of the faculæ. Results obtained with a large spectroheliograph set up at the astronomical observatory of the University of Coimbra. This instrument is identical in dimensions and characteristics with the instrument installed by M. Deslandres at Meudon Observatory, and the results from one station will serve to fill up gaps caused by bad weather at the other.—W. H. **Keesom**: The curve of fusion of helium. Data are given for pressures and temperatures ranging from 77·09 cm. of mercury on the helium bath (T. $4^{\circ}\cdot21$) to 0·057 cm. (T. $1^{\circ}\cdot13$).—G. **Darrieus**: A relation between the gravitation constant and other fundamental constants.—Henri **Malet**: The mathematical synthesis of the laws of electrodynamics.—A. **Dauvillier**: The spectrography of X-rays of large wave-length.—Mlle. J. **Liquier**. The variation of the rotatory power of solutions of quinine salts as a function of the hydrogen-ion concentration. The rotatory power of asparagine and the salt effect.—Salomon **Rosenblum**: The retardation of the X-rays by matter.—Georges **Fournier**: The absorption of the β-rays by matter.—Henri **Belliot**: Experiments on photographic solarisation.—A. **Boutaric** and Mlle. G. **Perreau**: The existence of two zones of instability in the flocculation of certain suspensions by electrolytes with trivalent and tetravalent cations.—P. **Brun**: The miscibility of quaternary water-alcohol mixtures. Details of the study of miscibility of mixtures of ethyl alcohol and water with two other alcohols not miscible with water, isobutyl and isoamyl alcohols.—**Pariselle**: The tartrates of pyridine and quinoline.—A. P. **Rollet**: A new colorimetric determination of nickel. The colour reaction utilised is produced by the oxidation of nickel dimethylglyoxime and will show 0·0005 mgm. nickel in 1 c.c.—René **Girard**: The action of saline solutions on the ferrous metals.—Mlle. **Bardon** and Mme. **Ramart**: The action of organo-magnesium derivatives on the glycidic ethers.—Mlle. **Marthe Montagne**: Researches concerning the action of organo-magnesium derivatives on some fatty dialkylamides.—E. E. **Blaise** and Jean **Miliotis**: Researches on the transposition of functional groups.—Jacques **Bourcart**: The stratigraphy of the Bouches de Cattaro (Jugoslavia).—Paul **Caubet**: Eruption of the peak of La Fournaise, December 1925 to April 1926.—V. **Agafonoff**: The genesis of the black earth and other soils in the neighbourhood of Clermont-Ferrand.—Ch. **Jacquet**: Researches on the radio-active springs of the Puy-de-Dôme.—Henry **Hubert**: The general movements of the air in western Africa.—M. **Bridel** and C. **Béguin**: Biochemical researches on the composition of *Salix triandra*. Preparation of rutoxide, asparagine, and a new glucoside hydrolysable by emulsion, salidroxide. The leaves of this plant contain glucoside, which can be hydrolysed by rhamnodiastase and a glucoside which under the action of emulsion gives an essential oil smelling of rose.—René **Souèges**: The embryogeny of the Liliaceæ. The development of the embryo in *Muscari comosum*.—Jules **Amar**: Observations on the cellular pigments.—G. **Lafon**: The intimate mechanism of muscular contraction.—Charles **Perez**: The sexual characters of the caudal fin in the Galatheideæ.—René **Fabre** and Henri **Simonnet** Study of the photo-sensitising action of hæmatoporphyrine.—F. **Vlès** and A. de **Coulon**: The receptivity of the organism for grafts of tumours, in relation with the iseolectric points of the tissues.—L **Lutz**: The soluble ferments secreted by the Hymenomycetes fungi. Reducing actions.—E. **Fauré-Fremiet** and Mlle. Laura **Kaufman**: Remarks concerning the curve of annual decrease of eggs laid by the domestic fowl.—Constantino **Gorini**: The stimulation of the bacterial activities in milk.—A. **Paillot**: The etiology and epidemiology of the *Gattine* of the silkworm, or the transparent head disease.—H **Bordier**: The action of diathermic d'Arsonvalisation on synovia.

Official Publications Received.

Bulletin of the National Research Council. Vol. 10, Part 4, No. 54: Quantum Principles and Line Spectra. By Prof. J. H. Van Vleck. Pp. 316. 3 dollars. Vol. 11, Part 1, No. 55: The Determination of the Protein Requirements of Animals and of the Protein Values of Farm Feeds and Rations. Report of the Sub-committee on Animal Nutrition. By H. H. Mitchell. Pp. 44. 75 cents. (Washington, D.C: National Academy of Sciences.)

Aeronautical Research Committee: Reports and Memoranda. No 985 (Ae. 197): The Reduction of Aircraft Performance Tests. By R. S. Capon; with an Appendix by W. G. Jennings and F/O. Falkner. (A.4.a. Full Scale Work. Aeroplanes General, 124—T. 2090 and a.) Pp. 20+18 plates. 1s. 3d. net. No. 998 (E. 16): Gaseous Combustion at Medium Pressures. Part 1: Carbon Monoxide-Air Explosions in a Closed Vessel; Part 2: Methane-Air Explosions in a Closed Vessel. By R. W. Fenning. (I.C.E. 471; I.C.E. 472.) Pp. 25. 1s. net. No. 999 (Ae. 206): Step-by-Step Calculations upon the Asymmetric Movements of Stalled Aeroplanes. By Prof. B. M. Jones and Miss A. Trevelyan. (A.2.a. Stability Calculations and Model Experiments, 97—T. 2126.) Pp. 22+25 plates. 1s. 9d. net. No. 1010 (Ae. 216): On the Effect of the Walls of an Experimental Tank on the Resistance of a Model. By H. Lamb. (D.2. Misc. Committee Papers, 174—T. 2200.) Pp. 6+1 plate. 6d. net. No. 1020 (Ae. 221): The Behaviour of certain Aeroplanes when the Controls are Abandoned in Stalled Flight. By H L Stevens. (A.2.b. Stability Full-scale Experiments, 85—T. 2160.) Pp. 9. 9d. net. (London: H.M. Stationery Office.)

Department of Agriculture, New South Wales. Science Bulletin, No. 26: Veterinary Research Report, No. 2. By Dr. H. R. Seddon. Pp. 48. (Sydney, N.S.W.: Alfred James Kent.)

Reprint and Circular Series of the National Research Council. No. 69: The Service of State-Supported Agricultural Research. By Sidney B. Haskell. Pp. 10. 20 cents. No. 70: Forest Research under State Auspices. By F. W. Besley. Pp. 10. 20 cents. No. 71: Science and Engineering; a Visualization of the Material Elements of our Civilization as Complex Products of Manifold Studies, Fundamental and Applied, that Interlock and Trace Back to the Broad, Basic Concepts through which we attempt to interpret the Phenomena of Nature. By William F. Durand. Pp. 18. 20 cents. (Washington, D.C.: National Academy of Sciences.)

British Association Meeting, Oxford, 1926. Exhibition of Scientific MSS. and Printed Books at the Bodleian Library. Pp 22. (Oxford: Bodleian Library.)

Société des Nations: League of Nations. Bulletins de l'Institut International de Co-operation Intellectuelle. Bulletin des Relations scientifiques. No. 1, Juillet. Pp. 52. (Paris: Les Presses Universitaires de France.) 8 francs.

Proceedings of the Royal Society of Edinburgh, Session 1925–1926. Vol. 46, Part 3, No. 22: Present Problems in Colour-Vision; the Laws of Visual Fatigue and of Resultant Sensation. By Prof. W. Peddie. Pp. 245-263. 1s. 6d. Vol. 46, Part 3, No. 23: A Geometry associated with the Double Binary (2,2) Form. By Wm Saddler. Pp. 264-282. 1s. 6d. Vol. 46, Part 3, No. 24: On the Effects of Vasectomy and of Epididymodeferentectomy in the Mouse. By Y. Tamura and F. A. E. Crew. Pp. 283-293. 1s. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

East Africa. Report of the East African Guaranteed Loan Committee appointed by the Secretary of State for the Colonies. (Cmd. 2701.) Pp. 47. (London: H.M. Stationery Office.) 9d. net.

Newport Public Libraries, Museum and Art Gallery. Fifty-sixth Annual Report and Balance Sheet for 1925–26. Pp 11. (Newport, Mon.)

Natural History Booklets. B101: Pine Marten. Pp. 4. B102: Harvest Mouse. Pp. 4. B103: Fallow Deer. Pp. 4. C99: Barn Owl. Pp. 4. (London: British Museum (Natural History).) 6d. each.

Falmouth Observatory. Meteorological Notes and Tables for the Year 1925, also additional Meteorological Tables for the Lustrum 1921–1925, with Mean Values for 55 Years (1871–1925). By Joshua Bath Phillips. Pp. 16. (Falmouth.)

Department of Agriculture, Ceylon. Bulletin No. 74: House Flies and their connection with Manuring Operations on Estates in Ceylon. By F. P. Jepson. Pp. 16+7 plates. 40 cents. Bulletin No 75: A Preliminary Investigation on the Absorption of Fertilisers by Ceylon Soils. By A. W. R. Joachim. Pp 19+8 plates. 40 cents. (Peradeniya.)

The Gardens' Bulletin, Straits Settlements. Vol. 4, No. 1: A List of the Mosses of the Malay Peninsula. By H N. Dixon. Pp. 40. (Singapore: Botanic Gardens.) 50 cents.

Memoirs of the Geological Survey of India. Vol. 46, Part 2: The Cutch (Kachh) Earthquake of 16th June 1819, with a Revision of the Great Earthquake of 12th June 1897. By R. D. Oldham. Pp iv+77+viii+4 plates. (Calcutta: Government of India Central Publication Branch.) 3 rupees; 5s. 6d.

U.S. Department of Agriculture. Farmers' Bulletin No. 1499: The Melon Aphid and its Control. By F H Chittenden and W. H. White. Pp ii+17. (Washington, D.C.: Government Printing Office.) 5 cents.

Department of Commerce. Bureau of Standards. Scientific Papers of the Bureau of Standards, No 527: Short Tests for Sets of Laboratory Weights. By A. T. Pienkowsky. Pp. 65-93. (Washington, D.C.: Government Printing Office.) 10 cents.

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 329: Manual of First-Order Triangulation. By C. V. Hodgson. (Special Publication No 120.) Pp. vi+186. (Washington, D.C.: Government Printing Office.) 40 cents.

Canada. Department of Mines: Victoria Memorial Museum. Museum Bulletin No. 43, Biological Series No. 11: List of Mushrooms and other Fleshy Fungi of the Ottawa District. By W. S. Odell. (No. 2039.) Pp iv+15. (Ottawa: F. A. Acland.) 10 cents.

Scientific Papers of the Institute of Physical and Chemical Research. No 63: Chemical Studies of Vitamin-B in Japan. By Umetaro Suzuki. Pp. 295-302. 25 sen. No. 64-65: On the Catalytic Hydrogenation of the Carbonyl Group in Aromatic Compounds under Pressure in the Presence of Copper. Parts 1 and 2. By Bennosuke Kubota and Taro Hayashi. Pp. 10. 20 sen. No. 66: Pleochroic Haloes in Biotite; Probable Existence of the Independent Origin of the Actinium Series. By Satoyasu Iimori and Jun Yoshimura. Pp. 11-24+plates 1-3. 50 sen. No. 67: On the Hardness of Different Structure in Steel. By Kanzi Tamaru. Pp. 25-44+plates 4-5. 50 sen. No. 68: Effect of Electric Field on the Spectral Lines of Zinc and Cadmium. By Yoshio Fujioka. Pp. 45-54+plates 6-9. 40 sen. No. 69: Spectroscopic Study on the Discharge in Helium. By Toshio Takamine. Pp. 55-61+plates 10-12. 40 sen. (Komagome, Hongo, Tokyo.)

Aeronautics. Report of the Aeronautical Research Committee for the Year 1925–26. Pp. 50. (London: H.M. Stationery Office.) 2s. net.

The Rockefeller Foundation: International Health Board. Twelfth Annual Report, January 1, 1925–December 31, 1925. Pp. xx+229+24 plates. (New York City.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 48 (Division of Chemistry Series No. 66): Fumigation with Hydrocyanic Acid Gas; Concentration and Distribution as influenced by Fumigation Procedure. By B. J. Smit and Dr. T. J. Naude. Pp. 22. (Pretoria: Government Printing and Stationery Office.) 3d.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 78. The Land Mollusks of the Republic of Panama and the Canal Zone, by H. A. Pilsbry; Costa Rican Land Shells collected by A. A. Olsson, by H. A. Pilsbry. Pp. 57-123+plates 9-11. (Philadelphia.)

Diary of Societies.

SATURDAY, SEPTEMBER 4.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Wales District Meeting) (at Llantrisant), at 10.55 A.M.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern District Meeting) (at Blyth), at 12.30.

FRIDAY, SEPTEMBER 10.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern District Meeting) (at Middlesbrough), at 2.

CONGRESSES.

SEPTEMBER 6 TO 11.

INTERNATIONAL CONGRESS OF PSYCHOLOGY (at Groningen), with Sections on Eidetic Imagery, Psychogalvanic Reflex, Higher Psychic Processes, Animal Psychology, Psychopathology, and Applied Psychology. Papers by, among others, F. C. Bartlett, Dr Wynn Jones, Dr. Thouless, Dr. Aveling, Dr. E. Jones, Dr. C. S. Myers, and Prof. Spearman.

AMERICAN CHEMICAL SOCIETY (at Philadelphia).—In eighteen Divisional Gatherings, dealing with various branches of Pure and Applied Chemistry.

SEPTEMBER 7 TO 10.

SMOKE ABATEMENT CONFERENCE (at Birmingham).

September 7.—Industry and Smoke Abatement, with Particular Reference to Boiler Smoke and embodying an Official Statement of Policy by the Smoke Abatement League.

September 8.—Papers on Housing and Smoke Abatement, by E. D. Simon, Marion Fitzgerald, Dr. R. Unwin, P. Taylor, Dr. L. Hill, and Mrs. C. S. Peel.

September 9.—Dr. Margaret Fishenden and A. S. E. Ackermann: Smokeless Production of Heat and Power.

September 10.—Combustion in Connexion with the Full Scale Model Boiler House which will be erected in the Conference Hall.

SEPTEMBER 9 AND 10.

CERAMIC SOCIETY (Refractory Materials Section Autumn Meeting) (at Queen's Hotel, Leeds), at 10.30 A.M.

September 9.—W. J. Rees: A Further Note on the Influence of Iron Oxide in Promoting the Inversion of Silica.—F. West and J. W. Fagan: Practical Results and Experience in the Drying and Burning of Refractory Materials.—Dr. G. Martin: Refractory Linings for Cement Kilns.

September 10, at 10 A.M.—Prof. J. W. Cobb, Dr. H. S. Houldsworth, and J. F. L. Wood: The Influence of Foreign Matter on the Thermal Expansion and Transformation of Silica.—W. T. Gardner: Refractories in the Gas Industry.—H. M. Ridge: Note on Modern Clay-working Machinery as used on the Continent.—C. E. Moore: Note on the Products obtained by Heating Stourbridge Fireclay with Potassium Chloride.

SEPTEMBER 12 TO 18.

INTERNATIONAL CONGRESS FOR APPLIED MECHANICS (at Federal Technical University, Zurich).—Lectures by Prof. P. W. Bridgman, Prof. P. Debye, Prof. T. Levi-Civita, Prof. L. Prandtl, and Prof. G. I. Taylor.

SEPTEMBER 13 TO 17.

INTERNATIONAL CONGRESS OF PHILOSOPHY (at Harvard University, Cambridge, Mass.).

SEPTEMBER 14 TO 16.

INSTITUTION OF PUBLIC LIGHTING ENGINEERS (Annual Meeting and Conference) (at Newcastle-upon-Tyne).

September 15, at 9.30 A.M.—R. Davison: Presidential Address.—J. F. Colquhoun: The Improved Lighting of a City.—Major S. Cooke: Motor Traffic in Relation to Lighting (*a*) on the Highway, (*b*) on the Vehicle.

September 16 (Morning).—R. Beveridge: Variations of Hours in Public Street Lighting.—H. Dickinson: Electric Street Lighting in Liverpool.

SEPTEMBER 19 TO 26.

GERMAN SCIENTIFIC AND MEDICAL ASSOCIATION (at Dusseldorf).

SEPTEMBER 22 TO 24.

GERMAN RÖNTGEN SOCIETY (at Dusseldorf).—Discussions on X-ray Treatment of Inflammation, the Compton Effect, and Irradiation of the Ovary and Offspring.

SEPTEMBER 26 TO 29.

INTERNATIONAL CONGRESS OF INDIVIDUAL PSYCHOLOGY (at Dusseldorf).

SATURDAY, SEPTEMBER 11, 1926.

CONTENTS.

PAGE
Evolutionary Physiology 361
The Assaying of Brabantius. By Alfred Noyes . 363
The Atom Again By Prof. J. A. Crowther . . 365
Aurora Polaris 366
Our Bookshelf 368
Letters to the Editor:
Science and Psychical Research.—Dr. J. P. Lotsy; Dr. R. J. Tillyard, F.R.S.; Sir Arthur Conan Doyle 370
The Three-dimensional Reproduction of Tracks of β-particles Ejected by X-rays.—Orrell Darbyshire 371
Spatial and Time Relations in Dreams.—M. E. J. Gheury de Bray 372
Pernicious Grafting.—R. C. Knight and Ronald G. Hatton; Albert Howard and Gabrielle L. C. Howard 372
The Constitution of the Stars.—Prof. Kerr Grant 373
The Volatility and Dissociation of Borax.—Prof. H. V. A. Briscoe and P. L. Robinson . . 374
Photographic Theory.—Prof. R. A. Sampson, F.R.S. 374
Kaufmann's Experiment and the Spinning Electron. —L. H. Thomas 374
Liver Extracts in the Treatment of Malignant Disease.—A. Piney 374
Oceanic Isostasy in Relation to Geological Tectonic. By Sir Joseph Larmor, F.R.S. 375
The Golden Eagle. By Seton Gordon . . . 377
The Regional Balance of Racial Evolution. By Prof. H. J. Fleure 380
The London School of Hygiene and Tropical Medicine. By T. Ll. H. 383
News and Views 385
Our Astronomical Column 388
Research Items 389
Excavations in Kent's Cavern, Torquay . . 391
Irish Limnology. By F. S. R. 391
Studies on the Origin of Cultivated Plants. By W. B. Turrill 392
University and Educational Intelligence . . . 393
Contemporary Birthdays 394
Societies and Academies 394
Diary of Societies and Congresses 396

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Evolutionary Physiology.

THE presidential address to Section I (Physiology) delivered by Prof. Leathes at the recent meeting of the British Association in Oxford was so remarkable in its width of view that it may be said to constitute a landmark amongst such addresses. In the past the main objects of physiological research have seemed to be two: first, to investigate the chemical nature of the substances which enter into living matter, or perhaps it would be better to say recently killed matter, and secondly, to invent imaginary machines which in their working would resemble the functions of living beings. But even if the second object were completely attained (and in no single case has this been done) it would still leave unanswered, as Sir Charles Sherrington has pointed out, two fundamental questions—namely, first, how such machines are built up out of the formless protoplasm of the egg, and secondly, how mind inserts itself in matter. Leaving the second question aside as too profound to discuss even in the pages of NATURE, we may note that Prof. Leathes boldly grapples with the first: he discusses the nature of life itself, as well as the chemical nature of the substances with which it deals.

The first and most obvious explanation of the phenomena of life which suggests itself is that these peculiarities are due to the chemical nature of the compounds which enter into protoplasm. These Prof. Leathes classifies as proteins, nucleic acid, lipoids (compounds of the higher fatty acids), and sterrols. The proteins have been shown to be long chains of as many as 100 links, each link consisting of an amino-acid. As all chemists are aware, these acids have, as their name implies, a basic as well as an acid 'hand'; and they owe their ability to form chains to the fact that each with its basic hand can grasp the acid hand of its neighbour. But, as Prof. Leathes tells us, there are only about twenty amino-acids known, and the infinite variety of proteins must be due to the order and number of the links which are put together. In this order lies one of the fundamental secrets of life, namely, that of assimilation. Modern research on digestion seems to show that the organism does not incorporate ready-made blocks of protein into its structure, but first of all breaks up these blocks into their constituent amino-acids and then mysteriously reassembles them in its own proper order. The analogy of a crystal segregating from its mother-liquor will not help: in this case we have to do with a rigid framework of similar atoms, bound together in a solid, and life is only manifested in a fluid medium. In a crystal, moreover, the particles which are added to the crystal face are similar to those already constituting it and previously exist as such in the liquid, but in the formation of protein chains a varied assortment of amino-acids is added according to a definite scheme. To build up the chain by the elimination of the elements of a molecule of water as each link is fastened to the next requires the expenditure of energy. This energy is supplied either by the radiant energy of the sun or by the oxidation of some other compound.

The mystery of life is not the creation of energy; it is essentially, as Prof. Driesch put it in a forceful address delivered this year, in London, the 'control' of energy—the control which out of a chaotic assemblage of materials whirling about in the fluid builds up a definite specific structure. The word 'regulation' coined by Driesch about 1895 to denote the mode of activity of his 'entelechy' and abhorred by the mechanistic school of which the late Prof. Loeb was the principal ornament and exponent, is creeping back into the vocabulary of experimental embryologists like Spemann and von Uebisch because the facts with which they deal will allow of no other explanation. The number of possible permutations of the order of the links in these protein chains is almost infinite, so that, as we have seen, the structure of the unfinished chain discloses no necessity of giving rise to a completed chain of a particular kind. Prof. Leathes speculates as to whether an occasional 'permutation' in this order may not be the cause of what biologists term a mutation. It is greatly to be desired that this word 'mutation' should either be rigidly defined or else removed from the scientific vocabulary altogether. Sometimes it is used to denote any change whatever in the hereditary potentialities of an organism, and then to say that evolution is explained by occurrence of 'mutations' is merely a truism. But the fact that this is a truism is often illegitimately employed to support another theory, namely, that violent and sudden divergences from type such as Prof. Morgan encounters in his cultures of Drosophila, and which form the 'sports' familiar to every breeder and gardener, constitute the raw material of evolution.

All the evidence at our disposal is hostile to such a suggestion: these 'mutations,' though they are certainly hereditary, are all characterised by weakened vitality and are unable to hold their own in the struggle for existence. This fact has been ably expounded in the address to Section D given by Prof. Osborn and printed in NATURE of August 21, who, in order to emphasise the view that the changes by which animals evolve are widely different from mutations, introduces the word 'speciation.' Further, as Prof. Leathes wisely says, a mutation is not eternal This, indeed, is its most interesting characteristic; the sport transferred to a natural environment, where, in the absence of dangerous competitors, it has a chance to survive, will after a certain number of generations revert to type; like the feral pigs of Jamaica, which have gone back to the wild boar. We submit that the cause of a mutation is to be sought in the weakening or inhibition of one of the processes which make up the activity of the germ plasm, a weakening which under better conditions is transmitted to succeeding generations in ever-lessening degree and eventually disappears.

Prof. Leathes eloquently discourses on the relation of function to structure and rightly states that physiologists who study function are well fitted to make contributions to the doctrine of evolution. What is 'functional' survives, and structure is the expression of function. This is shown by the fact that the same type of cell, the fibroblast, or, as embryologists term it, the mesenchyme cell, will develop connective tissue fibres and give rise to tendon at the end of a muscle, and will form and deposit calcium phosphate where bone is required. Every particle of bone, he asserts, is the response of the organism to the strains which the exercise of its members brings about. These products of cell-secretion he terms irreversible, as opposed to the reversible changes which take place in muscle.

The difference, however, is after all only one of degree Cary has shown that muscular fibrils are developed in mesenchyme cells under the influence of strain. In the embryo pig the gut-tube grows faster than its mesenchyme envelope, and the development of these cells into smooth muscles takes place in accordance with the elastic tension to which they are exposed, and, on the other hand, are not the osteoclasts which remove superfluous bone essentially identical with the osteoblasts which deposit it where it is required?

The fact is that the early exponents of evolution, being naturalists and morphologists, had only a superficial knowledge of function, and any structure the meaning of which was not obvious was ascribed to 'chance' variations which 'happened' to suit the environment. An example of this method of reasoning was the explanation of the dark pigmented spots found on the forehead of certain carnivora as devices intended to deceive their enemies into the delusion that the animal whilst asleep was really awake and gazing at them. As our knowledge of comparative physiology has progressed it has become more and more obvious that the whole body of the animal is an expression of its functions; or, as a zoologist would phrase it, of its reactions to its environment.

That the functions of cells are reactions to their environment was demonstrated in a beautiful way by Nageotte. He took a piece of sterilised bone from a rabbit's digit and implanted it in the cartilage of the ear. The introduced bone was soon surrounded by 'fibroblasts' drawn from the neighbouring fibrocartilage and connective tissue. These invaded it and actually deposited new bone around it, although in the normal course of affairs these cells never would form bone.

Prof. Leathes also discusses 'the conditioned reflex.' This is most simply described as a new association of ideas, though Prof. Leathes interprets it as the establishment of a new machinery in the nervous system. The classical example is, of course, Pavlov's wonderful work on the dog, in which the animal was made to associate the sound of a bell with the arrival of food. As a consequence copious secretion of saliva was produced by the sound of the bell. Koffka in his book "The Growth of the Mind" has shown how powerless is the conception of fixed reflex arcs when examined in detail to explain the formation of the new associations. Leaving this special difficulty on one side, however, Prof. Leathes truly remarks that the establishment of new functional relations is only of importance in evolution if this rise of new functions—in a word, the acquisition of new habits in the parent—affects the offspring so that the establishment of the same functional relations in them is effected more and more easily as the generations succeed one another. As most people are aware, this is at once the most fundamental and at the same time the most hotly disputed question in biology. Pavlov has asserted that he has demonstrated, by his experiments on mice, that conditioned reflexes in parents do affect the children. These results have been received by the supporters of 'chance variations' with the same incredulity with which they have received other similar results obtained by investigators of less world-wide fame than Pavlov. Prof. Leathes, as an impartial outsider, whilst awaiting confirmation by Pavlov himself of his own preliminary work, seeks to conciliate the more violent opponents by the use of the phrase 'parallel induction.'

By this phrase is meant the theory that whilst the body is incapable of affecting the germ cells which are embedded in it, yet an external influence may at one and the same time affect the body so as to provoke a new reaction and thus initiate a new structural change, and also affect the germ cells so that the next generation will show the same structural change. Surely this theory may aptly be described as the last ditch in which the opponents of the inheritability of acquired habits are prepared to die. Can it be seriously maintained that external changes in light and temperature can penetrate the somatic tissues and alter the deeply-seated germ cells, and yet that the body, which is in close physiological relation to these cells, is powerless to affect them?

Prof. Leathes makes a striking reference to the coincidence of the rediscovery of Mendel's laws of segregation in the hybrid offspring of different breeds, and the cytological discovery of the coming together of paternal and maternal chromosomes in the maturation of the germ cells and their subsequent disjunction into different cells. This 'meiosis' has been widely accepted as the physical basis of this segregation, and it is an hypothesis of seductive simplicity to take this view. But the whole history of physiology ought to warn Prof. Leathes of the peril of accepting simple mechanical explanations such as these. Again and again physiologists have believed themselves to be on the verge of simple physical explanations of vital functions, such as the diffusion of water from the blood through the glomerulus of the kidney, or the passage of oxygen through the alveolus of the lung, and each time closer examination has proved how disappointing and illusory such explanations are. In that wonderful school of cytological and Mendelian research established by the late Dr. Bateson in the John Innes Horticultural Research Institution, a body of devoted students have been studying Mendelian problems for years, and Miss Sverdrup's discovery that there are nine sets of independently segregating characters in the pea, but only seven chromosomes, is a result of just the same kind as physiologists have obtained in other fields.

In conclusion we may say that Prof. Leathes' eloquent appeal to his fellow physiologists to study functional evolution has our warmest sympathy. We feel convinced that if they respond to this appeal the whole aspect of evolutionary philosophy will be enormously changed and improved.

The Assaying of Brabantius.

The Assaying of Brabantius and other Verse. By C. S. Sherrington. Pp. iv+67. (London: Oxford University Press, 1925.) 4*s.* 6*d.* net.

THIS book of poems should interest all lovers of literature, not merely because of its author's eminence in the scientific world, but also for its own artistic quality. It contains the most accomplished verse that has been published in England by any man of science; and one of the most remarkable facts about it is that the point of view throughout is purely artistic. The poem on Keats, for example, is a poem of joy in the artistic handling of words. It shows them "in music swayed attire," shadows moved by the fire of thought. It shows them as "raised trumpets blown at morn," or as "foamed sea-capes calling through mist." It does not talk philology, but it finds them "still across this day of ours weaving fancy's storied woof."

The philistine who prides himself on his superiority to 'words' and on his inability to express his own ideas has conquered a large section of the literary world in recent years. Under a new disguise, as the advocate of a crude realism, and the opponent of what he calls 'rhetoric,' he has succeeded in convincing the thoughtless sections of the public that the incomparable language used by the rhetorical author of "Paradise Lost," with its infinitely subtle lights and shades, is less vividly expressive and less full in content than the broken-down jargon of the streets. Violence, the schoolboy use of the most conventional 'scarlet words,' is mistaken for strength, while the true use of language as an exquisite intellectual instrument, capable of the most precise expression of the subtlest ideas, is mistaken for smooth insipidity or what lisping school-girls now call, under the influence of weak-minded newspaper-ridden teachers, 'lack of guts.'

We are living, artistically, in an Aristophanic comedy. Prof. Ward in his really profound "Pluralism and the Realm of Ends" draws largely on Tennyson to elucidate some of the subtlest philosophical ideas of modern times. At the same moment a child of sixteen, quite unaware of any of those ideas, announced to her friends in Chicago lately, "I cannot wead Tennyson. He is so tewwibbly twite. But there's a poem in the *Little Weview* this month which I simply adore. It's so wed-blooded. It's about a bwothel." This is an extreme case; but it is a perfect illustration of the ignorance and conceit which have been allowed to mislead the arts, during the last decade or two, into the insane chaos where so much of the recent work has been floundering. It seems possible that if merely literary criticism cannot save the arts from self-destruction, the scientific mind may have to come over and help them, in the interests of our civilisation, with a little cool lucidity, and a few elementary lessons in rhythm, order, proportion, symmetry, and all that these things imply. When first principles go into the melting pot we may even have to re-demonstrate to our æsthetic agnostics that twice one is two. But science and art have one great common ground, in the ultimate unity of beauty and truth. That ground has never yet been fully charted or explored. The day may come when the golden mathematics of music, in its ascensions to heaven, and its unexpected opening of celestial gates, may unlock some of the most baffling problems of philosophy. Even now, when philosophical terms fail us, we can point to certain movements in a Beethoven symphony and say, "There—that is what I mean," not as an emotional, but as a logical solution. In the meantime it is all to the good that Sir Charles Sherrington in his lines on Keats appreciates so justly the æsthetic values of language. Words, to him, are not mere lifeless counters or labels, but creatures of the heart and mind of man, evolved through ages and having messages of "heavenly things to tell":

Words, deliverance of joy,
Words, blithe feet that move in dance,
Flute-throat words of girl and boy
Pæaning the spring's advance,
Weeting death not nor mischance;

Words, heaped torrents swollen with rain,
Words, cloud voices league-long blown,
Words, begotten of human pain
Grief-matured through nights of moan;
Words like bell-towers sobbing in stone.

Art, as I suggested above, has its chaos; but philosophy has certainly its confusions. There is no precision of expression like the precision of great poetry. Modern thought would have been a century ahead of its present stage if certain famous philosophers had been able to express their ideas with the profound lucidity of Wordsworth's "Tintern Abbey." Sir Charles Sherrington's own verse has not that limpid depth. He is often a little wilfully tortuous and so he deliberately limits its effectiveness. But he strikes many chords that linger in the memory, and in his enthusiasm for great poetry his book is of real value to both science and literature.

The great dead—not they lie dumb,
Nor are their lips stopped with clay.
Listening fresh to their graves come
All the new-born every day.
We that breathe speak less than they.

There are many glowing pictures in the narrative poem entitled "The Assaying of Brabantius," of which perhaps the most immediately striking is the description of the sea-robbers' attack upon the lordly pleasure-house wherein Brabantius was losing his soul:

Where throngs
Of slaves flowed dancewise and made songs
To please the fanswept dwellers there
Pavilioned over perfumed air.
And how upon them broke a day
Brought, trespassing their sun-caped bay,
Fierce urgéd purple hulls of ships
With tumult filled from brine-caked lips,
And ear-ringed robbers little loath
Shook loose their knives, and, hoarse with oath,
O'erleaping row-bank, thwart and oar,
The beaked keels grounding, swarmed ashore
To clamber up the milky flights
Of graded marbles, till the heights
They won, and swept the pillared shade
Of court and dome and colonnade,
And slew, nor in their slaying stayed
Till all the dazzling streets bereft
Of life they left, and pool-strewn left
As market-stones are with wine lees
With blood the burnished terraces.

The influence of William Morris will perhaps be discerned in this. Here, as elsewhere, the remarkable fact is that there is scarcely a sign anywhere in the book that the author is interested in anything but his art. He never touches upon any scientific subject. But the scientific quality of his mind is revealed in the analysis of character in the "Assaying of Brabantius," which is certainly different from anything in William Morris, and more modern in feeling. It shows itself also in the sonnet entitled "Speech":

And thus accomplished, after lapse of time,
Dear meed of converse binds life's scattered ones,
With healing of the schism of old prime
As light rejoins the pulses of old suns.

Fragmentary quotation, however, is unjust to the book. It emphasises the somewhat deliberate archaism, and the twisted phrasing. Twisted though it be, it is artistically twisted, and there is a gleam of beauty on almost every page. The sonnet on Oxford is one that none of her sons and lovers who read it will easily forget:

The night is fallen and still thou speakest to me,
What though with one voice sole, with accents many,
Tongued turret and tongued stream, tracked pasture fenny,
And cloister spirit-trod, and centuried tree;
And, bondsmen loosed in Time's tranquillity,
Thy bell-dischargéd hours . . .
And now, below, through shadows starred, a boat
Steals by me laden with singing and young laughter
And, higher, a wide-flung casement casts afloat
Pulses of waltz the which white robes sway after;
Sworn Priest of Beauty, these thy shrines among,
That kneelst with old folk and that dancest with young.

ALFRED NOYES.

The Atom Again.

(1) *The Basis of Modern Atomic Theory.* By C. H. Douglas Clark. Pp. xx+292. (London: Methuen and Co., Ltd., 1926.) 8*s.* 6*d.* net.

(2) *Die Konstitution der chemischen Atome: Mechanische Theorien in Physik und Chemie.* Von Prof. Dr. Arthur Korn. Pp. 159. (Berlin: Georg Siemens, 1926.) 7·50 gold marks.

WHATEVER properties may ultimately be assigned to the atom, there is one which cannot be omitted—its power to seize and captivate the human mind. In fact, if we judged by the output of the printing press in the last few years, we might not unfairly assume that no sooner does any one fall within the sphere of influence of this radiating personality than he is seized with an irresistible determination to go home and write a book about it. Nor is this proselytising zeal confined to the pure physicist, whose protégé the atom may be presumed to be. We have books on the atom, some of them quite well done, by chemists, by mathematicians, by technicians, and by journalists, and addressed to all sorts and conditions of readers. Thus we have "Atoms for Amateurs," "Atoms for Adepts," "Atoms for Adolescents," "Atoms for Archdeacons," "All about Atoms for Anybody"—these are not the exact titles, but they indicate the scope of the volumes well enough—in fact, there seems to be a determination that no class of reader shall be left without an exposition of the subject suited to his condition and attainments. As these volumes continue to pour forth—there are two fresh ones before us as we write—we must assume that they find purchasers and readers. If we add to these the enormous output of serious scientific contributions from the many laboratories engaged in investigating the structure and properties of the atom, it is clear that this infinitesimal particle exerts an attraction unique in the history of science over the minds and imaginations of many types of men.

These reflections have been induced by the almost simultaneous appearance of the two volumes the titles of which are given at the head of this review. These differ in almost every conceivable way. One is in English, and is by a lecturer in chemistry; the other, in German, by a professor in a technical institute. One is a compilation involving an enormous amount of reading and abstracting; the other is an account of the author's highly individual speculations. They have only one thing in common. Both authors have been seized and fascinated by the subject, and cannot rest until they have expressed their enthusiasm in print. This, after all, is the only legitimate excuse for writing a book.

(1) Mr. Clark, in his enthusiasm, has read omnivorously and abstracted widely. In 282 pages he makes a clean sweep of the subject from Lucretius to Bohr, Sommerfeld and Debye. There can scarcely be any paper dealing with the atom which Mr. Clark has not consulted, and very few of which he does not make some mention. To have condensed so much into so small a space is a miracle of compression, and his difficulties have been increased by the fact that, as a chemist, he has thought it necessary to devote an appreciable part of his volume to the theories of Langmuir, Lewis, and the physical chemists which a physicist, straitened for space, would probably have been content to treat in a much more summary manner

It has evidently been the author's aim to include some reference to everything which has been either thought or discovered about the atom. To give anything like an adequate account of the subjects touched upon in this book would require many volumes of equal size, and the author's treatment of the different parts of the subject is necessarily very brief and summary. We must confess to a personal prejudice against the author who skims lightly from flower to flower without extracting the last drop of nectar from each, and quotes formulæ without giving an adequate notion of the steps by which they are derived. For us, not only the chief value but also the main pleasure of science lies in the process rather than in the product, and we were inclined at first sight to regard Mr. Clark's book as falling under the ban of superficiality.

A closer reading, however, convinces us that the book performs a very useful piece of service. In geography we have original books of travel which give us minute accounts of various peoples and places; we have text-books, more or less voluminous, which give abstracted accounts of larger areas; and finally we have the atlas and gazetteer, which is content to tell us what places there are, and where to look for them; and each type of work has its uses. Mr. Clark has provided us with a gazetteer to the atom, and on turning over its pages one realises how much such a gazetteer is needed for this vast and ever-expanding tract of human knowledge. From this point of view the book is excellent. The student who uses it, and any one who is working on atomic physics may be recommended to do so, will find it a mine of information as to what there is to be known about the subject, while admirable lists of references and two good indexes will tell him precisely where to look for the information required. When next we are troubled by vague memories of a paper in some forgotten journal, by an author whose name we cannot for the moment recall and containing results which were probably important if we could only remember what they were, we shall certainly turn to Mr. Clark's book for assistance, and, if the paper has any reference to the atom, we shall not turn in vain.

We cannot congratulate the publishers on their share of the production. We recognise, with regret, that we cannot expect very many pages of print for 8*s*. 6*d*., and in this respect the publishers have not been ungenerous. The artificial increase in the mere bulk of the volume, produced by printing it on absorbent paper and appending a catalogue of general literature, adds nothing to our sense of its value, and does detract very materially from its appearance. The binding is poor and unattractive. The text is good enough to deserve a better dress.

(2) Dr. Korn's book differs widely in its purpose from the one we have just been considering. Whereas Mr. Clark records, almost without comment or criticism, the diverse views which are still current on atomic constitution, Dr. Korn's purpose is to develop and to popularise a highly individual theory of his own. He feels that his theory, as expounded in various papers in the *Physikalische Zeitschrift* and elsewhere, has not received the attention it merits; and surmising that this may be due to its highly mathematical form, he presents his views, in the present volume, in a way which he thinks will be within the capacity of physicists to apprehend. It is clearly outside the province of a book review to criticise original work of this kind. In brief, Dr. Korn proposes to add to the positive and negative particles which are known to be present in the atom, a third class of particles, gravitating particles, the existence of which has not yet been demonstrated experimentally. He then modifies the law of force between the particles by introducing an exponential term into the Coulomb law of force, and on these assumptions builds up a series of atomic structures the properties of which approximate, with some considerable degree of precision, to the properties of the known elements.

We think that physicists are more likely to be deterred from accepting Dr. Korn's theory by his assumptions than by his mathematics. The quantum theory in its applications to the Rutherford-Bohr atom is flowing on in a full current which shows no signs of abating. Unless and until it meets with some unexpected and quite unsurmountable obstacle, it is unlikely that the main stream of atomic science will turn back to flow along the alternative channel which Dr. Korn provides. Physicists, however, who wish to investigate this channel for themselves will find the theory excellently and fully expounded in Dr. Korn's book.

J. A. CROWTHER.

Aurora Polaris.

Australasian Antarctic Expedition, 1911–14. Scientific Reports, Series B, Vol. 2, Part 1. *Records of the Aurora Polaris.* By Sir Douglas Mawson. Pp. 191+6 plates. (Sydney, N.S.W.: Alfred James Kent, 1925.) 15*s*.

IN view of the connexion between ionisation in the upper atmosphere and the propagation of radio waves, special interest is likely to be taken at present in observations of the aurora and related phenomena, particularly in the regions where the aurora and associated ionisation are most strongly developed. The records of the aurora polaris from the Australasian Antarctic Expedition present the detailed observations from the three stations occupied by that Expedition between 1911 and 1914, and will be followed by two other parts in the same volume—" Records of Magnetic

Disturbances" and "Records of the Range of Transmission of Wireless Signals."

All three stations were situated fairly close to the southern auroral zone, a belt about the magnetic axis of the earth, but at some distance from it, in which auroral display is very frequent. Two of the stations were situated on the Antarctic coast and lay within the zone; the third, on Macquarie Island, lay outside it. Observations at Cape Denison (the main headquarters in lat. 67° 00′ S., long. 142° 40′ E.) were far more complete than at Macquarie Island (lat. 54° 30′ S., long. 158° 57′ E.) or at Queen Mary Land (lat. 66° 20′ S., long. 95° 02′ E.), which formed the western base of the Expedition. When combined with the results of previous expeditions, consideration of the azimuths in which the aurora was most frequently and least frequently observed from the different stations enables one to fix approximately the point of intersection of the magnetic axis with the surface of the earth in the southern hemisphere. This point lies, roughly, half-way between Cape Denison and the geographical south pole.

The visual observations of the aurora at the Cape Denison station are the most complete of their kind for any Antarctic observatory. The programme could not, however, be carried out as planned, since unfavourable weather rendered impossible the proposed photographic determination of the height of the aurora. The general sequence of events is what might be expected at a station lying a little within the auroral zone. The aurora is most frequently seen in the northern quadrants and least frequently in the southern. The normal quiet day sequence comprises a series of approaches from the north and retreats from the station, the aurora often passing overhead in the early morning, though the late afternoon is also favoured by the appearance of aurora near the zenith. During auroral storm periods, greater light intensity is accompanied by more vivid coloration and greater movement.

The most spectacular effects (the "intensity maximum") occur, however, shortly before midnight, at which time the aurora may pass to the south of the station. After the maximum southerly extension, the curtains may wane and retreat to the north, or rapidly spread in the heavens as a sheet of brilliant nebula. These very bright manifestations appear to be special phenomena superposed on the normal quiet day cycle, and it is worthy of note that certain short magnetic storms of "special type"[1] seemed also to be unusual phenomena occurring chiefly in the winter months and always very close to the time of the auroral intensity maximum at Cape Evans.

The local mean time of the intensity maximum differs at the various Antarctic stations and seems to occur, as in the north, shortly before local magnetic midnight, defined as the time when the station, the magnetic axis of the earth, and the sun all lie in the same plane. This relation is not indicated for the Queen Mary Land station, where, however, the observations were not so complete as elsewhere. Observations at the Macquarie Island station lying outside the auroral zone were also less complete than those at Cape Denison, but sufficient to show that strongly coloured displays were more marked at this station than at the others and often persisted for a long time.

Though the statistical method used is the only one adapted to bring out clearly the relative frequency of the aurora at different times of the day and its distribution in azimuth, an exceptional similarity in form is sometimes observed at the same time on successive days. These repetitions of form are much more striking than the repetitions occasionally observed on magnetograph traces, as indeed seems reasonable, since the magnetic disturbances are probably closely correlated with the *average* intensity of display in the auroral zone. This circumstance is probably in some measure responsible for the fact that the correlation between auroral activity and magnetic disturbance found by the British (*Terra Nova*) Antarctic Expedition was not more pronounced.

Special attention was paid by Sir Douglas Mawson to the observation at Cape Denison of the trend or orientation of the relatively straight auroral bands (arches) when near the zenith, which are a special feature of the early morning quiet day maximum. These were found to show a definite anti-clockwise rotation, a movement which may conveniently be expressed by the statement that the arches pointed roughly towards the sun during the dark hours when observation was possible. Probably, however, chief interest will be taken in the section of the report which deals with the observations of very faint auroral phenomena in the form of haze patches and arches. These very faint manifestations were quite impossible of discernment until the eye became fully accommodated to the dark, and could only then be seen by the most acute of the observers. They were seen to maintain themselves for many minutes and often for several hours, waxing and waning in intensity. The report does not, however, indicate what criteria were applied to distinguish these faint auroral effects from the night luminous clouds which have been observed elsewhere at a height of about 80 km.

Careful perusal of the report will probably leave the reader with the feeling that our knowledge of the aurora in high latitudes is still very incomplete and that, even in the field of investigation covered by the expedition, there is much which requires further study. The occurrence of the very faint phenomena is a case in point. The anomalous behaviour of the aurora at the Queen Mary Land station furnishes another example, the fairly even distribution of the aurora in different azimuths at this station being difficult to explain in view of the relative infrequency of its occurrence in the zenith.

---

[1] "British (*Terra Nova*) Antarctic Expedition, 1910–13", "Terrestrial Magnetism," p. 270; "Observations on the Aurora," p. 34.

The enhancement of the diurnal variation in the magnetic elements in high latitudes on disturbed days during the winter indicates an associated ionisation comparable with that due to sunlight, and there seems no doubt that this ionisation is responsible for the interesting correlations between auroral and magnetic activity. Whether any effective correlation exists also between auroral activity and radio transmission in and across the polar regions is not known, but the promised Part 3 of the present volume should throw some light on this question.

Quite apart from these interesting correlations and the laboratory work in progress to determine the properties of the radiations responsible for the aurora and the constitution and form of matter which emits the auroral light in the upper atmosphere, an immense amount of research is still required to clear up the position. More determinations of height and more spectroscopic observations, particularly at great heights, are required at widely separated places and especially in the Antarctic. More work is necessary to determine the cause of the occurrence of unusual colours during unusually active displays and to determine the wave-lengths of the weaker lines of the spectrum and their relative intensities. The relation between the light of the night sky and the occurrence of the auroral green line seems to demand further investigation, as also the fact that the polar aurora appears nearer the magnetic axis of the earth in storm periods, while the occurrence of an aurora in low latitudes is on occasions of world-wide magnetic disturbance.

This list of problems is only a small selection from a very large number which require investigation before the accepted outline theory of the origin of aurora can usefully be elaborated.

Our Bookshelf.

Fourfold Geometry: being the Elementary Geometry of the Four-Dimensional World. By David Beveridge Mair. Pp. viii + 183. (London: Methuen and Co., Ltd., 1926.) 8*s.* 6*d.* net.

MR. MAIR states clearly in his preface the scope of his book, which deals essentially with the elementary geometry of a four-dimensional continuum of space and time, the existence of straight lines being assumed. His aim is to prepare the ground for an understanding of relativity geometry rather than to treat his subject as a special case of general manifold geometry. The terminology is evidently chosen from this point of view, and the distinction between 'time-like' and 'space-like' vectors is made early in the book and used throughout.

The author begins with an account of the line vector from which he builds the area, volume and super-volume vectors. He explains geometrically his frames of reference or lattices in two, three, and four dimensions in turn, deals with combination of vectors, defines the tensor operator and establishes the invariants for transformation of lattices. As examples he discusses the velocity vector, derives the Lorentz transformation and gives a brief account of the motion of a particle. One feels, however, that these results are not so much illustrations as part of the scheme of the book.

From the first the notation is carefully explained and chosen to foreshadow and fit the tensor operations which thus emerge naturally and easily. The style is lucid and precise. Such terms as 'perpendicularity' and 'parallelism,' for which new definitions are needed, are treated with admirable clearness. The dependence of results upon the straight line hypothesis is emphasised, and it is shown how the removal of this restriction leads to the wider problems of the curved fourfold, which, as Mr. Mair points out, are beyond the scope of the book, although he indicates the use of the geodesic. The idea of invariance for different lattices is well stressed so that the reader cannot fail to realise its importance. A knowledge of Cartesian geometry is assumed, but very little more. The careful diagrams and well-thought-out exercises interspersed in the text, together with solutions at the end, add to the value of this stimulating little book.

Essentials of Systematic Pomology. By Prof. Brooks D. Drain. (The Wiley Agricultural Series.) Pp. v + 284. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1925.) 13*s.* 6*d.* net.

THE increasing number of varieties of fruit and the uncertainties of commercial nomenclature render the study of pomology full of pitfalls, and the student and grower alike will welcome Prof. Drain's attempt to set forth the essentials of the subject in a lucid style, shorn of unnecessary detail. Though dealing with American conditions, the text-book should prove of value to workers in other countries also. In studying the principal varieties of hard and soft fruits the various points are tabulated into good and bad characters, with notes on distribution and extent of cultivation. Various keys for the classification of apples are considered, that of Carpenter and Stafford being regarded as the best, Shaw's key for leaves and Keil's group classification of the fruit also finding a place. Of special interest are the sections on fruit exhibition and judging, details of American rules being given with the appropriate methods of scoring points. Exercises for class work are suggested, with practical hints on the cold storage of soft fruits for examination at later dates. A glossary of pomological terms and a certain number of references are included.

The development of fruit varieties in North America has been closely connected with the settlement and development of the country. The early explorers and settlers brought in varieties of fruit from their native lands, many of which successfully passed through a period of acclimatisation. Selection and breeding from these old stocks have resulted in the production of new varieties better adapted to the needs of the growing fruit industry. Inevitably, increasing confusion of nomenclature has resulted, and therefore the American Pomological Society has drawn up a code of fruit nomenclature, in an endeavour to simplify matters. This code has been considered as the final umpire since about 1865, the last revision of 1923 being that now in use. W. E. B.

Grundzüge der Paläontologie (Paläozoologie). Von Karl A. von Zittel. Neubearbeitet von Prof. Dr. Ferdinand Broili und Dr. M. Schlosser. Abteilung 1: *Invertebrata.* Sechste verbesserte und vermehrte Auflage. Pp viii + 733. 17 gold marks. Abteilung 2: *Vertebrata.* Vierte vermehrte und verbesserte Auflage. Pp. v + 706. 15 gold marks. (München und Berlin: R. Oldenbourg, 1923–24.)

BOTH geologists and zoologists are much indebted to Prof. Broili, of Munich, and the enterprising publishers of Zittel's "Elements of Palæontology," for a rapid succession of new editions of this indispensable handbook, keeping it up-to-date. It is a compendium of facts, with references to the scattered literature of the subject, such as are needed for research in many directions, and the arrangement of the matter, as originally planned by Zittel, makes it easily used. It still tends to be conservative in admitting new hypotheses or schemes of classification, and most of the additional figures resemble those of the first edition in being actual illustrations of fossils rather than explanatory sketches. The work indeed retains all the essential features of Zittel's incomparable exposition.

In the sixth edition of the section on Invertebrata the mollusca have been particularly revised with the aid of Prof. A. Naef and Dr. J. Schröder. In the fourth edition of the section on Vertebrata, the mammals, birds, and fishes have been revised entirely by Dr. Max Schlosser. Prof. Broili has thus supplemented his own labours by securing the co-operation of other well-known specialists, and the result is an encyclopædic work which inspires confidence. There are more small misprints than should appear in technical statements that are so carefully edited; and the additions sometimes necessitate changes which are not attended to in the context. Until, however, another Zittel arises to re-write the whole from the beginning, the minor blemishes incidental to patchwork cannot be avoided.

The Natural History of the Oxford District. Contributions edited by Comdr. James J. Walker. Presented to the Members of the British Association for the Advancement of Science, Oxford Meeting, 1926. Pp. viii + 336. (London: Oxford University Press, 1926.) 10*s.* net.

IT was to be expected that the natural history of the country immediately surrounding a great and ancient university would have been studied with especial thoroughness. None the less, the naturalists attending the Oxford meeting of the British Association must have been impressed with the richness and variety of the plant and animal life and with the great geological interest of the district, as revealed in this handbook. The very abundance of the material at their disposal must have added to the difficulties of the task which the editor and his fellow-contributors set themselves and discharged with such conspicuous success. The volume consists of more than twenty short articles by authorities on their respective subjects. It opens appropriately with sketches of the physical history of the land forms and various other aspects of local geology. These are followed by accounts of the botany of the Upper Thames, and of the birds, insects, and other animals of the Oxford district. The final chapters deal with the entomological treasures in the Hope Department of the University Museum, the wonderful ethnological series in the Pitt-Rivers Museum, and the fine collection of early scientific instruments formed by Dr. Lewis Evans and housed in the Old Ashmolean Museum. The handbook constitutes a summary, and provides a record of local species, which will be of permanent value to such members of the University as are interested in biological studies, as well as to naturalists generally. It is perhaps permissible to suggest that, for the immediate purpose of its compilation, something a little less technical in style might have had an even wider appeal.

Clouds and Weather Phenomena: for Artists and other Lovers of Nature. By C. J. P. Cave. Pp. x + 31 + 23 plates. (Cambridge: At the University Press, 1926.) 5*s.* net.

FOURTEEN years ago, the Cambridge University Press published a book by Mr. Cave on "The Structure of the Atmosphere in Clear Weather," a well-known work on upper winds written by a meteorologist for meteorologists. "Clouds and Weather Phenomena," which is also published by the Cambridge Press, is of a very different type, and while a work on clouds by Mr. Cave will undoubtedly be read by most meteorologists, the book is not intended for those engaged in the study of the weather but for the general public, and more particularly for artists, whose knowledge of cloud forms is often shown by their works to be very slight. In accordance with this object, the book is written in the simplest manner and contains scarcely any reference to meteorological theory.

The first half of the text deals with the colour of the sky, including sunset colours, with rainbows, halos, and other optical phenomena, describing under what conditions and in which parts of the sky these are seen. The next section is devoted to clouds, the international nomenclature being followed and the types illustrated by twenty-two excellent photographs taken by the author, placed together at the end of the book. Some notes on the position and appearance of the moon at different seasons conclude the volume. Perhaps one may be allowed to express a doubt whether even an authority like Mr. Cave, backed by the Cambridge University Press, will be able to reform the ways of artists, but all meteorologists will extend a hearty welcome to the book and wish the attempt success. J. S. D.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Science and Psychical Research.

In Nature of July 31, Dr Tillyard, the well-known entomologist, reproaches Huxley for not being interested in the phenomena of what Sir Arthur Conan Doyle and others call spiritualism. He extends this reproach to all who consider the claim that from "the organism of the medium 'psychic stuff,' by the moulding of which they [the invisible operators] can produce at will the phenomena of independent voice, levitation, materialisations of portions of their personalities, and so on," so highly improbable that they refuse to spend their time and energy in the efforts required for obtaining or refuting proof. Yet it is by such limitations, and by them only, that science has hitherto obtained its results.

No doubt Dr. Tillyard, guided by the experience which he gained during a long and successful career in entomology, would refuse to investigate reputed cases of insects with bony skeletons suckling their young. Why then should he be so hard on the physicist who, on the ground of his experience, refuses to investigate levitation, or on the biologist who, mindful of Harvey's *omne vivum ex ovo*, considers his time better spent in his usual pursuits than in an investigation of reputed "materialisations of portions of personalities"?

Dr. Tillyard evidently approves of the scientific movement which displaced the medieval church from its position as the guardian of all knowledge—natural as well as supernatural. Why then should he object to that great majority of his fellow-scientists who think that the change would be for the worse if they accepted the guardianship of the medium? This, however, is what Dr. Tillyard really advocates; he is not satisfied with the liberty accorded ungrudgingly to any one willing to investigate even the most improbable phenomena; he wants physicists and biologists to leave "the broad highway" of science and to enter "The neglected side-path, foul with mire and overgrown with noxious weeds" along which the medium is anxious to guide them. If science did so help, its name would be superstition.

J. P. Lotsy.

Like Mr. Campbell Swinton, Dr. Lotsy confuses psychical research with spiritualism; he then charges me with reproaching Huxley for refusing to be interested in the latter! If he will again read carefully through the third paragraph of my article and follow it logically with the beginning of the fourth, he will see how far he has wandered from my meaning. He then selects the rarest and most puzzling of all psychical phenomena, namely, the ideoplastic moulding of teleplasm into forms resembling "portions of personalities," and says that I extend my reproach to all who refuse to consider this as a valid phenomenon worthy of scientific study! This would be rather like reproaching a peasant who lived in the middle of Asia for refusing to believe in the existence of submarines when he had never even seen the sea!

Dr. Lotsy is quite sure about what I would do if I were confronted with reputed cases of "insects with bony skeletons suckling their young." I am not! If one of our leading entomologists were to write to me and state that he had observed a case of one of the higher pupiparous Diptera suckling its young, I should most certainly want to investigate it, though I might feel sceptical about his use of the term "suckling." The more improbable the reputed facts, the more I should consider the weight to be attached to the reputation of the man who made the statement. If the fact were vouched for by three entomologists of the standing in their own science that Lodge, Crookes, and Richet hold in theirs, I should consider that a good case for investigation had been made out. The weak point of Dr. Lotsy's argument is that he tries to draw a comparison between something in entomology which has never been even 'reputed' to occur and something in another branch of science which many leading men of science state clearly has occurred in their presence under test conditions; so that the only question which remains is to decide whether it is really true or whether they are liars or under delusions.

As for Harvey's *omne vivum ex ovo*, I doubt very much if modern biologists are compelled to regard this as a strictly accurate statement of the origin of life. Certainly Dr. Lotsy himself does not, for he has been trying for years to get them to accept instead his own emendation of *omne vivum ex hybrido*! Personally I prefer Harvey's dictum, but I do not think that the first unit of life that appeared on our world was either an egg or a hybrid. Moreover, the phenomena of teleplasm do not controvert Harvey's statement. For the 'psychic stuff' itself is admittedly drawn from the physical organism of the medium, and the medium is "ex ovo." Even if the ideoplastic moulding is really done, not under the control of the subconscious mind of the medium but by the will of an invisible operator who has once lived in the flesh, that operator by his own claims and admissions was once "ex ovo." The facts of psychical research do not *contradict* any of the broad principles of biology.

Finally, Dr. Lotsy makes the usual blunder of those who, knowing nothing of the elementary principles of psychical research, persist in regarding the medium as the 'guide' in the experiments, whereas the medium is actually in trance and does not know what is going on. I can only repeat that the conditions of the experiments are just exactly what the researchers choose to make them; the facts can be studied and tabulated like other scientific facts. My plea is simply one for assistance instead of obstruction in the attempt to obtain them. To parody Dr. Lotsy's last sentence, "If Science do not so help, then her name is stagnation."

R. J. Tillyard.

Zurich, Switzerland,
August 26.

Mr. Campbell Swinton's account in Nature of August 28 of the incidents connected with the Combermere photograph is both inaccurate and misleading. Since he uses my name so freely perhaps you will permit me to state shortly the true version. The whole story, with the photograph, will be given in the next number of *Psychic Science*—the organ of the Psychic College.

This photograph, which shows plainly the outline of an elderly man seated in an armchair, was sent to me with the endorsement of the Combermere family, who may be expected to know as much about the matter as their relative by marriage. On the back was written that it was taken by a certain lady at the time of the old peer's funeral, and that the shadowy figure was supposed to be the wraith of the deceased man. This I showed (among fifty other psychic photographs) at the Queen's Hall, simply giving the facts as supplied by the family, and making no assertion myself, since I had no personal knowledge of the matter. Shortly afterwards, several violent letters appeared in the press from Mr. Campbell-Swinton, in which he used such injurious terms as "photographic fraud." As to the seated figure, he gave in successive letters three different contradictory explanations; the first that it was a photographic flaw, the second, that the butler had crept into the room and seated himself in the chair; and the third, that plates if kept for some time before development may show strange images. He wound up by challenging me to publish in the *Morning Post* the 'ghost' photograph, alongside of a photograph of the peer taken in life. I at once sent up my photograph without any suggestion whatever that it would not reproduce. That statement is pure invention upon the part of Mr. Campbell Swinton. The editor refused to take the risk of an inferior reproduction, and could only guarantee a good one by touching up, which would be objectionable. A reproduction was afterwards made by the *Daily Sketch*, but whether touched up or not I could not tell.

That is all a technical question with which I had nothing to do. What was, however, strange and rather amusing was that when the photograph of the peer was finally published he proved to be remarkably like the 'ghost,' having a very high forehead and some indication of a short tufted beard. Thus the result of Mr. Swinton's labours was to add one more point to the argument for the authenticity of the picture. There is clear evidence that there was no male visitor or servant in the house who wore a beard.

ARTHUR CONAN DOYLE.

September 1.

[No useful scientific purpose would be served by the discussion in NATURE of the production of spirit photographs or of the reality and origin of the various phenomena manifested during séances with a medium believed to be in a state of trance and to know nothing of what is occurring. The main point of Dr. Tillyard's article in NATURE of July 31 was that scientific men generally presented an unscientific attitude to the subject of psychical research; and he pleaded for critical inquiry in a field hitherto mostly neglected by scientific investigators. This alone is the matter which we think may be usefully discussed in NATURE, or to which we are inclined to devote space.

In his letter Mr. Campbell Swinton raised the question of the alleged spirit photograph of the second Viscount Combermere, his uncle by marriage, and it is only just that Sir Arthur Conan Doyle should be given an opportunity of replying. We do not propose, however, to let other correspondents range themselves on either side in regard to the authenticity of the Combermere photograph, or to submit or expose evidence of psychic phenomena of any other kind. For the present, at any rate, correspondence must be limited to the plea made by Dr. Tillyard for "the *scientific* study of what are called *supernormal phenomena*."—EDITOR, NATURE.]

The Three-dimensional Reproduction of Tracks of β-particles Ejected by X-rays.

THE use of a stereoscopic camera by C. T. R. Wilson in the photography of tracks of β-particles ejected by pencils of X-rays led to the revelation of two types of asymmetry of initial direction of ejection (*Proc. Roy. Soc.*, A, 104, 1923). One is characterised by an excess of tracks having their initial portions in or near the plane containing the X-ray pencil and its electric vector; the other by an excess of tracks having a forward component in their initial velocities. They have been termed 'lateral' and 'longitudinal' asymmetry respectively. The former distribution reveals the partial polarisation of the primary beam, the preponderance of primary X-rays the electric vector of which is in the plane containing the cathode stream. The latter distribution has been accounted for qualitatively on the basis of Richardson's hypothesis that the absorption of a quantum $h\nu$ of energy by the electron is accompanied by the transference of the momentum of the absorbed radiation causing a resultant motion in the forward direction. A third feature of interest and importance revealed by Wilson's photographs was the existence of short, unidirectional, fish-like tracks with tails towards the X-ray source and produced only by X-rays of wavelength not exceeding about 0·5 Å.U. The phenomena of fish-tracks are most completely and satisfactorily explained by the application of the Compton quantum theory of scattering of X-rays.

In further examination of these features other investigators have adopted the stereoscopic method. F. W. Bubb, in an examination of the initial directions of β-particles ejected by polarised X-rays scattered by a paraffin block, has photographed the tracks directing the camera lens axes end-on to the X-ray pencil for the observation of lateral asymmetry and broadside-on for the observation of longitudinal asymmetry. O. K. de Foe and D. H. Loughridge have examined independently longitudinal asymmetry by stereoscopic photography from the broadside-on position. The latter calculated initial direction of ejection from measurement of depth in the photograph of the end of the initial straight portion by means of a stereocomparator, and of height and breadth by direct measurement by dividers.

The work of F. Kirchner involving the stereoscopic photography of tracks produced by Compton electrons was described by Prof. W. Wien in his paper "On the Direction of Electrons emitted by the Photo-electric and Compton Effects," read before Section A of the British Association on August 10, 1926. Prof. Wien referred to the difficulty of ascertaining correctly, by examination of the photographs stereoscopically, the initial directions of the tracks with reference to the primary X-ray pencil. This difficulty had been met to some extent by the co-option of observers who could not possibly have any 'Compton bias.' I myself experienced this difficulty in some work done in 1924 in which I examined stereoscopically tracks produced by $K\alpha$ copper radiation homogenised by reflection from rock-salt, and was led to consider the possibilities of photography in two directions at right angles eliminating the stereo-vision difficulty and at the same time increasing very considerably the precision with which the forms and initial directions of tracks could be determined. It appeared, too, that such photography would avoid two other difficulties inherent to stereoscopic examination of lateral asymmetry in which photographs are taken end-on to the pencil. Tracks would be formed across the full width of the cloud-chamber (15 cm., say), and it is impossible under the conditions of the experiment for all to be sharply in focus. Also, even in the absence of this difficulty overlapping and confusion is inevitable.

It was at once evident that the most suitable directions of the lens-axes, using separate single lens cameras and the direction of the primary X-ray pencil being horizontal, would be the vertical and horizontal perpendiculars to the pencil. The photographs so obtained would give the projections of tracks on two perpendicular planes. Measurement of the angles made by the initial straight portions of the projections with the direction of the X-ray pencil makes it possible to calculate the angle between the actual initial portion of the track and the plane containing the pencil and the electric vector (δ) and the angle between that portion and the direction of the X-rays (θ). Statistical examination of values of δ and θ might then be expected to show most probable values of these angles and the existence of lateral and longitudinal asymmetry. Further, it would be possible to determine the three co-ordinates of any point on a track and therefore the true path of the β-particle in its flight through space.

In practice, adopting the Wilson mercury-lamp flash method of illumination and directing the illuminating beam almost horizontally on the line of the X-ray pencil, it was found that whilst ample light was scattered forward, giving good records in the horizontal camera, so little was scattered at right angles, that is, vertically, that the tracks were not recorded on the negative in the vertical camera. This difficulty was overcome by placing in the appropriate position on the base of the cloud chamber a right-angled glass prism and producing total internal reflection of the illuminating beam in a direction bisecting the angle between the axes of the cameras. Photographs so obtained were of satisfactory and approximately equal density.

Measurements have been made by low-power microscopic observation of the negatives directly and the advantages anticipated by the substitution of right-angle for stereo-photography realised. Using heterogeneous X-rays and moist air in the chamber, the existence of both types of asymmetry has been found. Experiments are now in progress in which homogeneous X-rays produce tracks in gases other than air.

ORRELL DARBYSHIRE.

Physics Department, Armstrong College,
Newcastle-upon-Tyne, August 19.

Spatial and Time Relations in Dreams.

IN NATURE of August 7, Dr. J. H. Kenneth refers to my letter which appeared in the issue of March 17, 1923, and he describes further observations of hypnopompic images.

In my letter I referred to an observation at the high-speed extreme end of the scale of time, in which the speed was so high that the image consisted only of blurred fleeting parallel lines, seen in an almost unconscious state. Curiously enough, after more than a year without any observations worth mentioning, I was enabled this very morning to confirm my statement that "the speed of succession (I ought to have said, of translation) of the images is an inverse function of the degree of wakefulness," by an observation at the other extreme end of the scale, thereby completing the series of observations necessary to establish the relation between speed and consciousness on a sound scientific basis.

I had just been roused from a deep sleep (the whole of the previous night having been spent journeying in a railway carriage, and therefore practically sleepless), I had exchanged a few words on the weather with the person who had awakened me, and I was therefore *quite awake*; I had closed my eyes for a few minutes before getting up, when, to my surprise and delight, an image at an *absolute standstill* appeared suddenly. The image represented a grassy rising slope with outcropping rocks, the details being so clear that, had time permitted, I could have counted the rocks; it lasted some eight or ten seconds before vanishing, and during that time it remained quite motionless. While observing its details I was fully realising that I was witnessing the process of unconscious mind-picture forming at the hitherto unobserved zero end of the scale, and verifying the relation I had expressed several years ago, and to which my attention had been again called by reading, last night, Dr. Kenneth's letter

It is perhaps significant that, two days ago only, I was in North Wales and I had climbed the Moel Siabod (2860 ft.) alone, and therefore with my mind entirely free from diversions, and naturally concentrated on the orographic feature which had faced me during most of the time taken by the ascent, namely, up to the final steepest climb, a grassy slope from which emerged innumerable rocks.

I have used above the word 'mind-picture,' but it must be understood that such a hypnopompic image is quite different from a mind-image, as usually conceived, every detail of which is necessarily the result of an act of volition on the part of the person whose mind forms the image. A hypnopompic image appears as a whole, in all its intricacy of wonderful details, without any volition whatever. In the *Journal of the Society for Psychical Research* I have stated that the image seems capable of gradual modification at the result of volition, but on the whole my observations do not seem conclusive enough on this point, and it remains doubtful.

This study of hypnopompic images is not only very interesting, but it is also perhaps the only direct path of approach towards the elucidation of the *modus operandi* of the formation of an image by the mind and its perception as such, with all its minute details. Occasions in which such images come under reasoning observation are necessarily few and far between, and all students of psychology are greatly indebted to NATURE for keeping on record such scanty observations as are available, and which otherwise would be lost, or fail to fall under the notice, and awake the interest, of others.

The principal features of interest are, besides the speed relation referred to above, the possible simultaneous existence of several superposed 'films,' their variable inclination and the possibility of their snapping, referred to in my letter. Dr. Kenneth has established a most important feature, namely, the relationship between the inclination of the line of motion and the position of the observer, which I have so far failed to notice. I have forgotten the details of the observations described in my letter to which Dr. Kenneth refers, and I must therefore abide by my notes; these seem to imply the simultaneous existence of several films, superposed and at different inclinations, and this is at variance with Dr. Kenneth's observations. As the latter appear to be much more precise than mine, so far as this particular question is concerned, mine consisting but of one single instance, noted in 'passing, while my mind was concentrated on other details, I think that they should be given more weight, until my own observations are confirmed. Both states can possibly occur, according to circumstances

M. E. J. GHEURY DE BRAY

40 Westmount Road,
Eltham, S.E 9, August 22.

Pernicious Grafting.

THE question raised in a letter on this subject from Dr. Grabham in NATURE of July 17 is one of very real interest to horticulturists in Great Britain as well as to growers in Madeira. Examples of 'incompatibility' between stock and scion occur in practically all the commercial fruits which are propagated by budding or grafting. Moreover, there is a very complete graded series, ranging from the case in which perfect harmony apparently exists between the two individuals, to that in which they are quite incompatible and no growth at all takes place. It may be, for example, that the dwarfing influence of certain stocks upon scions is the result of incomplete harmony. The phenomenon is more distinct in the case of stocks sometimes used for pears, upon which some varieties will grow perfectly satisfactorily for one or even two years, after which growth ceases and the plant eventually dies. A slightly different aspect of the matter may be observed in the case of plums, in which it is a matter of difficulty to induce the budded scion of some varieties to grow at all on certain stocks, and it should be emphasised that success depends upon both stock and scion. Whilst a variety which does not 'take' well on one stock grows quite satisfactorily on another, at the same time a stock which is unsuitable for one scion proves a good 'mother' to others.

It has been established at this Station that even seedlings which are closely related may vary considerably in their capacity to unite with a scion. The seedling Myrobolan plum stocks of commerce are an example of this variation. One Myrobolan seedling, for example, gives 95 per cent. success with buds of Czar plum, whilst another from the same batch gives less than 50 per cent. of satisfactory unions with the same variety. A similar range of variation exists within single groups of seedling stocks used for peaches; for example, the S. Julien group.

The problem is somewhat complex physiologically, and at present it is not even possible to state it accurately, although observations are now accumulating to this end.

From a practical point of view, there are two possibilities of circumventing the difficulty. Some pear varieties are incompatible with quince stocks, but a satisfactory tree is obtained by the process of 'double grafting' or 'intermediate grafting,' which involves grafting a compatible scion on the stock and regrafting the desired variety on the first scion a year later. There appears to be no reason why this method should not succeed with peaches.

A more certain method of avoiding the effects of incompatibility is to discover a stock which is suitable for the desired variety and to propagate that stock vegetatively. In this way the variation which is involved in the use of seedlings is obviated.

R. C. KNIGHT.
RONALD G. HATTON.

East Malling Research Station,
East Malling, Kent,
August 17.

THE ill effect which often follows the grafting of the peach on seedling stocks described by Dr. Grabham in NATURE, July 17, is very common in peach nurseries on the Western Frontier of India, especially when the peach is budded on the almond. In the summer of 1919, a few weeks before our service in Baluchistan came to an end, we paid some attention to this matter, the results of which are published in the *Indian Forester* of December 1919. We found that the restricted growth which often follows budding was due to imperfect sap circulation caused by an abnormal amount of callus tissue at the point of union between the stock and scion. Analyses of the peach leaves of affected trees in September 1919 showed that they contained less nitrogen, ash, phosphorus, lime, and potash, and much more starch, than normal leaves. Consequently root development was far below the average.

The trouble can be avoided (1) by ring budding the peach either on seedling peach or seedling almond stocks and (2) by destroying all weakly abnormal plants in the nursery before planting out. Ring budding is best done when the peach or almond seedlings are growing vigorously in the early summer. At this time a ring of bark, with one bud, is easily removed from the parent peach tree. This is placed in water and at once fitted on the cylinder of wood of the seedling stock, care being taken to push it well home and in contact all round with the living bark of the stock. Union is rapidly established and the peach bud begins to grow in about ten days.

The adoption of this method of propagation in Madeira, combined with the elimination of all abnormal plants in the nursery stage, would probably solve the difficulties described by Dr. Grabham.

ALBERT HOWARD.
GABRIELLE L. C. HOWARD.

Institute of Plant Industry,
Indore, Central India, August 9.

The Constitution of the Stars.

ON the theory of radiative equilibrium of stellar interiors, as developed mainly by Eddington, the assumption appears to be implicit that the density, mean molecular weight, and other contingent properties of stellar material, vary in a *continuous* manner from the star's surface to its centre. This assumption appears questionable.

Considering for simplicity a star consisting entirely of like atoms, it would appear probable that with the removal of each successive electron from the atom, due to increase of temperature with depth, or at least with the removal of all the electrons constituting each successive quantum-shell, abrupt discontinuities of state would occur comparable, in a general sense, with the separation of atomic matter into its phases.

The recent confirmation by Adams of Eddington's prediction of an abnormally high density for the 'dark' companion of Sirius may be held to prove that an assemblage of 'atoms' entirely 'stripped' of their electrons cannot result from a mere extrapolation of the laws of a perfect gas—or, for that matter, of any phase of atomic matter—to matter in this sub-atomic condition. Eddington's application of his theory of radiative equilibrium to stellar substance obeying the gas laws throughout makes the density at the centre of the star only 'fifty' times the mean density; it seems possible that 'fifty million' would be nearer the truth.

The suggestion is, then, that the central portion of every luminous star consists of 'stripped' atoms and electrons—or possibly in the earlier stages of its life-history at least of protons and electrons—surrounded by successive shells of atoms in various stages of association. As the density, so the pressure and temperature in the sub-atomic core of the star would be enormously higher than on the assumption of continuous variation, and, conjecturally, high enough to condition the building up of the more complex nuclei from the simpler, with the consequent conversion of mass into radiation.

The mean temperature, the effective temperature, and the absolute magnitude of the star would depend mainly on the mass of the central core, and would continually adjust themselves to its variation, so that stability would appear to be assured. But it is easily conceivable that for different stars the total mass may bear very different ratios to that of the central core, in which case the output of radiation per unit mass of star would correspondingly vary. The view expressed by Russell and Jeans, that differences in this quantity depend on differences in amount of a hypothetical active material, is thus in accord with the hypothesis.

The question of reconciling it—or otherwise—with current views of the course of stellar evolution, is another matter which, if further consideration appears to warrant it, may be dealt with in a future communication. At present I remark only that it suggests an origin for stars in an assemblage of protons and high-speed electrons—the problem of whether and how these have a beginning lies deeper—and an unforced explanation for the occurrence of 'white dwarfs,' differing entirely from either of those proposed by Dr. Jeans or Prof. Eddington.

KERR GRANT.

Department of Physics,
University of Adelaide, July 5.

The Volatility and Dissociation of Borax.

KOLTHOFF (*J. Amer. Chem. Soc.*, 1926, 48, 1447) states that he has been unable to confirm our statement (*Jour. Chem. Soc.*, 1925, 127, 150) that fused borax loses sodium oxide. He reports that "even after the substance had been heated for two hours at 800° the weight did not change." His experiments, however, appear to be scarcely precise enough to prove that borax on heating (1) is not volatile, and (2) does not change in composition; as a matter of fact the volatility of borax at high temperatures is well established, having been observed by Hoskyns-Abrahall (*Jour. Chem. Soc.*, 1892, 61, 650), Leonard (*Chem. News*, 1898, 77, 104), and Smith and Van Haagen ("The Atomic Weights of Boron and Fluorine," *Carnegie Inst. Washington*, Publication No. 267, 1918).

We would direct attention especially to the last-mentioned publication, where it is stated that "it is certain and not at all surprising that borax cannot be fused for any considerable time without loss." This evidence is so conclusive as to require no emphasis here. There is, however, another interesting piece of evidence. The inside of the silica muffle used for the fusions of borax in our investigation was completely coated with a white opaque enamel, about 0·06 inch thick, of a product of a reaction between the volatilised material and the silica. Clearly the salt had volatilised in some quantity, and with such a volatile substance, selective loss of the constituents could be detected only by analysing the residues. We believe that the analyses given in our paper can only be interpreted to mean that borax on prolonged fusion leaves a residue poorer in sodium oxide than is required by the formula $Na_2B_4O_7$, and afford definite evidence of a preferential loss of sodium oxide.

H. V. A. BRISCOE.
P. L. ROBINSON.

University of Durham, Armstrong College,
Newcastle-on-Tyne, August 10.

Photographic Theory.

IN the course of photographic investigations at the Royal Observatory, Edinburgh, it has been found by Mr. E. A. Baker that the initial stages of the photographic action, including the deviations from the reciprocity law, are calculable and well represented by assuming that the developable product is formed in two stages, each requiring one quantum; and that the product of the first stage returns in the absence of further stimulus to its original sensitive state, according to the usual law governing the progress of a mono-molecular change. In the case of process plates, where the grains are small and nearly uniform in size, the experimental results agree so closely with those deduced on this theory as to warrant the belief that the departures from it with fast emulsions, where not due to the reversal action, are to be accounted for by the diversity of grain size. The results of these investigations will be submitted to the Royal Society of Edinburgh during the coming session.

Experimental results for single layer fast emulsions and weak light are much to be desired in this connexion. The purpose of the present note is to express the hope that some of the researches at present in progress at different places may be directed to that end, and that results already obtained may be published.

R. A. SAMPSON.

Royal Observatory, Edinburgh,
August 13.

Kaufmann's Experiment and the Spinning Electron.

IN NATURE of August 21 Dr. L. C. Jackson quotes Wentzel as having supposed a *force*

$$(\mu[vX])/c \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

to act on a magnetic electron with moment μ moving with velocity v in electric field X (c is the velocity of light). He deduces from (1) that Kaufmann's experiment shows that the electron cannot have a magnetic moment as large as a Bohr magneton.

Wentzel, however (*Zeitschrift fur Physik*, 37, p. 911), used (1) as *Storungsfunktion, i.e. energy*. (For an electron describing a periodic orbit in an atom energy

$$(\mu[vX])/2c \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

would, I think, lead to the correct first order perturbation, but the equations of motion are not of Hamiltonian form and (2) would not apply in general.) Thus Dr. Jackson's argument rests on a mistake. His formula can be seen to be wrong dimensionally. 'He' has not the same dimensions as '$X\mu/c$.' In fact, extra force on a magnetic electron will depend on the gradient of the field. Kaufmann's experiment in no way precludes the electron from having a Bohr magneton of magnetic moment.

L. H. THOMAS.

Trinity College, Cambridge.

Liver Extracts in the Treatment of Malignant Disease.

THE letter from Dr. J. R. Howitt in NATURE of August 21, p. 263, appears to be based upon an extraordinary presumption. The liver, in early fœtal life, is large because it is an active blood-forming organ, but Dr. Howitt seems to suppose that it must have some endocrine function relating to growth. If this idea were correct, it would seem rational to presume that it was a growth-accelerating hormone, for the embryo is growing rapidly. Dr. Howitt seems to think that it is a growth-retarding or, at least, a growth-regulating hormone. That the method advocated may have clinical value is, of course, possible, but it is difficult to understand the theoretical basis of the treatment. I have no knowledge of decreased activity of growth in tumours when associated with enlargement of the liver due either to simple hypertrophy or to resumption of its blood-forming activity.

A. PINEY.

Institute of Pathology,
Charing Cross Hospital,
London, W.C.2, August 22.

Oceanic Isostasy in Relation to Geological Tectonic.[1]

By Sir JOSEPH LARMOR, F.R.S.

1. A CENTURY ago geodetic and gravitational universal surveys were mainly concerned with determining the effective (gravitational) ellipticity of the earth, after due allowance had been made for local anomalies, with especial view to the exact purposes of physical astronomy. One of the chief of these anomalies was exhibited by a remark of Airy, after scrutiny of the available data in his treatise (1830) on figure of the earth in the "Encyclopedia Metropolitana," that the observations show gravity to be abnormally in excess on island stations. It appeared, for example, that this cause might make the mass of the moon uncertain up to 2 per cent. A very refined explanation of this anomaly of island stations (which will be seen presently to be only partially effective) was offered by Sir George Stokes, from whom this last remark is quoted, in the course of a memoir,[2] fundamental for theoretical geodesy, in which he demonstrated that no outside survey could lead to any certain knowledge of the distribution of mass inside the earth, even in its outer crust, except as a matter of probability when backed up by geological knowledge.

It is explained there that the form of the sea-level must be locally depressed over a deep ocean, owing to defect of density; and in consequence on insular stations gravity at sea-level is measured abnormally nearer to the centre of the earth as a whole, so that from this cause its value is greater than that belonging to the mean spheroidal surface. In fact, the form of the ocean is an equipotential surface, including therein the potential of the centrifugal force of rotation in the familiar manner: but the part of the potential arising from the local water is abnormally small on account of its low density, and this defect must, in absence of local compensation, be made up by a greater potential of the earth as a whole, which demands depression of the local ocean surface towards the earth's centre.

The opposite result would arise from excess matter of an adjacent mountain or island peak: that would raise the ocean level in its vicinity and thereby indirectly diminish gravity, measured at sea-level as determined by levelling operations.

For example, at the centre of a circular oceanic basin or radius b and uniform depth h, its defect of potential would be with sufficient accuracy $\int \gamma\rho' h 2\pi r\,dr/r$, where ρ' is the defect of density of the water below that of the average terrestrial crust; thus it is $2\pi\gamma\rho' bh$, where γ is the constant of gravitation given by $\gamma E/a^2 = g$. Here $E = \frac{4}{3}\pi a^3 \rho$, ρ being $\frac{11}{2}$, is the mass of the earth of radius a. As the potential of the earth as a whole is $V = \gamma E/r$, this change of local potential, say δV_0, would be compensated by change of sea-level δh, where $\delta V_0/V = -\delta h/r$. Thus in the present case the fall of level relative to depth of ocean is given by the expression

$$-\frac{\delta h}{h} = \frac{a 2\pi\rho' b}{E/a} = \frac{3}{2}\frac{\rho'}{\rho}\frac{b}{a} = \frac{9}{22}\frac{b}{a},$$

while

$$\frac{\delta g}{g} = -2\frac{\delta h}{a}.$$

If the radius b of the oceanic basin is 50 miles this fall would be the fraction $\frac{9}{11}\cdot\frac{50}{4000}$ or $\frac{1}{100}$ of its depth; if the radius were larger it would increase in direct proportion until it is a considerable fraction of the earth's radius. A cup-shaped ocean could be similarly treated.

The steady sea-level would thus be depressed by $\frac{1}{10}$ of a mile owing to local causes, at the centre of a basin of 500 miles radius and 2 miles deep, in free communication with the other oceanic waters: and this approach to the earth's centre would involve increase of g measured at ocean level, given by $\delta g/g = -2\delta h/a$, or here $\delta g = 0{\cdot}05$ cm./sec.^{2}, where g is about 981, which is over one-third of the order of magnitude of the observed excesses at island stations.

But this explanation fails because there is a predominant offset. The vertical attraction of the local ocean regarded as an extensive flat slab of water is abnormally small by $2\pi\gamma\rho' h$, where $g = \gamma E/a^2$, that is by $g\rho' 2\pi a^2 h/E$ or $\frac{3}{2}\frac{\rho'}{\rho}\frac{h}{a}g$; thus this direct defect in g may be much the greater, being $\frac{1}{2}a/b$ times the indirect excess. There is however some effect in the other direction due to excess density of the local land, which is usually a substantial correction. This preponderance destroys and even reverses the Stokes explanation of the oceanic anomaly. Indeed closer examination shows that, as based by him,[3] rather confusedly as it seems, it depends on a potential equation used by Laplace which can, in limited manner, apply only to a locally infinitely thin spherical layer. The principle of depressed level became familiar, simple examples being worked out, *ab initio* and so correctly, by way of illustration in Chap. IV. of Col. A. R. Clarke's standard treatise on geodesy (1880), from the point of view however only of levelling operations, not of gravity.

But soon the discussion of the data of the Indian geodetic survey, by Archdeacon Pratt in India, revealed new features,[4] by showing strong residual defect of gravity on the Himalayas, such as could only be accounted for by a large defect of density underneath the mountains. Airy's idea that the mountains might be buoyed up by extensive roots floating in a denser magma, existing beneath a *thin* crust, could not of course now be maintained, at any rate in that form, in view of the high rigidity of the earth as a whole. But there was much to be said, on various counts, for a thinner and deeper viscid stratum, lying between the crustal material and the solid core, in which in the tendency towards equilibrium the pressure due to the weight of the crust must in course of ages have become equalised laterally, at any rate partially, and the load upon it thus made uniform to that degree everywhere. It is implied that there are no local abnormalities of density in the core, which is reasonable as the core is probably metallic. This is the hypothesis of isostasy, propounded as a universal principle by Dutton and worked out systematically by Hayford and his colleagues of the American Survey, who found that it gave a fair account of the usually slighter anomalies (mainly of levelling) revealed in that great undertaking.[5]

---

[1] Abstracted, with Sections 2 and 3 added, from *Proceedings of the Cambridge Philosophical Society*, Feb. 8, 1926.

[2] *Cambridge Transactions* (1849): reprinted in "Math. and Phys. Papers," vol. ii. Some idea of the great debt owed by the Indian and other gravitational surveys to the continuous amateur advice of Sir G. G Stokes, spread over half a century of their development, may be gleaned from the collection of his "Scientific Correspondence" (Camb. Univ. Press), vol. ii. pp. 253-325.

[3] "Math. and Phys. Papers," vol ii p. 153. Stokes did not make any correction in this reprint in 1883; but Dr. Bowie states (*loc. cit. infra*) that there is no generally accepted explanation other than compensating excess of density beneath the ocean

This analysis of Stokes in fact establishes as a general proposition that the effect of *distant* irregularities of surface mass consists of a direct vertical attraction, say g', together with an indirect part due to change of level, equal to $-4g'$, thus countervailing four times; this influence, of wide range and presumably actually small, is superposed on the *local* effect here considered.

[4] In 1855–59: cf. A. R. Clarke, "Geodesy," pp. 96-98.

Circumspection is, however, suggested in applying these ideas to the anomalies at oceanic stations; for the Stokes explanation already claimed to be an effective *vera causa,* without aid from compensation of density underneath. It happens that the subject is amenable in a general way to simple elucidation: and as the essential circumstances for submarine mountains and landscapes can perhaps be more directly estimated, it seems indeed to provide in some respects a closer test. On an ideal very narrow island-peak of negligible mass, in a wide ocean of uniform depth, with adjustment as a whole to general isostasy by denser horizontal strata underneath, there would be but slight resultant abnormality of the local part of the attraction. For the totality of the strata could almost be regarded as an extensive thin flat sheet, while local defect of potential on which change of sea-level depends would be still more closely compensated by the extra mass below.[6] Hence, in contrast to the Stokes uncompensated case above, under isostatic conditions gravity and level ought both to be regular over a wide ocean of nearly uniform depth with strata nearly horizontal underneath.

2. The distribution of gravity over an oceanic surface, beneath which local compensations of terrestrial density are taken to be complete, may thus be envisaged, perhaps most simply, by drawing a widely extended arbitrary horizontal boundary beneath the water, and marking out all above it up to the level surface as ocean separately compensated beneath, the law of depth of the compensation being for that hypothetical layer of the density of water unimportant. There will then remain the effect of the surplus of density, over the oceanic water, of the solid parts situated above this arbitrary flat boundary; and it is from this reduced submarine mountain-landscape alone, together with emergent peaks with density undiminished, and the nature of its compensation, that the amount of the actual local excess of gravity is to be estimated on the hypothesis of isostasy, the circumstances thus being analogous to those of a range like the Himalayas, but modified, as all the observations now belong to the same level near the tops of the submarine mountains instead of the bases. The nature of the compensation, in the deep-seated material, of this effective local excess load, would thus permit of being judged by itself; in particular, for steep submarine island peaks it is almost negligible, whatever varying distribution in depth be assigned to it, provided only it extends deep down, say towards the order of 10^2 kilometres.

The long-recognised excess of gravity at island stations was thus really evidence quite as forcible, and also as direct, as the subsequent records of Himalayan surveys, indicating that the defect of density of the masses of water is actually compensated, even over wide uniform oceans, at any rate to a very considerable degree, by excess of density below.[7] The systematic discussion of the level and gravity surveys of America, primarily by Hayford, has enlarged and forced into prominence the same very striking and surely fundamental type of conclusion, as extended even to the usually smaller and less abrupt anomalies there revealed.

The evidence, then, is on all sides remarkably strong, that with increase of depth the terrestrial material gradually becomes softer, so to say, possibly owing mainly to rise of temperature, down to a limit which perhaps at an outside estimate may approach 10^2 kilometres: that below some such depth the mass of the earth presents again a perfectly solid, though doubtless elastically deformable, foundation on which the softer strata directly above have flowed gradually in the course of ages towards an equilibrium nearly hydrostatic, depending in detail, however, on the distribution and range in depth of the softness, in a way that is scarcely much amenable to scrutiny. To effect such adaptation, the displacement of deep-seated material need be only over slight distances, unless the yielding layer is thin. An unyielding foundation underneath is essential to any approach to local isostasy; the earth as a whole must be solid, as it is known to be for dynamical reasons. As regards the relatively shallow upper terrestrial layer which thus becomes viscous with depth, in a way not necessarily uniform nor to the same depth everywhere, the question of rupture or damping of transmission of internal earthquake tremors in crossing these softer layers arises, and is probably ripe for discussion; such a stratum may of course be even completely yielding for slow secular stress while thoroughly elastic for the rapid alternations in seismic oscillations. It is to be remarked, however, that as a result of theory superficial travelling waves, at any rate on uniform elastic material, could scarcely arise from other than a superficial cataclysm, secondary it may be, so that purely superficial seismic undulations would have to come from sources located within their own quite small range of depth. But the velocity would change (dispersively) with wave-length, and this conclusion may be modified, as Prof. Love pointed out, if the elastic quality or density, instead of being uniform, changes notably within the depth of a wave-length.

Why distinct settlement of the strata towards isostasy such as is thus variously confirmed should be necessary at all, affords direct scope for fundamental tectonic speculation, of an interest quite apart from geological detail. Is this abnormally small density beneath mountain ranges due to higher temperature or to lighter material? How could such locally varying temperatures have become established over a consolidating earth? If the height of the mountains is determined largely by the defect of density beneath, they must to that degree have been pushed up hydrostatically from below rather than elevated by lateral stresses; yet folding of the mountain strata is conspicuous. Subsidence towards isostasy might perhaps induce folding to some degree. If the depression of the Pacific Ocean is thus determined in the main hydrostatically, is there not less room for the cosmic theory that it may represent the cavity from which the moon was originally shed away?

---

[5] Cf. the chapter in H. Jeffreys' recent treatise "The Earth."

[6] In the case illustrated above, with radius of ocean about 500 miles and depth of compensation 100 miles, about 10 per cent. of the anomaly both of attraction and of potential would remain after compensation of the ocean.

[7] For recent special estimates see a note by W. Bowie, *Proc. Washington Acad.*, Dec. 1925.

3. *Postscript.*—One observes that these and cognate questions, insistent and fascinating, form the subject-matter of Prof. Joly's recent path-breaking book, "The Surface History of the Earth," which invokes steady evolution of heat by radioactivity of the rocks, interacting with isostatic influences, as the cause of periodic outbursts of surface activity which have fashioned the existing features. There are to be compared the views developed in H. Jeffreys' recent comprehensive treatise, "The Earth." For a condensed account over an extensive range *cf.* "A Symposium on Earthquakes," by F. A. Tondorf, N. M. Heck, W. Bowie, A. L. Day in *Journal Washington Academy*, May 4, 1926, pp. 233-254 (also more recently G. R. Putnam). In a less special way, such questions have been prominent since the treatise of E. Suess on the earth's surface features. There is also the problem of the time-scale of development, projecting into vast æons of the past, yet with clues arising mainly from the fossil traces of the succession of forms of life.

A few special remarks may be significant here.

It appears that the lag in compensation of accumulating great depths of sediment is but small, compared at any rate with the time of accumulation, for the compensation is always well advanced.

Tidal pulls on these adjustable surface-sheets would on Newtonian principles be differential, and so extremely slight. Thus even the extreme case of an elastic earth surrounded by an ocean of molten lava of the order of 10^2 kilometres in depth, in which continents would be analogous to ice-sheets and mountains to icebergs, is not unthinkable dynamically, however it be thermally; though the existence of the actual oceanic tides would demand a rigid and deep crustal layer.

But even if the lagging tidal pull were large enough, it could only cause a westward drift of the fluid surface material around the earth as a whole, not of continents and mountain ranges floating thereon. For the principle of Archimedes asserts itself; as regards the uniform field of force the floating mass can be replaced by the magma which it displaces, up to the level surface; thus it is the same as if the tidal forces acted on a uniform sheet of magma without surface excrescences and no differential drift could arise—except in so far as a uniform drift may be obstructed or deflected locally by the more solid roots of the floating continents that are carried along with it.

The earliest table-lands, of primitive rock, must have been pushed or floated up, and to great heights; it would appear from the literature that their subsequent denudation by aereal influences accumulated stratified deposits along the coasts of the oceanic hollows, which gradually sank into the magma by their own extra weights, perhaps most in the middle so as to curl over by the lateral pressure,—themselves sinking down while the adjacent denuded high land is floated up, until by accumulation combined with sinking, and helped by effusions from below, they attained to considerable slopes and great thicknesses, even five miles or more, that then somehow they were pushed up again bodily, yielding after repetitions of such processes folded mountain-ranges of stratified rock such as geologists know, the primitive elevations having passed largely out of sight. At any rate nothing more plausible seems to have been hitherto thought of.

The Golden Eagle.

By SETON GORDON.

"Thrice the age of a dog the age of a horse,
Thrice the age of a horse the age of a man,
Thrice the age of a man the age of a stag,
Thrice the age of a stag the age of an eagle,
Thrice the age of an eagle the age of an oak tree."
—*Old Gaelic saying.*

THE golden eagle is the most magnificent bird of the Scottish highlands. Up to the middle of last century, the erne or white tailed eagle shared the cliffs of the western seaboard and islands with the golden eagle, but the erne is now extinct, although so late as the middle of the last century almost every headland of the Isle of Skye had a pair of these fine birds nesting upon it.

The flight of the golden eagle has inspired many poets, and from the earliest times it has been looked upon as lord of the air. In the Book of Proverbs we read:

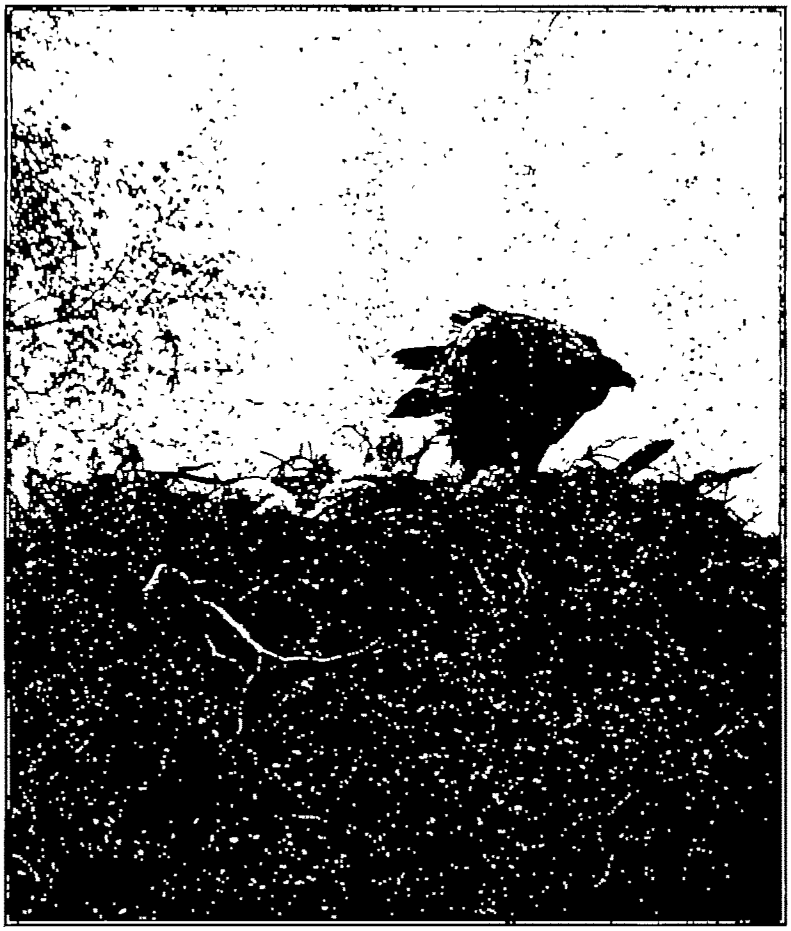
"The way of an eagle in the air,
The way of a serpent upon a rock,
The way of a ship in the midst of the sea,
The way of a man with a maid."

These, says the writer, are the four things too difficult to understand. Keats wrote in 1818 "Eagles may seem to sleep wing-wide upon the air," and how descriptive are Wordsworth's lines "Faint sound of eagle melting into blue." Scott writes that the eagle from her rocky perch on Ben Venue "spreads her dark sails to the wind."

The eagle is the royal bird of Greek mythology; an eagle of gold was the standard of the Romans. At least three countries have the eagle as their emblem: Assyria, Persia, and Rome. It is, or was, the national arms of France, Germany, Russia, Italy, Austria, and Poland.

At the present day the golden eagle is confined to the central and western highlands of Scotland. In the more accessible districts it is terribly harried by egg collectors, and here very few eyries escape. It is unfortunate that the golden eagle, almost alone among Scottish birds, should never lay a second time in a season, even if its first clutch of eggs be taken when quite fresh, but, despite the egg collector's zeal and the keeper's gun, I do not think the eagle is on the decrease, except here and there. Each pair of eagles has two, sometimes three, eyries. The same eyrie is seldom used two years in succession, because the eaglets remain long (about eleven weeks) in the nest and from the accumulated remains of prey the eyrie becomes foul towards the end of the time and needs more than a twelvemonth to be thoroughly cleansed by winter frost and summer sun. Some of the Scottish eyries have been used regularly for at least half a century, and probably much longer.

The nesting site may be a tree or a rock. In the central highlands a tree is frequently chosen, and I have seen nests in a Scots fir, and, rarely, in a birch. In her choice of nesting material the golden eagle is most particular. The eyrie may be from six to eight feet in diameter, and the crown on the nest is composed entirely of green fir branches (if there are any fir trees in the district), which the eagle breaks off the trees with her powerful bill. Near one eyrie that I know of a solitary fir grows, and each spring the eagles fly to it and strip it of some of its branches. The lining of an eyrie is, when possible, always made of the great woodrush, *Luzula sylvatica*.



Copyright] [*Mr and Mrs. Seton Gordon*

FIG. 1.—The hen golden eagle preparing to feed the family

Eagles build early, and I have seen a large branch being carried to the nest on January 27. In the more sheltered nesting-places the eggs are laid in mid-March, and the eaglets hatch between April 29 and May 1.

It is not known whether the cock bird takes his turn at hatching the eggs. In April of the present year I was watching an eyrie when the male bird flew up the corrie and settled on a branch a few yards from where his mate was brooding her eggs. I hoped that I might witness the 'change over,' but, after apparently satisfying himself that all was well, the cock shook himself like a dog (there had been a heavy hail shower a few minutes before), spread his great wings, and was gone from my sight.

Although the golden eagle usually lays two eggs, she frequently rears only one bird, and there is no doubt that one eaglet sometimes kills the other. Last season my wife and I built a hiding tent thirty feet from an eagle's eyrie, and spent between two and three hundred hours in it photographing and observing the home life of the birds. As usual, one eaglet was a hen, the other a cock. In birds of prey the female is the larger, and when the eaglets were ten days old there was a marked difference in size between the two. During the early days of their lives the young hen frequently drove her brother round and round the eyrie. The attack was always entirely unprovoked. Sometimes when the cock eaglet was lying asleep in the nest his sister rose and walking unsteadily over to him aimed a deliberate and vicious blow at him. Fortunately for him the young cock was the quicker of the two on his feet, and I am convinced that on more than one occasion his superior speed alone saved his life. Each time his sister pecked him she tore out much of his down, until the eyrie and the heather around were strewn with this white down. The victim never once retaliated; indeed he was a miserable young person at this stage.

Sometimes, after almost exhausting herself by her attacks on her unfortunate brother, the aggressor stood up unsteadily in the eyrie and flapped her downy wings (her feathers had not as yet commenced to grow), uttering as she did so a wild yell of defiance. It was a weird and very extraordinary cry, and I shall never forget it. Once the mother eagle returned in the midst of this bullying and calmly watched the down being torn from her unfortunate son. Perhaps she thought it better that he should be brought up in a Spartan school.

This pair of golden eagles brought to the eyrie a varied collection of prey for the youngsters. Blue hares, grouse, and ptarmigan were brought regularly, and, more astonishing, the birds hunted squirrels and brought them to the nest. Although the eyrie was in a deer forest no red deer calves were brought, but two roe deer calves were carried up to the eyrie from the low ground. My wife had the good fortune to be in the 'hide' when one of the calves was brought. The calf was minus head and entrails, and even then its weight was such that the cock eagle had to rest several times upon trees on his way to the nest. He was carrying the calf in one claw, and when he arrived he threw down his burden and stood breathless at the edge of the nest. The eaglets were filled with excitement, and the young hen pounced upon the calf with the same weird yells of triumph she had uttered after her fierce attacks upon her brother. The latter picked up a feather from the floor of the eyrie and dashed about holding it in his mouth !

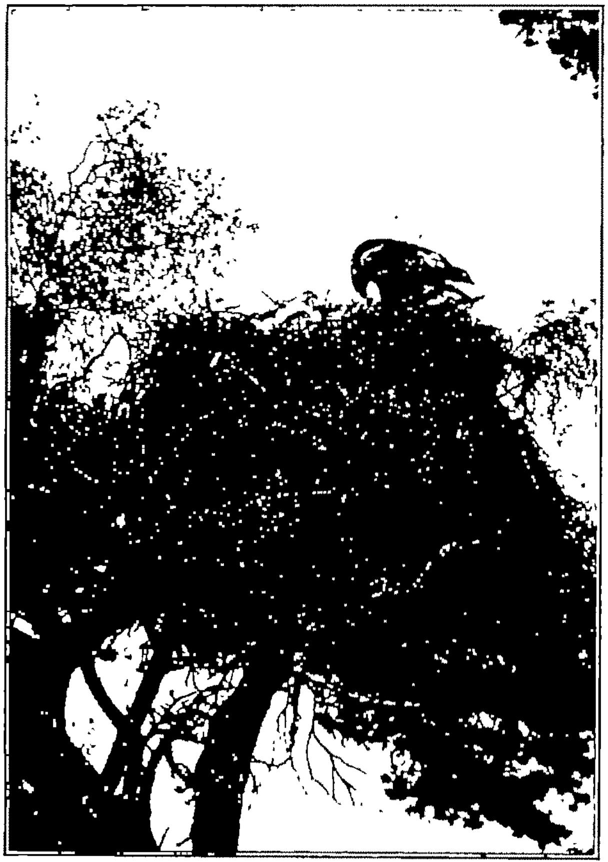

Copyright.] [*Mr and Mrs Seton Gordon*

FIG. 2.—Cock golden eagle tearing up a hare for the eaglet.

The cock eagle was a magnificent bird. He was smaller than the hen, and his plumage was lighter than hers. He was dashing and debonair; the gleam of his eye was magnificent, and he was a true king of the hills.

One sunny afternoon the interior of the 'hide' was so stuffy that I put my head half out of the entrance to get a breath of air. Against the blue of the sky I saw a small black object which I thought at first glance was an insect. But with incredible speed the dark speck grew in size until I saw that it was the cock eagle rushing down towards the eyrie from the high snow-streaked corries above. He was travelling like a thunderbolt In one claw he held a ptarmigan, and this extra weight no doubt increased his speed. I suspect that I shall be accused of exaggeration when I say that his speed was at least two hundred miles an hour, but I am convinced that this is no over-statement. I have seen nothing in the bird world to equal that splendid downward rush, and to see it was worth many hours of patient watching.

Regularly about three o'clock each afternoon the cock eagle arrived at the eyrie from his hunting. In the eyrie he laid his prey, and, after looking at his yelping brood for the space of about a minute with indifference, he spread his great wings and sprang into space. On these occasions his mate must have been watching him from a neighbouring tree, for almost immediately he had left she glided down to the nest and fed the family on the prey he had brought.

When the eaglets were small there were days of wild west wind, when the squalls of hail pattered like small shot against the sides of the 'hide.' The eagle's tree rocked in the wind, and the mother eagle, as she guarded her young after having fed them, swayed gently to and fro, balancing herself with all the skill of a sailor when his ship is meeting heavy weather. The young hen eagle left the nest early in July, but the cock, being more backward (partly, no doubt, because of his ill-usage in his early days), was not ready to follow her. For some days the parents fed him in the eyrie, but then seemed to decide that he was ready to leave. Each day they brought him less food, and at last the eyrie was bare. The parents were starving him, and daily he became weaker and constantly scanned the skies for his father or mother. He practised wing exercises repeatedly during these days, and also practised 'grabbing' exercises with great ferocity. At last, on July 16, the eyrie was vacant—starvation had compelled him to take his first flight, the biggest step in his young life.

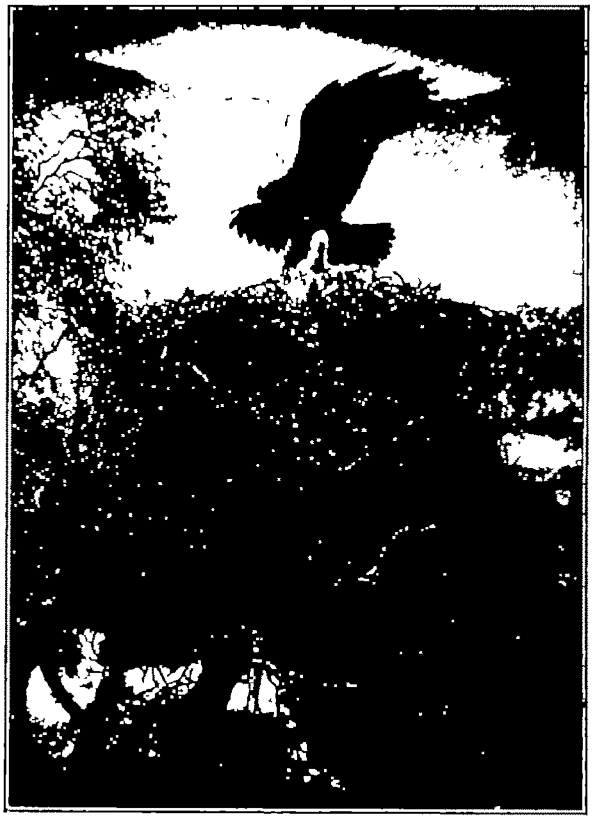

Copyright.] [*Mr and Mrs Seton Gordon.*

FIG. 3.—The cock golden eagle brings in a rabbit

The Regional Balance of Racial Evolution.[1]

By Prof. H. J. FLEURE.

THE Oxford meeting of the British Association naturally recalls to one's mind the famous controversy about evolution, the fact of which is now universally accepted despite little outbursts where old modes of thought survive on the fringes of civilisation. The application of the idea of evolution to the study of mankind has been carried very far, and we have especially Elliot Smith's recent summary with its emphasis on correlated improvements of eyes, brain, and hands. I shall not venture upon the ground so well covered by one of our greatest leaders, but shall merely add a few points necessary for my main purpose, which is an attempt to outline the field of research into the distribution of the characteristics of modern living men.

First may be mentioned the very probable, not to say certain, lengthening of pre-natal life from about 220 to 280 days, with consequent continuance of growth of brain and delay of hardening of frontal and facial elements and the passing of the stage at which hair was previously developed now under new conditions conducive to the maintenance of embryonic, downy hair (lanugo), rather than to the growth of the definitive hair. Thus the lengthening of pre-natal life seems to have been an important factor in that reduction of hairiness which is a feature of mankind. It has also contributed to the increase of skull volume and of consequent difficulty in head support, so that infancy and opportunities for lengthened maternal care have been prolonged. The postponement of fixation of characters, the maintenance of more or less embryonic conditions with resulting unfolding of new features in response to opening up of new possibilities, has thus become a cardinal fact for the human race.

The prolongation of infancy has also contributed to differentiate women's work from men's work, and it may well have accompanied the growth of the hunting habit in man; woman remained more a gatherer. This differentiation increased personal relations and gave two mutually supplementary types of food, doubtless a valuable step forward at that stage of evolution. The consequent enrichment of social life is an obvious fact, but in mentioning this one must emphasise that human society does not so much result from the coming together of individuals as that human individuality results from the liberation, bit by bit, of individual initiative within groups.

The stone implements of early Pleistocene man are generally of a few types only, though they may be wonderfully executed. The heavy hand of tradition has often limited initiative, but also often allowed the compensation of the craftsman's joy. Mid-Pleistocene man, at least, seems to have made ceremonial burials and thus, perhaps, to have begun to dream of a future life. It is with the Aurignacian phase, or the beginning of the late Pleistocene, or, to use another name, the beginning of the neanthropic period, that we note a great liberation of initiative, and it is from this phase that we have the earliest assured evidence of modern types of man, so far all or almost all from the north-western quadrant of the Old World.

Efforts have been made to estimate the climates at which men's bodies and minds function best and to argue thence to the home under the conditions of which they became men of modern type. The best conditions for bodily efficiency are not very different from those of our present British climate, for mental efficiency they are like those of our cooler (but not too bitterly cold) spells. Olbricht has ventured the suggestion that there was probably a big mental advance during a cold period such as a late phase of the ice age; but at such a time a climate like our present one favoured the south Mediterranean and the belt from the Sahara to Mesopotamia, perhaps only this belt. This belt seems to give abundant evidence of inhabitants of, possibly, mid-Pleistocene date.

We may venture provisionally to place the early modern men in the zone from the Atlantic edge of the Sahara to Persia, and should think of a fairly large population not all exactly alike. What sorts of men were they?

They may have been more or less brown-skinned with blackish hair and brown eyes, with jaws and brow ridges much reduced from the conditions known in many of the earlier forms of man, with heads almost balancing on the vertebral column, but the erect posture not yet attained in all cases.

The well-known youth and old woman from the lower layers at the Grotte des Enfants, currently known as the Grimaldi type, were short, with broad noses and strongly projecting mouths, but without brow ridges. Their heads were long, narrow, and high. They have often been said to be negroid, but it would be wiser to say that both in them and in many living Africans we find some of the same characters.

The name of Cro Magnon has often been used as a label for nearly all the types of the late Palæolithic except the Grimaldi skeletons just mentioned. Giuffrida Ruggeri urged a more restricted use of the term, but his views were held back from general acceptance for a while owing to exaggerations due to Klaatsch, exaggerations which Klaatsch retracted before he died. Using the term more carefully and more strictly, it applies fully to about four skeletons and partially to two or more of presumed Aurignacian date as well as to other later ones. In the Cro Magnon type the head is long absolutely, but only moderately long relatively, the cephalic index being about 74, 75, or 76. The height of the skull is much less than its breadth, the nose and chin are strong and narrow, the brow ridges do not stand out separately in front of the forehead, the stature is great, the cheek bones are large and project laterally, and the face is short and broad.

It is difficult to accept either the Brünn or the Brüx calotte as suitable objects from which to name a race, and there are difficulties about naming it from the Combe Capelle skull. We await anxiously the full description of skulls found at Predmost. The general characters here are extreme length and narrowness of the head, so that the cranial index is rarely so high as

---

[1] From the presidential address to Section H (Anthropology) of the British Association, delivered at Oxford on August 9.

73 on the skull; the height of the skull is usually greater than the breadth, the brow ridges are well marked and in this connexion the rather exaggerated term 'Neanderthaloid' has often been used. There are a few skulls otherwise belonging to this type which are low in the vault.

Skulls from Solutré show high heads without strong brow ridges, but heads which are so much shorter as to make the usual index 78-83. We await confirmation of the date and detailed descriptions of the Solutré skulls.

Reviewing these early skulls comparatively, we notice that great length of head is a very general feature. This is combined with a very narrow and rather high-ridged form in some cases, and a less narrow and less high-ridged form in some others.

The great majority of the apes and the extinct types of man do not seem to have been relatively long-headed, if we are careful not to include the enormous brow ridges of some of them in measuring the head length. Comparing the skulls of Aurignacian men with these others, we note a marked growth in length, especially in front of the ear. This implies special additions along the coronal suture. Now the temporal muscles were of very great importance to the flesh hunters of the late Palæolithic age, who doubtless had to tug at flesh food. They had been important, no doubt, in earlier times as well, so they may be looked upon as an ancient feature persisting for a while and exerting an influence on the new growth. The early closing of the sagittal suture gave a firm anchorage to the temporal muscles and limited growth in breadth anteriorly at least; increase of anterior space must thus be secured mainly by increase in length. It is therefore permissible to suppose that a great lengthening, extreme in some cases, was a feature of skull growth among most, but not necessarily among all, early representatives of modern types of man.

In several cases the two sides of the skull roof seem to have been pulled down, or in other words the sagittal line was ridged up, and this is found frequently associated with a deep temporal hollow, so that the brow ridges are left outstanding. In other cases the temporal muscles seem to have pulled the sides down to a lesser extent, and the head is less narrow and the brow ridges less outstanding. Lest too much importance be attached to the pull of the temporal muscles, it is well to remember that the face was still heavily developed in most early examples of modern man, and that to balance this the head tended to grow so as to project backwards, *i.e.* to grow in length.

It is thus possible to think that in the evolution of modern men we may have:

(*a*) Types with little of the additional growth just mentioned. These would be sub-brachycephalic and small.

(*b*) Types with considerable growth, almost entirely growth in length, and with the sides of the skull sloping steeply from the sagittal ridge. These would be hyperdolichocephalic and usually high-headed, often with strong brow ridges.

(*c*) Types with considerable growth in length but without the sharp down slope of the sides. These would be more moderately dolichocephalic than (*b*), less high-headed and usually with less strong brow ridges.

(*d*) Types with considerable growth more generally distributed along the various sutures. These would be mesaticephalic or sub-brachycephalic with parietal rather than frontal breadth as a distinguishing feature.

I think it useful to figure the great lengthening as a feature in the main groups of early modern men in the early home zone, and then to think that there were fringing groups who remained without this lengthening. These fringing groups on the hot south side, probably subject to unfavourable conditions, would have relatively small growth and would remain as small mesaticephals. On the cooler north side they, then or later, were able to accomplish longer continued growth and so gave better grown, larger headed mesati- and sub-brachycephals.

The first group seems illustrated by the Andamanese, Semang, Aeta, Tapiro and other pigmies of south-eastern Asia, and the Akka and other small peoples of equatorial Africa, the last being much less strongly pigmented than the others. All have flat, broad noses, the Tapiro less than the others. It seems almost necessary to think that some of these types have left their mark on the population of various parts of India, and some of their characters seem to survive also among various African peoples other than the equatorial pigmies. The Bushmen, on the view here sketched out, would be types showing some measure of head lengthening, and the Tasmanians also.

I have not mentioned hair. The downy hair has fairly straight roots even in Bushmen, and the spirally curved hairs so characteristic for Africa develop that curve with a sharp angle between it and the root. As ape hair also has fairly straight roots, it thus seems likely that spirally curved hair is a specialisation among some early types of modern man, chiefly, I think, types on the south side of the early home zone under hot conditions, where hair reduction and the pressing of the roots up toward the surface would allow the freer giving off of heat.

Next we may think of cases in which head lengthening had taken place fully. Broom's Hottentots and Koranas fall here, and so do most of the African peoples. Among some the pressing of the hair roots up to the surface has made possible a large growth of blood vessels in the skin, and the reduction of hair has gone very far in certain cases. The thin supple epidermis without many dry non-conducting layers, the everted lips, as well as the development of skin blood vessels and the reduction of hair, all promote cooling.

It was mainly types with broad, flat noses, prominent mouths, feeble brow ridges, and spirally curved hair that drifted southwards in Africa, from the south flank of the early home zone, but a brow-ridged type also went that way.

The south-eastward drift was a drift rather from the end than from the flank of the early home zone, and for this reason it was more varied. Pigmies with spiral hair and medium broad heads; dark Tasmanians with spiral hair and partly lengthened heads; south-east Australians with lengthened but often low heads, dark colour, and wavy hair; North Australians with lengthened and high heads, dark colour and wavy hair; Papuans and Melanesians with long high heads, dark colour, and spirally curved hair and so on—an interesting series of drifts through a long and relatively narrow belt. This contrasts with the African drift through a wide belt lying on the south flank of the early home.

Let us turn now to the northern flank of the early home zone and think of migrants across from Tunisia to Sicily and Italy, migrants mostly with very long heads, the bearers of Capsian culture to Europe. In addition to these we have to think of people drifting northward between Elburz and Hindu Kush as the ice diminished. Once north of this barrier the human drifts could spread either north-eastwards in the lowlands or north-westward to the European loess. These early drifts have been pressed upon by subsequent streams and their survivors are now found in peripheral situations and in a few refuges on the way. Survivals of these early characters are shown in types found at Plynlymon. The new work on blood constituents is interesting in that it is tending to show that the blood of the peripheral, longheaded peoples is inherited with little alteration from a phase before certain specialisations occurred in the composition of the blood of many human stocks.

When the belt of the westerly winds from the Atlantic shifted northward as the ice sheets diminished and the land sank in north-west Europe, inner Asia lost its rain to a large extent, but melting ice seems to have kept it moist for some millennia. Mesopotamia remained moist for the same reason for a good while. The change of climate in north-west Europe produced a human crisis; the spread of the forest broke the old schemes of life, especially as the first phase was that of a pine forest, very unfriendly therefore to man. In south-west Asia, wild barley and possibly wild relatives of wheat have been found. Somewhere then, probably on the northern fringe of the early home zone, there arose sooner or later a culture complex, including cultivation of wheat and barley, the art of stone grinding perhaps developed through the use of stone for digging, the consequent invention of the stone wedge, and so the rise of new power over wood to haft tools, to make palisades that kept animals under man's command for milk, etc., the making of pots, the dawn of metallurgy and so on. I think of this complex, provisionally, as spreading among hill folk rather than plains-men, for the latter might more easily keep up their old habits of following herds of animals, and it seems that it spread through Anatolia to Hungary and so, after a long history, ultimately to western Europe probably about the end of the fourth millennium B.C. There is, however, no need to picture the awakening west as copying exactly from old and distant cultures.

The mastery of a wood technique, food production, and the potter's art all helped home-making and the provision of soft food for infants, delaying the hardening of the skull or, in other words, prolonging infancy. In this connexion one pictures diminution of jaws and brow ridges and freer growth of the skull along many sutures leading to a maintenance of the mesati- and sub-brachycephalic skull form. This form and the brachycephalic form, which I believe is derived from it, are mainly characteristic of the great mountain belt of the Old World.

Another factor that enters into the story here is the probable increase of chewing at the expense of tugging, and Prof. Thomson and others have associated with this an increased width of the malar bones to which the masseter muscles are largely attached. Increased width of face and jaws is likely to have encouraged increased width of head as well. It is important to note that there has been no suggestion that some functional change in the jaws led to a transformation of dolichocephaly into brachycephaly. The suggestion is rather that the brachycephals have originated from fringing mesaticephals or sub-brachycephals. I appreciate and accept Prof. Thomson's observations and views on the lower jaws of the typical broadheads. These thoughts make me incline to criticise our present use of terms for skull forms.

Brachycephals give one the impression of evolution and drift from Anatolia and surrounding regions. It is noteworthy that Pamir broadheads are much like Alpo-Carpathian and Cevenole. For the present, I look upon the extreme broadheads of the high plateaux of east central Asia as showing in some cases a flattening of the nasal bones and an insinking of the nasal chambers, but others have the profile prominent enough. The broadheads of the high plateaux have yellow-brown skin, the early brown being retained and the yellowness being increased by the insinking of blood vessels, and the thickening of the dry superficial layers—both protective devices in a region of intense winter cold. The very variable extra fold of the upper eyelid may have begun as a consequence of the facial flattening, and once developed would be a valuable protection against glare.

The well-known diagram of Ripley shows the distribution of broadheads in Europe as known in his day, and its relation to the mountain zone is very marked. A preliminary attempt has also been made to design a map of types in Europe. Around the mountain zone the broadheads have spread and the longheads are mostly peripheral in the north-west and in the south-west. In the north-west, climate encouraged long continuation of growth and diminution of pigment, and I look upon the tall fair Nordic as to a large extent a regional specialisation. In the south-west the Mediterranean type links on to the Hamitic type of North Africa and the longheads of the Arabian wastes, all having among them an element surviving with little change from the early days of modern man, but many showing somewhat more general growth along the various sutures, and therefore less extreme length of heads. The fundamental element of the British population I look upon as drifting from the continent in late Palæolithic times, with a southern element fairly well represented but, nevertheless, on the whole neither fully Mediterranean nor fully Nordic, but, as I think Sir Arthur Keith would say, just British.

I have tried to suggest that development of the individual depends on hereditary factors of a conservative nature, and on environmental influences which have changed with climate, food, and equipment. Thus they have affected plastic infancy, and in the end have moulded race types blending hereditary characters sometimes brought from afar with other features in which the changes of environment have had more power. A doubt persists in my mind as to the assignment of more than a somewhat limited value to taxonomic treatment of the question. It seems worth while to think rather of regional gatherings together of physical characters.

Changes of environmental influence are usually cumulative, for natural processes are essentially irreversible even if, as in climate, there is something of a cyclic scheme of change. The cumulative change may be said to draw out the course of development more and more from its original path, thus creating a state of internal strain. No two embryos are exactly alike, and in some the hereditary units may vary towards, in others away from, a condition which would diminish that internal strain. Those varying so as to diminish the strain would probably grow best. So we have a theoretical possibility of variation of the germ limping after variation of the soma. In the case of man, whose development is so closely linked with varying balances of the influence of endocrine glands, the adjustment of the variation of the germ to the variation of the soma may not be very slow.

A special attempt has been made to suggest the part played by the development of social life in the evolution of human physique, and the importance of parental care. These factors seem in particular to have led in certain circumstances to a vast liberation of individual initiative within our human societies, especially after the development of intercourse between groups.

We must speedily undertake more and more biological observation and measurement among ourselves, and we must exercise ever more care in the treatment of our measurements. Averages of cases which are not properly homologous should not be made lest we mask the biological truth in mathematical abstractions. If our anthropological work can but go on becoming more biological, gaining insight into physiology, especially of the brain and the endocrine organs and their correlations with growth, I venture to think that racial study will develop great practical value for education, for the fight against tuberculosis and other diseases, and for race-improvement. Evolutionary race biology seems to be a hopeful sphere of work that may bring about a much-needed enrichment of public opinion on social questions, a diminution of race-arrogance, and a check on schemes that do not sufficiently allow for the mutual adaptations between diverse human stocks and diverse environments. I would ask for faith in the future of such work to bring out its great possibilities for nobler races with freer personal initiative in societies both more stable and richer in the things that are not seen.

The London School of Hygiene and Tropical Medicine.

HYGEIA, the goddess of health, daughter of Esculapius, was included among British *lares et penates* some fifty years ago, when the Public Health Act of 1875 was adopted. Since that time Great Britain has been a world pioneer in the achievements of its public health service. Attention was concentrated in the earlier years on drains and sanitation, but gradually the scope of the work of the public health authorities has widened. The results, as seen in the reduction of the death-rate to 12 per thousand and the consequent increase in the span of human life and in the health and happiness of the people, have undoubtedly had a bearing on industrial efficiency and national prosperity. But much remains to be done. Official evidence before and during the War relating to national physique and the statistics of diseases indicate the need for sustained effort in the health crusade. Even the layman can form some conception of the vast field for scientific research from the wonderful discoveries of which information is published from time to time, such as those relating to the curative power of natural and artificial sunlight and chemical methods of preventing goitre.

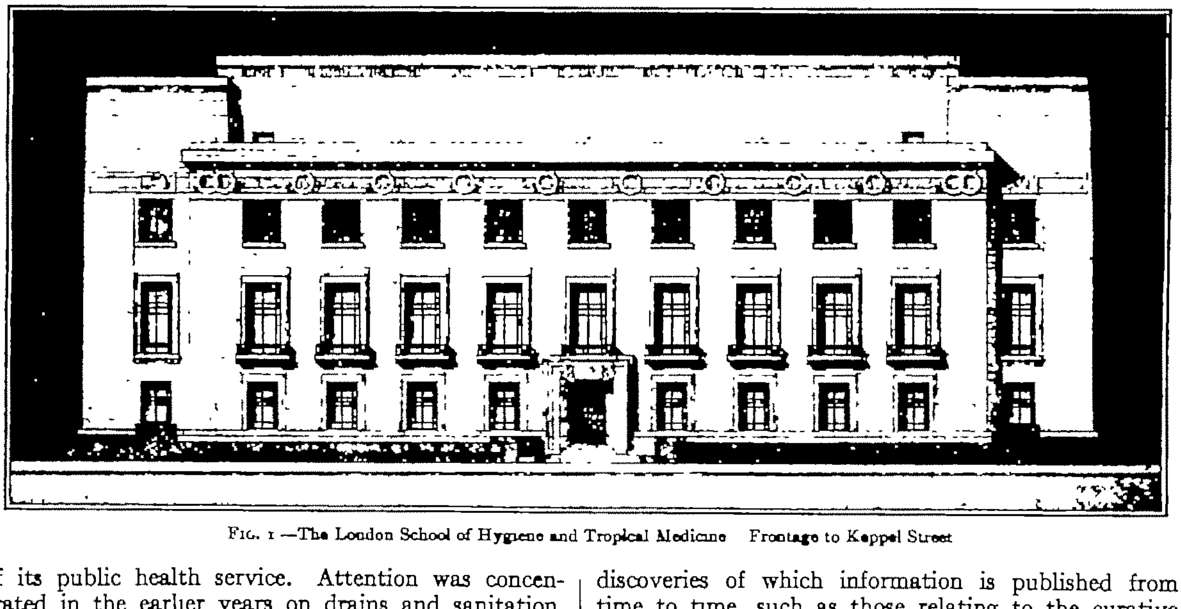


FIG. 1.—The London School of Hygiene and Tropical Medicine. Frontage to Keppel Street.

The Ministry of Health, as in duty bound, early recognised the need for extending facilities for instruction and research in preventive medicine. A committee appointed by the Ministry and presided over by the Earl of Athlone submitted a report in

May 1921 advocating the establishment of a post-graduate medical school in London and also an institute in State medicine. An expert committee was afterwards appointed to consider the recommendation as to a new school of hygiene. Financial difficulties, which may well have appeared insuperable, were miraculously removed by the generous offer of the Rockefeller Foundation to provide two million dollars (400,000*l.*) towards the cost of the building, on the understanding that the Government would accept the responsibility for maintenance, the cost of which was estimated at about 25,000*l.* a year. The appointment, in October 1923, of Dr. Andrew Balfour as director enabled definite progress to be made in the planning and organisation of the new school, the foundation stone of which was laid by Mr. Neville Chamberlain, Minister of Health, on July 7.

Such is the brief but honourable history of an enterprise representing one of the most important educational and scientific developments of our day and generation. For the London School of Hygiene sets a new standard in building and equipment, a standard worthy of the subject and of the Imperial city in which that subject is to be studied and investigated. The School is also the most important example—Oriental studies and history are other examples—of the new and proper method of organising higher instruction and research in selected subjects in London under the ægis of the University, a method which will inevitably be followed for many other academic and professional subjects if and when the University, through re-constitution, obtains the necessary powers and driving force.

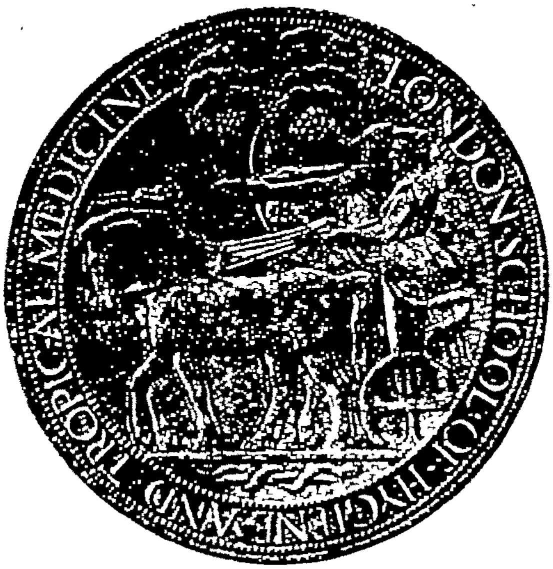

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE

FIG. 2.—The design of the seal adopted by the London School of Hygiene and Tropical Medicine owes its inspiration to a coin of ancient Sicily, believed to have been struck to celebrate the deliverance of one of the cities from a pestilence caused by the stagnation of the waters of the river. The design shows the deities Apollo and Artemis proceeding slowly in their chariot, Artemis driving while her brother, the sun-god, discharges arrows from his bow. The arrows are the healing rays of the sun, which drive away the malaria mists, and Artemis is beside him as the goddess who eases the pains of women labouring with child. The fruitful date palm has been added to symbolise the tropical side of the work, and at the foot is the serpent staff of Æsculapius.

The main frontage of the new building, of which an elevation is reproduced (Fig. 1), faces Keppel Street, looking southwards towards the impressive north façade of the British Museum, across the vacant site purchased by the Government for the University of London, and recently re-sold to the vendor, the Duke of Bedford. Return frontages, considerably longer than the main frontage, face Gower Street and Malet Street. The architects, Mr. P. Morley Horder and Mr. Vernon O. Rees, have produced a design combining simplicity and economy with dignity and the maximum of light and air. The building will be faced with stone drawn from Portland—the veritable womb of London. In addition to the teaching of hygiene in all its branches, provision has been made for tropical medicine, the London School of Tropical Medicine in Endsleigh Gardens having been amalgamated with the new institution. Altogether, the School will accommodate 250 students, including 100 students of tropical medicine. Routine instruction will be directed towards the various degrees and diplomas in public health, which form a necessary qualification for the public health service at home and abroad. The general shape of the building is a letter H closed at the south end by the Keppel Street frontage. The north court will be left open, and the south court will contain the lecture theatre. Ventilation, it is interesting to note, will be by 'natural' means, a provision for which those who have worked in buildings ventilated by 'scientific' methods will be grateful. Possibly, however, the School may itself devise new methods of ventilation, a worthy subject of hygienic research. One-sixth of the total accommodation will be reserved for research, the large lecture theatre and museum, as well as numerous class-rooms and laboratories, being regarded for the purpose of this computation as accommodation for teaching.

The division of the subject of hygiene adopted by the School has had reference to the regulations for the Diploma of Public Health, and is as follows: (1) applied physics, physiology, and the principles of hygiene; (2) chemistry and bio-chemistry; (3) immunology and bacteriology; (4) medical zoology, parasitology, and comparative pathology; (5) epidemiology and statistics; (6) principles and practice of preventive medicine, general sanitation, and administration. Dr. Andrew Balfour, in his interesting address to the Society of Medical Officers of Health on December 12, 1924, has explained the many ramifications of these subjects. Thus applied physiology includes nutrition, ventilation, illumination, physical exercise, not only in relation to adults. One of the most encouraging developments of recent years has been the increased attention to the special hygiene of infants and children. The hygienist approaches the realm of the educationist and psychologist in such questions as rest, sleep, and fatigue; the physiology of speech, reading, and writing; tests of intelligence. In his discussion of the position of chemistry, Dr. Balfour attaches little value, from the view-point of the training of the public health officers, to pure chemistry, but stresses the importance to bio-chemistry. "The future, in many directions, lies with the bio-chemist." In Division 3, the order "Immunology and Bacteriology" is deliberate. Division 4 relates mainly to tropical medicine. As regards Division 5, Epidemiology and Statistics, Dr. Balfour recognises the need for more stimulating teaching of epidemiology, and has a good word to say for the methods adopted at Johns Hopkins University, under Prof. Frost. He admits that statistics is a "difficult and deadly subject for any one who is not blest with a gift for mathematics." Division 6, though placed last, is the largest and most important of all. Not less than thirteen special courses are grouped under the main heading. The subject is so wide and is developing so rapidly that Dr. Balfour's hint that "refresher" courses may be arranged for medical officers of health will not cause surprise.

It remains to add that the planning of the building corresponds to this comprehensive programme. Full details are given in the *British Medical Journal* (July 10, 1926). The lecture theatre (the flat roof of which will be laid out as a garden-court) and the museum (occupying 15,000 feet of floor space) are important features of the building. The library, a large and imposing room 35 feet by 120 feet, occupies the place of honour in the front of the building. There is a "Publications Department," in which provision will be made for informative and propaganda work. The Chemical Division in the north-east corner of the building will accommodate 70 students and the biochemical and nutritional laboratory 35 students; and there is also a number of staff and research rooms and a class-room with 70 seats. The third floor is mainly occupied by medical biology, and will absorb the greater part of the work of the old London School of Tropical Medicine in Endsleigh Gardens. It is hoped that the building will be completed in two years.

T. LL. H

News and Views.

THE sixth annual report of the Forestry Commissioners (Sept. 30, 1925) is a document of considerable interest if only for the summary it contains of a forest policy recently enunciated by the Government. A century or two has elapsed since any Government in Great Britain can be said to have held definite ideas on the subject of what a forest policy for the country should aim at. The Government of the day has now publicly recognised that the development of such a policy is largely dependent upon State action continuously applied over a period of years, a point which has for long been beyond dispute in many European countries. It is further recognised that large areas of land in many parts of Great Britain are more suited to the production of timber than food, that private forestry should be encouraged by a system of grants, and that the systematic establishment of forest workers' holdings at the rate of 5 holdings per 1000 acres of afforestable land should be aimed at It may be said at once that this definition of the Government's opinions and aims in this matter is admirable. If persevered in, the progress of forestry should be assured.

THE total area of land acquired by the Forestry Commissioners to Sept. 30, 1925, was 286,198 acres, of which 177,633 acres were classified at the time of acquisition as plantable. Of the plantable area 100,244 acres (56 per cent.) are in England and Wales and 77,409 acres in Scotland. The Crown Woods, *e g* Forest of Dean, New Forest, and so forth have now been placed under the Commissioners. When the Commission was appointed it was laid down that 150,000 acres should be afforested in the first ten years. In the Acland Report the rate of planting per year was prescribed; 50,000 acres to be planted by the sixth year. This acreage has been slightly exceeded. In some respects the laying down of rigid planting prescriptions by area is unfortunate, since the effort to maintain the planting figure may result in poor or bad work and takes no account of possible losses from drought and so forth, experiences well known to all foresters. It also results in waste. For example, in the table of cultural operations in the 1925 report, 22,615*l.* is shown as expended on planting and 9526*l.* on beating up, *i.e.* filling up plantations in which deaths have occurred. This represents nearly 40 per cent. of the planting expenditure. Forestry, like agriculture, has to face unfavourable climatic factors, but the excessive expenditure alluded to above appears difficult to justify.

THE debate, which is a usual feature of the *Forum*, in the issue for August deals with the question "Is Civilization Contagious?" and is opened by Prof. Elliot Smith with a statement of the case for 'diffusion.' The argument proceeds on the lines which he has already made familiar in putting the case for Egypt as the place of origin and centre of diffusion of culture. The reply is by Dr. B. Malinowski, who argues ingeniously that the opposition between 'diffusion' and 'independent invention' is misleading. He maintains that 'invention' is not a single event for which one single individual is responsible, but a process consisting of a series of infinitely small, infinitely many, steps for which many individuals are responsible. Every cultural achievement is due to a process of growth in which invention and diffusion have equal shares. The familiar example of the 'diffusion' of a match he regards as futile because the match does not become an element of the culture of the native, but is merely a mechanical importation. So far Dr. Malinowski's formal answer to the 'diffusionist'—in effect a compromise which would commend itself to the average anthropologist, if not to the out-and-out upholder of 'independent invention,' should there be any such, whom Prof. Elliot Smith holds up to scorn. But Dr. Malinowski's quarrel goes deeper, and it is this which constitutes the real value of his contribution to the discussion. Only in the field, he maintains, can the problem be solved as a live issue and by functional analysis. Then it appears that every aspect of culture corresponds to a specific need of human nature, to the local environment, and to the general character of given civilisation. The problem is resolved then by the writer's conclusion that diffusion never takes place, it is always a readaptation. Culture is neither invented nor diffused, but is imposed by "the natural conditions which drive man upon the path of progress with inexorable determinism."

The Rothamsted Experimental Station has renewed its offer to Chambers of Agriculture, the National Farmers' Union, Students' Societies and the like, to supply, during the coming winter, lectures on a variety of subjects. These lectures are offered by way of supplement to the provision already made by county education committees and agricultural colleges covering the general field of agricultural education. Coming, as they do, from workers engaged on agricultural research, the addresses should prove of extreme interest to their hearers. The agricultural sciences have now become so highly specialised, and the volume of research published daily is so great, that there is a great field of exposition open to those whose duty it is to keep in touch with new things in the branch of research with which they are specially concerned. On the other hand, the director of Rothamsted may be assumed to be fully aware of the value to the experts themselves of direct contact with the actual workers on the soil. While it is true that the pursuit of knowledge should be the sole object of the research worker, that pursuit is in danger of becoming too academic when confined to the laboratory alone. The list of subjects upon which lectures are offered is some indication of the scope of work with which the Rothamsted Station deals. Following the transference of the workers in phytopathology from Kew and Manchester, the station now deals with every aspect of plant life in health and disease, as it concerns the farmer. It may be added that a recent addition to the roll of lecturers is Mr. C. Heigham, whose thoughtful articles on the business aspects of farming were, until recently, a feature of the Saturday page in a London journal. The main headings of the syllabus which accompanies the Rothamsted circular are: soil micro-organisms; agricultural botany; agricultural chemistry; soil physics; insecticides and fungicides; entomology and mycology.

The weather of August in the British Isles has just been dealt with by the Meteorological Office, in a tentative way, as a supplement to the *Daily Weather Report*, similar summaries being issued on the first day of each month. The promptness of the issue adds much to its value, dealing with facts while fresh to the memory. In many respects the weather of August this year is said to compare favourably with the average August weather. At Kew Observatory temperature and sunshine were both above the average, while rainfall was remarkably low—the lowest since 1899. During the last ten days of the month high barometric pressure spread over the southern districts, giving generally fine weather; at Kew there was no appreciable rain after August 21 until the early morning of September 1. About 12 hours' sunshine were enjoyed daily in south-east England on August 26–29, while day temperatures rose until August 30 when 83° and 84° were registered in London. Some abnormally high night temperatures were recorded during the latter part of the month. On the night of August 24–25 the thermometer remained well above 60° F. in many places, and did not fall below 65° F. in several parts of London. The mean temperature for the month at Kew was 64°·1, which is 2°·5 above the normal; winds were chiefly westerly and the barometer was high. Thunder only occurred on two days in London. The duration of bright sunshine at Kew was 207 hours, which is 20 hours more than the normal

The present status of long-range weather forecasting is dealt with by Prof. R. De C. Ward, of Harvard University, in an article written for the American Philosophical Society. The subject is being very actively considered not only in America but also in many of the European weather offices. Prof. Ward's purpose is to take stock of the subject rather than to offer any contribution to the discussion. He mentions that man's natural craving for advance knowledge of coming weather extends thousands of years back of any attempt at scientific weather forecasting. Allusion is made to the group of animal weather proverbs which have come into existence. Prof. Ward asserts that animals have no foresight which people credit them with, but these are simply characteristics of food supply and other conditions. Some credit is given to the very general forecasts based on sequences in the character of the seasons, but it is pointed out that just when a definite sequence seems to have started the chain is somehow likely to break and the sequence ends. With further and closer study something more definite may develop along this line. Allusion is made to the weather fluctuations associated with sunspot cycles, and it is stated that the results of these studies have not come up to expectations. A longer period generally recognised as having been fairly established is known as the Brückner 35-year cycle, but this may vary between 20 and 50 years. At present, and until such periodicities or variations are more fully understood, long-range forecasts definite and trustworthy cannot be based upon them. Prof. Ward, with high authority behind him, sums up the subject with the statement that the results reached are not yet generally applicable to definite seasonal forecasts, but there is, however, promise for the future.

Among the news items published in the *Bulletin for International Relations* (July) are the announcements of the adoption of the metric system in Greece on March 1 last, and of a decree of the Soviet Government for its introduction into Russia on January 1, 1927. A list of international scientific meetings to be held in 1927, 1928, and 1929 is also included. In 1927 there will be a congress of the International Institute for Cold, at Rome; a general assembly of the International Institute for Anthropology; a general assembly of the International Commission for the Investigation of the Air, at Prague; the sixth international Congress of Medicine, at Leyden; the seventh international Congress of Statistics, at Cairo; the fifth international Congress on Seed-Testing, at Rome, in May; the fifth international Congress of the Science of Heredity, in Berlin (the first international congress to be held there since the War); the second Australasian Medical Congress, in Dunedin (N.Z.), in February; and a congress of the International Association of Medicinal Hydrology, in Italy. In 1928 there will be held an international Congress of Mathematics (the first to be held since the Toronto meeting in 1924), and in 1929 the seventh American Scientific Congress, at San-José, Costa Rica. The bulletin concludes with the communication, already announced in our columns (July 3, p 21) that the International Research Council has decided unanimously to modify its statutes in order to make possible the adhesion of all States, without distinction; and to invite Germany, Austria, Bulgaria, and Hungary to join the Council.

AN important branch of engineering at the present time is the manufacture of water turbines and electric generators for operation in hydro-electric stations. In the July number of the *Journal of the English Electric Co.* an interesting account is given of a 25,000 horse-power water turbine which they have manufactured for the Sao Paulo Electric Co., Brazil, and which has now been running successfully for some considerable time in the Sorocaba Power Station. The station is on the river Sorocaba at a distance of sixty miles from Sao Paulo. The hydraulic power is converted by three 15,000 H.P. units, also made by the E. E. Co., and by this new turbine which acts in parallel with them. The new machine operates under a head of 670 feet of water and it has its rated output at 600 revolutions per minute. At full load the discharge of water is 400 cubic feet per second and the velocity of the water relatively to the vanes is 130 feet per second. As a very close speed regulation was desired the turbine guide vanes are closed in 1½ seconds when the load varies from full load to zero. The casing has the form of a logarithmic spiral. This gives a perfect intake vortex ensuring that the water all round the guide apparatus has the same entrance velocity. The formation of disturbing eddies is therefore avoided. The efficiency is about 90 per cent.

OUTDOOR switchgear, although in fairly common use in America and on the Continent in connexion with electric power transmission, is still rarely used in this country. The account given therefore by the English Electric Co., in the July number of its journal, of the switchgear the Company has erected in the open air for connecting the electric supply systems of the Preston and Blackburn Corporations by means of high-tension transformers and a 33,000 volt cable, is of interest and value. The two necessary sub-stations are almost identical. The switchgear is carried on a light steel structure supported by a concrete plinth on which stand four 2900 kilovolt ampere transformers, the ratio of transformation being from 6600 to 33,000 volts. On the low-pressure side the circuit is broken under oil, but on the high-tension side air-break switches are employed and are mounted with 'arcing horns.' The scraping action of the type of contact employed ensures the pushing away of any sleet or snow and thus renders the switches satisfactory for use under any weather conditions. The parts are so strong that the contacts can be separated even when they are frozen together. As this type of gear can be employed up to 110,000 volts, it is probable that it will soon become common.

THE National Research Council (U.S.A.) has published, in its reprint and circular series, an address on science and engineering by Prof. W. F. Durand, of Stanford University, California, in which the author deals in an interesting manner with a familiar theme—the nature and interdependence of fundamental and applied research. He points out that each element of material progress in civilisation is the final product of a vast number of interconnecting studies, all of which converge towards this product and have their source in fundamental facts or laws of Nature. He asserts that we can never get behind these basic facts, but he treads on somewhat debatable ground when he uses the term 'explanation' to connote description of phenomena in terms of basic concepts such as 'energy,' 'electrons,' and 'quanta.' As a good professor of engineering he believes that the results of fundamental research, and, indeed, that all knowledge, find their highest expression in terms of service to humanity; and he shows how certain types of industrial research are really fundamental, although all forms of research have their place as essential elements of progress. Engineering affords some excellent illustrations of the interdependence of academic and strictly utilitarian research, and the example of aeronautics, with its dependence on mathematics, physics, mechanics, thermodynamics, and chemistry, is a particularly happy one. In conclusion, Prof. Durand pleads eloquently for more intensive fundamental research in the United States, which he believes has been relatively neglected there.

MOST of the islands in the Azores are subject to earthquakes that occasionally attain destructive violence. One of the well-known centres, though not the most active, lies in the Horta district at the eastern end of the island of Fayal. In this zone a strong earthquake occurred on August 31. In Horta, hundreds of houses were completely ruined and there were few that remained undamaged. Heavy safes were thrown out of alcoves, steam boilers were displaced, and large fissures crossed the streets. Though the earthquake was felt in the neighbouring island of Pico and even at Ponta Delgada in the island of St. Michael, the disturbed area, as in most volcanic regions, seems to have been small, considering the strength of the shock at the epicentre.

THE following awards for the year 1926–27 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Company: Fellowships have been renewed to—Mr. H. S. Pink, University College, Nottingham, and University of Oxford (fellow, 1924–25, 1925–26), at the Massachusetts Institute of Technology; Mr. V. E. Yarsley, University of Birmingham (fellow, 1924–25, 1925–26), at the Polytechnic, Zurich; Dr. R. Campbell, Armstrong College, Newcastle-upon-Tyne, and University of Oxford (fellow, 1925–26), at the Department of Chemical Engineering, University College, London. Fellowships have also been awarded to—Mr. E. A. Bevan, East London College, University of London; Mr. R. M. Deanesly, University of Oxford; Mr. R. Edgeworth-Johnstone, College of Technology, University of Manchester; Mr. H. B. Spalding, University of Oxford. The Salters' Institute has also awarded fifty-one grants-in-aid to young men employed in chemical works to facilitate their further studies.

AN interesting addition has just been made to the exhibits in the electrical communication section of the Science Museum, South Kensington, by Messrs. Television, Ltd., who have lent to the Museum the transmitting portion of the original apparatus used by Mr. J. L. Baird in experiments which led him from the wireless transmission of outlines in 1925 to the achievement of true television nine months later, when, on January 27, 1926, the transmission of living human faces with light, shade, and detail was demonstrated before members of the Royal Institution. The subject of television was referred to in an article in our columns on July 3. The apparatus now placed on exhibition at South Kensington includes the original ventriloquist's head used in Mr. Baird's experiments, the revolving dial with lenses, the slotted disc which, revolving at high speed, interrupted the light reflected from the head, another revolving interrupter and the cell container with the aperture through which the flashes of light reach the sensitive cell.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant fishery officer in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary of the Ministry, 10 Whitehall Place, S.W.1 (September 20). Inspectors under the Agricultural Wages (Regulation) Act, 1924—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (September 24). A head of the Department of Commerce of the Witwatersrand Technical Institute—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (September 30). An assistant in the Essex Museum of Natural History, Romford Road, Stratford—The Principal, West Ham Municipal College, Romford Road, E 15 (September 30). An evening lecturer in botany at the West Ham Municipal College, Romford Road, E.15—The Principal (September 30). A pathologist to the Lancashire Asylums Board—The Clerk of the Lancashire Asylums Board, County Offices, Preston (October 1). Research chemists at the Chemical Research Laboratory, Teddington—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (October 7). An assistant master for engineering and workshop practice at the Kingston-upon-Thames Technical Institute—The Principal.

Our Astronomical Column.

SUSPECTED COMET.—Mr. Wilk, assistant at Cracow Observatory, who discovered a comet last year, has sent a telegram to the I.A.U. Bureau at Copenhagen announcing his detection of another cometary object of the sixth magnitude on September 1, $21^h\ 46^m{\cdot}0$ U T., in R.A. $15^h\ 53^m\ 12^s$; N. Decl. 3° 55′ (position referred to equinox of 1855). The motion was stated to be direct (that is, in the direction of increasing R.A.), and according to the wording of the telegram it reached the extraordinary amount of one degree in four minutes, but it is doubtful whether this is the correct interpretation. If so, the comet was very near the earth, and no forecast of its position is possible until more data are to hand. The writer of this note swept for a few degrees round the given position on September 4 without detecting any bright comet.

FIREBALL ON AUGUST 13.—Mr. W. F. Denning writes: "A large fireball was seen from various parts of England on August 13 at $9^h\ 13^m$ P.M. Among other places it was observed from Alford, Linc., Palling, Norfolk, Keynsham, near Bristol, and Derby. The meteor gave the impression of a brilliant rocket; for it illuminated the landscape and sparks followed the head along its somewhat lengthy course. As viewed from Derby it was described as being of an incandescent blue colour with a tail of similar tint and golden sparks. Another person says it emitted an intense bluish-white hue like lightning and that it vividly illuminated the country. I have compared the data and find that the radiant point is indicated at $303^\circ - 13^\circ$ near α Capricorni, and that the meteor traversed a path of about 84 miles, falling from 62 to 33 miles in height—velocity about 25 miles per second. The direction of flight was from south by east to north by west, and the meteor passed from over Huntingford to near Doncaster. The radiant point is a well-known one and has been often observed in July and August supplying slow and brilliant meteors."

THE PROBLEM OF 'ISLAND UNIVERSES.'—The true interpretation of spiral nebulæ, either as comparatively small bodies occurring merely as outlying members of our Galaxy, or, on the other hand, as very remote systems comparable both in size and nature with the Galactic system itself, still remains a matter of controversy. An important contribution to the problem is made by Dr. Hubble in the *Astrophysical Journal*, vol. 63, p. 236, in which a critical and detailed analysis is given of the naked eye spiral Messier 33, based on photographs taken with the great 100-inch reflector. The high resolving power of this instrument shows no difference between the images of so-called condensations and those of ordinary stars of the same magnitude. Ritchey's description of these objects as "nebulous stars" appears therefore to be no longer tenable. Numerous nebulæ, novæ, and variable stars have been discovered by Dr. Hubble in Messier 33, including 35 Cepheids. The distance as derived from the period-luminosity relation among the latter is about 263,000 parsecs. That this distance is of the right order of magnitude is confirmed by evidence from the novæ and from the luminosity function for the brighter stars. Dr. Hubble considers Messier 33 to be an isolated system of stars and nebulæ, far beyond the limits of the Galaxy; but as being more comparable in size and luminosity with the Magellanic clouds than with our own system.

Research Items.

Remission of Sins at the Shrine of a Moslem Saint.—A description of a fair at Pakpattan at the tombs of Bābā Farīd Shakarganj, which is quoted in the *Indian Antiquary* for August, contains several points of interest to the students of religious belief. The great attraction of this annual fair is the opening of the Gate of Heaven. On the death of the Bābā, who is credited in story with wonderful powers during his lifetime, it was published far and wide that whoever passed through his tomb between sunset and sunrise on the new moon in August would be forgiven the sins of the past year, and the fair was established for the benefit of the faithful attending at the tomb for this purpose. The fair is attended by worshippers drawn from districts so wide apart as the North-West Frontier and the United Provinces. On the final night when the gate is to be opened, all pilgrims collect outside the gates of the town, which are closed. On the signal by rocket that the sun is set, they are admitted to the town and all night long pass in single file through the tomb. At sunrise the door is shut. On one occasion the police used light switches to strike the people in order to hasten the movements of the crowd. The people, instead of avoiding the blows, courted them, and on inquiry as to the reason, it was stated that the switches represented the sword blades forming the legendary bridge between earth and heaven on which the feet of the faithful are cut, whereas the wicked fall between the gaps in the bridge into hell below. Those, therefore, who were hit by the police switches considered that they had had their feet cut by the swords of the bridge and were doubly sure of the forgiveness of their sins.

Intelligence and Family History.—Some interesting data bearing upon the question of how far superior intelligence is a family characteristic have been collected by Miss Grace Allen as the result of an investigation of 48 families to which belonged a number of children selected as the result of psychological tests by members of the Teachers' College, New York. The results have been published in *Bull.* 25 of the Eugenics Record Office of the Carnegie Institution of Washington. All the children were of exceptionally high character intellectually, and the study involved the more remote history of the family, present conditions, occupational and home ratings, physical and temperamental traits and birth conditions. Of these families 70 per cent. were Jews, and of these 20 per cent. of German extraction, and 10 per cent. more German on one side of the family. Only one child came of American stock on both sides, and in only three families were all four grandparents American born. As regards occupation, 70 per cent. of the fathers were professional men, and 25 per cent. did clerical or semi-intellectual work; 25 per cent. are college graduates, a frequency twelve times higher than in the population at large. Brothers and sisters and cousins tested for intelligence scored high. The fecundity was low, being about 0·8 of a reproducing child to each parent. First births occur twice as commonly as in the general population; but this is due to the fact that the intelligent groups have an exceptionally high population of first-born children only. The fathers are above the average age because this class marries late. Physically the families belong to a fine stock, being long-lived and robustly built. The children show few physical defects. In a preface, Dr. Charles B. Davenport sums up the results of the investigation as showing that the highest intelligence comes out of a stock that is highly developed on both sides.

Glass-making in Ancient Egypt.—The technique of the manufacture of glass vases in ancient Egypt is obscure. Sir Flinders Petrie has suggested in connexion with the examples discovered by himself at Tel-el-Amarna, the use of a rod and a core of sand dipped into melted glass, while Mr. Harry Powell in the "Encyclopædia Britannica" suggested alternatively that they were blown. Mr. James H. Gardiner in *Glass* for July considers that the true method of production must differ from anything that has yet been suggested, basing his view on the examination of a number of examples of the XVIIIth Dynasty. The softening or plastic temperature is about 900° C., not a great deal below that of good English flint glass. Some, however, have been drawn from material which would have needed quite 1000° C. to form. In the case of a fish-shaped vase from Tel-el-Amarna, the body is a well-melted blue soda metal with fine seeds. The tail portion is solid and has been made and ornamented first and then squeezed on to the soft body. The indentation of the flat-nosed tongs used for holding can be distinctly felt. The coloured-glass pattern was made by threading coloured glass on to the surface. Notwithstanding the weighty negative evidence of an absence of any indications of blowing tools or fragments showing clear inside surfaces, the author is strongly of the opinion that the glass objects of the XVIIIth Dynasty show the beginnings of fabrication of glass vessels by blowing, which afterwards developed into the blown ware of the Greek and Roman period. It is suggested that the fact that in all cases there was a circular opening in the neck showing abrasion, as if a metal rod had been introduced and withdrawn, may have been due to the use of a metal funnel to introduce hot sand while the material was soft, and that the object was then buried in hot ashes to cool slowly.

The Great Rift Valley.—In a paper in the *Geographical Journal* for August, on the Nyasaland section of the great Rift Valley, Dr. F. Dixey advances the view that in early Cretaceous or possibly late Jurassic times, the initial uplift in the Nyasa region took the form of a gentle anticlinorium, or large anticline, and that the more or less meridional troughs so produced were occupied eventually by rivers. At a later date rift faulting began, and continued intermittently through a large part of Tertiary and Quaternary times. Intersecting faults also extended into the regions bordering the main rift on both sides. The volcanic history of the area seems to have been largely confined to late Tertiary or early Quaternary times. Dr. Dixey finds no evidence to support the hypothesis of a marine sedimentary phase of Oligocene age. Lastly, he gives reasons in favour of the rift-faulting of the region being due to long-continued tensional stresses rather than to compression. These are the absence of thrusts and folds and the development of much block faulting; the occurrence of subsidiary rifts parallel with the main rift; the existence of a reticulated system of rift valleys; low-step faults extending into the middle of the rift valley floor; and the successive tilting of the floor of the northern end of the rift in one direction.

Tertiary Fossils from Japan.—No less than six papers on the tertiary mollusca of Japan, from the pen of Prof. Matajiro Yokoyama, appear in the first volume of the Journal of the Faculty of Science of the Imperial University of Tokyo. Most of these fossils come from the central districts of the main island of Japan, but some are from the oil-fields in the north-western part of the "Main Island of Hokkaido" (formerly known as Yedo). Prof. Yokoyama's communications total 87 pages illustrated by 19 plates, which are very good, but not quite equal to the efforts of the Japanese artist at his best. The text, beyond brief statements as to the position and age of the respective beds in which they occur, is confined to systematic descriptions of the species, many of which are described as new.

BAXTER BASIN GAS-FIELD, WYOMING.—Mr. Julian D. Sears contributes an interesting account of the geology of the Baxter Basin Gas-field, Sweetwater County, Wyoming, in *Bulletin* 781-B of the United States Geological Survey. This field was first proved in 1922 by the completion of two wells of large yield, previously, drilling on the Rock Springs anticline, of which the Baxter Basin occupies structurally the highest part, had resulted in little or no success; even now there seems to be small prospect of oil being found in commercial quantity. Gas is found in commercial quantity, however, in each of the three domes developed along the crest of the main structure, and is produced from the Upper Cretaceous Frontier and Dakota sandstones. Each dome has its own gas-pool, there being no single continuous pool common to all three as they are separated by structural depressions and by faults that offset the reservoir beds. Twenty-three wells had been drilled in this field up to the time of survey; these ranged from 1000 to 3400 feet deep, finding the Frontier sands at depths from 1800 ft. to 2000 ft., and the Dakota sands at depths from 2500 ft. to 3400 ft., according to the positions of the wells concerned. Some remarkable yields are recorded: one well gave 2,000,000 cubic feet per day from the Frontier and 70,000,000 cubic feet from the Dakota; another well found water in the Frontier but yielded 21,000,000 cubic feet of gas per day from the Dakota; other yields from the Dakota (unquestionably the richest sand in the field) are from 17,000,000 cubic feet to 35,000,000 cubic feet daily. Water occurs high on the flanks of two of the productive domes, thus leaving very little room for an intervening oil layer between it and the gas; this is one of the reasons dispelling any hope of commercial oil production from this field.

CYCLONES OVER CEYLON.—Cyclonic movements in Ceylon are dealt with by Mr. A. J. Bamford, the superintendent of the Colombo Observatory, in the *Ceylon Journal of Science*, vol. 1, part 1, in continuation of the series that have appeared in the past in the bulletins of the Colombo Observatory. Any discussion of the movements of cyclones wherever dealt with is of general interest, as cyclones are so decidedly the centres of action with respect to the weather both over land and sea. In the discussion several storms are analysed, and much information can be gleaned as to the main seat of control in that part of the globe. Other special features are dealt with in detail, especially the heavy rains over Ceylon of September 29-30, 1924, falls up to 12 inches being reported which occasioned floods in many places. The weather over the island at the time was of the usual south-west monsoon type; the fall of temperature on September 29 is said to be the result and not the cause of the rains. Maps are given showing the rainfall over Ceylon.

CLIMATOLOGY OF FALMOUTH.—Weather observations at Falmouth for the year 1925 and the mean values for 55 years, 1871–1925, have just been issued by Mr. J. B. Phillips, the superintendent of Falmouth Observatory. The observations are of considerable value, as they show great equability of the climate throughout the year. The mid-winter month January had the day maximum temperature between 50° F. and 54° F. on 24 days, and there was only one day with the temperature below 45°; the minimum or night temperature was only below 40° on six days and on three days was above 50°. The mean temperature for January was 3°·4 above the average. In November and December, when periods of exceptionally cold weather were experienced over Great Britain, the relation of Falmouth to other parts of the country is interesting. The mean temperature for the year was 51°·5, which is 0°·7 above the normal; the warmest months with relation to the average for 55 years were January and October, both of which exceeded the average by 3°·4. The total hours of bright sunshine in the year were 1819, which was 69 hours above the mean, and it was the highest for the year since 1911, when the sun shone for 2056 hours During the first six months of 1925, Falmouth had 43 per cent. of the possible duration of sunshine, while that for the British Isles was 35 per cent. For June, Falmouth had 77 per cent. of the possible duration of sunshine, while for the British Isles it was 50 per cent. The daily average sunshine at Falmouth for the several seasons was: spring 5·41 hours a day, summer 7·88 hours a day, autumn 4·33 hours a day, winter 2·36 hours a day. The total rainfall for the year was 49·77 in., which is 4·01 in. more than the mean. The outstanding feature of the year was the rainless period from May 29 to July 3, absolutely no rain falling in June, while the mean for 55 years is 2·24 in.

THE CRYSTAL STRUCTURE OF MAGNESIUM PLUMBIDE.—With the publication of J. B. Friauf's results on the crystal structure of magnesium plumbide (Mg_2Pb), in the *Journal of the American Chemical Society* for July 1926, the crystal structures of the three intermetallic compounds which magnesium is known to form with silicon, tin, and lead, are now completely determined. The plumbide, prepared by melting the calculated amounts of magnesium and lead under a protective layer of sodium and potassium chlorides, was ground to powder under kerosene, and a sample, covered with a little paraffin, rotated during exposure to radiation from a molybdenum target The powder diffraction pattern was photographed, and the unit cell found to contain four molecules. The position of the atoms corresponded with the calcium fluoride arrangement.

SPIRIT THERMOMETERS.—The August issue of the *Journal of Scientific Instruments* contains an article by Mr. W. F. Higgins, of the National Physical Laboratory, of considerable importance to the makers and users of spirit thermometers. It has been noticed that the readings of certain spirit thermometers when placed in melting ice have decreased with age at rates of the order of 1° F. per month. Experiment has shown that the decrease is not due to loss of spirit, through minute cracks in the glass or to change of volume of the glass, but to the presence of small quantities of acetone in the methyl or ethyl alcohol used in the instrument Ten per cent. of this impurity is sufficient to cause a lowering of the ice point at the rate of 1° F. every ten days for the first few months after the thermometer is made. The effect appears to be due to the polymerisation of the acetone under the influence of light.

Excavations in Kent's Cavern, Torquay.

AT the Southampton meeting of the British Association last year, a Committee was appointed to co-operate with the Torquay Natural History Society in investigating the important palæolithic site at Kent's Cavern, made famous by the researches of McEnery, Buckland, and Pengelly. For some time previously the future of the cave, which is in private ownership, and the possibility of dispersal to unknown destination of relics of antiquity which might be of the greatest moment for the early history of man in Britain, had been a source of anxiety to the local scientific society and to archæologists generally. It was hoped that the British Association Committee would be able to some extent to mitigate the dangers of the situation; but at the time of its appointment there seemed little hope of immediate excavation, and at the most it was hoped that it would hold a watching brief for archæology and ensure that any specimens of interest or importance to science which might come to light should, at least, be recorded and if possible made available for study. Early last winter, however, leave was obtained from the proprietor for a preliminary examination of that part of the cave known as the 'Vestibule.' Funds were raised from the British Association, the Royal Society, the Society of Antiquaries, and a fund for the employment of ex-service men; but the greater part of the work has been carried out voluntarily by members of the Torquay Natural History Society. A summary of the results of these excavations is contained in a report of the Committee which was presented at the Oxford meeting of the Association.

'The Vestibule,' which was selected for excavation on the advice of Prof. W. J. Sollas, is a chamber some 40 ft. by 32 ft., into which the northern entrance to the cavern leads. A trench was dug along the entire length of the northern wall slightly overlapping into the 'Sloping Chamber' and passing at its eastern end under the Magdalenian hearth discovered by Pengelly in 1866, which is known as the 'Black Band.' A beginning of a trench along the east wall in the direction of the entrance was also made The depth of the trench varies from 2 ft. 6 in. to 13 ft. according to the nature of the deposit. The area which produced the greater part of the finds was near the east wall. Heavy blocks of limestone were present throughout. At each end of the trench crystalline stalagmite has appeared at the bottom of the excavation, but it is too early to say if this represents portions of a stalagmite floor.

The cave earth is quite unstratified and the fauna identical with that found by Pengelly at the higher levels. No hearths or workshops were found, but 135 flints scattered here and there have been recovered. Nearly all are patinated a dull white. Omitting waste fragments and neuclei, they fall into two classes: end scrapers and 'blades,' the latter being about 80 per cent. of the total. The end scrapers are of the usual type with primary flaking along the length of the implement, terminating at the broader end in steep, fanwise retouches producing a convex scraping edge. The reverse is a flake surface. The implement is in the Aurignacian tradition. The 'blades' have primary flaking along the length of the implement with two facets meeting in a carinated median line, or three facets, when the central facet makes a flat ridge. This would appear to be an industry of simple unretouched blades, and corresponds to the implements collected by Pengelly from the higher levels. The absence of bone, horn, and ivory implements suggests that it is not true Magdalenian; the absence of Chatelperron and Gravette points that it is not true Aurignacian; and of burins that it is not either Aurignacian or Magdalenian. Certain similarities to Solutréan are probably intrusive. It is, however, certain that we have here a culture of Upper Palæolithic type.

The abundance of remains of the horse would indicate a steppe climate suggestive of the Aurignacian and Solutréan periods of southern France, but reaching England at a later date. The study of the fauna suggests that the cave earth was in process of formation when the upper part of the base level and the lower part of the middle levels were laid down in Mother Grundy's Parlour at Creswell, of which the upper middle level roughly corresponds to the Black Band of Kent's Cavern. The deposits recently examined in the Aveline's Hole in the Mendips seem to correspond to the granular stalagmite excavated by Pengelly.

In a skull found in a crevice outside 'the Vestibule' Sir Arthur Keith finds a close correspondence in the palate and teeth to those of the human jaw found in the granular stalagmite. It is brachycephalic and compares closely with two brachycephalic skulls found at Aveline's Hole, also associated with an industry of simple unretouched blades.

Irish Limnology.[1]

ALTHOUGH the study of lake life has received considerable systematic attention by other countries, especially on the Continent and in the United States, there had been no definite institution set up for that purpose in Great Britain or Ireland until the year 1920. It remained for the War to direct attention to our lack of knowledge of British lakes and their possible economic value; and, as a direct outcome of consultations at that time, a limnological station was established in August 1920 on the river Shannon, one mile from the northern end of Lough Derg, Ireland being considered the most suitable country in which to tackle the problem on account of its valuable inland fisheries and large area of fresh water.

The first report from the limnological laboratory by Mr. R. Southern and Mr. A. C. Gardiner, now before us, deals chiefly with the Crustacea in the plankton of Lough Derg and the river Shannon. The research, which included two full years, 1921 and 1922, was carried out with a thoroughness and attention to detail worthy of the greatest praise. Five to seven stations were worked with regularity, the positions being chosen so that information could be obtained on the plankton of the Shannon River itself and of the northern end of Lough Derg in regions outside and within the effect of the river's current and in special localities in which the effects of wind action might be shown. The technique of the plankton collecting was carefully worked out, and it is satisfactory to note that the results are based on collections made by horizontal hauls, although vertical hauls were generally taken at the same time. A great deal of attention was devoted to making these horizontal hauls as uniform as possible, and an ingenious method of drifting from an anchored boat until 100 yards of greased rope had run off a reel, and then rowing back through this 100 yards in a given time, was adopted, and ensured, so closely as is practicable, that fairly equal volumes of water were filtered on each occasion. Concurrently with the plankton collecting, observations were made of the following chemical and physical factors—temperature (air and water), wind, rainfall, water level, transparency of the water, hydrogen ion concentration, dissolved oxygen and complete chemical analysis of the water.

---

[1] "Fisheries, Ireland, Sci. Invest.," 1926, I. Reports from the Limnological Laboratory I. The Seasonal Distribution of the Crustacea of the Plankton in Lough Derg and the River Shannon. By R. Southern and A. C. Gardiner. Pp. 1-170 Plates I-XV. Text figs. 1-4.

Examination of the physical and chemical conditions has shown that Lough Derg differs from many lakes of which the features have been described on the Continent and in America, in that its waters are practically homogeneous from surface to bottom throughout the year, any evidence of a thermocline, and hence marked changes between surface and bottom oxygen content, being absent. This, in Southern and Gardiner's opinion, can be accounted for by the general shallowness of the lake (rarely more than 20 feet in the northern half, although the southern end is deeper with soundings as great as 119 feet), its narrowness, and hence continual change of the body of water flowing through it and the general mixing action of winds over the shallow water. In consequence, all the water of the lake is capable of supporting an abundance of living plankton organisms and of fish life. The ratio $\frac{\mathrm{Na}+\mathrm{K}}{\mathrm{Ca}+\mathrm{Mg}}$ is low: the phytoplankton is characterised by the relative scarcity of the Desmidiaceæ and dominance of the Diatomaceæ. This supports Pearsall's theory that if the above ratio is low the conditions favour the growth of diatoms, and, if high, of Desmids. It was also notable that large numbers of different species occurred together, at the same time, in great abundance. A further report on the phytoplankton is to be published.

The distribution of the crustacean plankton is considered from all aspects—seasonal and diurnal, both horizontally and vertically. In the horizontal distribution great stress is laid on the wind as a factor in causing irregularity, and the detailed discussion of the effects of winds is being kept for a subsequent report. Of the crustacea, *Daphnia longispina* was the dominant form, though *Bosmina coregoni*, *Leptodora Kindtii* or *Diaptomus gracilis* were most prevalent at times.

The importance of plankton crustacea as food for fish is discussed. Of the fish present in the lake, the Pollan, *Coregonus elegans*, is a plankton feeder throughout its whole life; these crustacea were also found to be an important constituent of the diet of the fry of pike, tench, rudd, bream, and perch. A correlation between the growth-rate of perch fry and the abundance of crustacea is given. It is interesting to see that to a certain extent big trout were also found to be feeding on plankton. The fact that these sporting fish will feed voraciously on small entomostraca is perhaps not generally known. In this respect it is interesting to direct attention to an experiment carried out at the Jersey waterworks showing the remarkable growth of young trout which fed on the abundant crustacean plankton present in the filter beds.[1]

It is sad to see that, after such a good beginning, the limnological station on the river Shannon is now closed down. It is necessary that such well-planned work should be carried out through the course of many years before the true significance of many of the seasonal changes in the plankton community can be fully understood and the foundations laid for a close study of the actual fish-producing power of these lakes.

Messrs. Southern and Gardiner have made an important addition to the many valuable works that have been published from time to time by the fisheries of Ireland.

F. S. R.

[1] "The Biology of Jersey Waterworks," by W. Rushton, P. A. Aubin, and A. J. Jenkins. Published by the Institution of Water Engineers, 1925.

Studies on the Origin of Cultivated Plants.

THE history of cultivated plants is a subject which has attracted many botanists; and numerous theories of their origin from one or more wild prototypes have been published. Until recently the conclusions of Alphonse de Candolle have been accepted with a minimum of critical revision. The great increase in genetical research and the marked desire of many geneticists to link their studies with other aspects of biology is, however, leading to renewed interest in the taxonomic and geographical history of our common cultivated plants. Much new material has been accumulated and a few geneticists are even devoting time to collecting in person cultivated, feral, and wild examples of the genera and species they are studying in experimental ground and laboratory.

Prof. N. Vavilov, Director of the Institute of Applied Botany and New Cultures, Leningrad, is well known in Great Britain by the numerous important works on genetics and allied subjects which he has published. In a paper which has recently been received [1] he deals in a decidedly original manner with the origin of the common cereals and a few other widely cultivated plants. The conclusions reached are very largely based on the researches carried out by Prof. Vavilov and his assistants in Central Asia and the Nearer East in the years since the War. In addition, many thousands of seed samples have been obtained from all parts of the world and grown at one or other of the experimental stations under the control of the Institute. While it is certain that many details have still to be discovered for all the groups studied, there is no doubt that important problems have already been solved, and that further applications of the new methods will aid in the elucidation of many obscurities in the past history of all species and races which have been so long in cultivation that not even archæological researches can alone prove their origin.

The law of homologous series, expounded by Prof. Vavilov in an able paper in the *Journal of Genetics*, **12**, 47, 1922, is applied here with the purpose of finding the geographical centre, or centres, of maximum varietal diversity within what is accepted as a "Linnean species." The data are set forth in tables and illustrated by exceptionally clear maps in the Russian text, to which is attached an almost full English translation. The results are comparable with the periodic classification of the chemical elements in that not only are the known variations classified, but also the existence of undiscovered varieties is postulated. In addition to the usual 'characters' of the taxonomist and morphologist, physiological characters, such as immunity to diseases and seasons of vegetative activity and of flowering, and cytological and genetical data are freely used. It was found that even for cultivated plants the variations are not haphazard in their geographical distribution, but that they occur about well-marked centres. The immense diversity of spring and winter forms of soft and club

[1] From *Bulletin of Applied Botany and Plant Breeding*, 16, 2, 1926, Leningrad.

wheats is concentrated in the mountainous districts of south-west Asia, while the polymorphism of the durum wheats is most marked in North Africa. Two centres of origin for the barleys are indicated in Abyssinia and south-east Asia. Cultivated oats are undoubtedly of polyphyletic origin, and five geographical and genetical groups are established. South-west Asia is recognised as the chief centre of diversity of rye. There is no reason to regard *Secale montanum* and *S. fragile* as progenitors of cultivated rye. Both oats and rye probably entered cultivation simultaneously and independently in different localities, primarily as weeds in crops of wheat and barley. Flax is referred to two principal groups: a large-seeded, large-flowered group connected with the Mediterranean, and a small-seeded, small-flowered one peculiar to south-west Asia. A third group may be centred in Abyssinia. It is shown that the mountainous districts of Asia and the Mediterranean region, being the centres of varietal diversity of nearly all the most important agricultural crops, were probably also the home of primeval agriculture.

The final paragraphs of Prof. Vavilov's stimulating paper form a fitting conclusion to this notice of his work: "Evolution proceeded in time and space, and only by coming near the geographical centres of the origin of forms, by establishing the links connecting species, shall we be able to master the synthesis of Linnean species (considering them as systems of forms). Only systematics and the knowledge of the geography of plants enable the geneticist to select consciously the initial forms for his crosses and to solve problems of experimental phylogenetics. The problem of the origin of species is thus considered as the problem of the origin not of separate varieties, which in Darwin's opinion differentiated into individual species, but of complex systems, such as are true Linnean species.

"As it follows from the above, the solution of the problem of the origin of species lies in a synthesis of thorough investigations of separate groups of plants by the differential systematical methods, by that of botanical geography (in the sense of establishing the centres of the origin of forms), and the methods of genetics and cytology. Only in using systematics, differential geography, genetics and cytology, can we find a way to the strongholds hiding the origin of species."

W. B. TURRILL.

University and Educational Intelligence.

LEEDS.—With the co-operation of the International Education Board of New York, an exchange of posts for the academic year 1926–27 has been effected between Prof. Otis F. Curtis, professor of plant physiology, Cornell University, Ithaca, New York, and Dr. W. H. Pearsall, reader in botany, the University, Leeds. Dr. W. H. Pearsall sailed for America in time for the International Congress of Plant Sciences, which was being held in Ithaca during August, and to which he communicated an account of his investigations of the aquatic flora of the Lake District, England. Prof. Curtis, who arrives in Leeds this month, has published interesting papers in many fields of plant physiology, but is best known for his work upon the channels in which food substances travel through the plant.

DR. NOEL J. G. SMITH, of the Department of Botany, University of Aberdeen, has been appointed professor of botany in the Rhodes University College (University of South Africa), Grahamstown. Dr. Smith was educated at the University of Edinburgh and at Cambridge.

BY the will of the late Sir John Williams, Bart., President of the University College of Wales and of the National Library of Wales, who died on May 24, leaving estate of the gross value of 123,742*l*., the residue of the property, which will amount to nearly 100,000*l*., is bequeathed to the two institutions of which he was president.

"MOTIVATION OF ARITHMETIC" is the title of a sixty-page report by Mr. G. M. Wilson, professor of education, University of Boston, published as Bulletin 1925, No. 43 of the United States Bureau of Education. It is based on some five thousand replies received from teachers in all parts of the country, and leads to the general conclusion that arithmetic, in spite of isolated attempts at motivation, is still largely a formal subject. Prof. Wilson's point of view is indicated by the question he urges teachers to think over: Should life be brought in to illustrate arithmetic, or should arithmetic be subordinated and become a means for the interpretation of life? There is, as he says, much work ahead for those who would realise the ideal of school work on a real life basis. Meanwhile his pamphlet with its examples of "actual life situations," of life situations used as a basis for school exercises, games, game devices, and other devices, representative of methods used by the most progressive and intelligent teachers in the public schools of the United States, will help substantially towards approximating school practices to his ideal. The bulletin is a good example of the levelling-up work undertaken by the United States Bureau of Education through making widely known among teachers the practices of the best.

THE report on the work of the Department of Petroleum Technology of the Sir John Cass Technical Institute for the session 1925–1926 has been issued. This department was established about five years ago to provide technical instruction for those engaged in or desirous of entering the petroleum industry. The courses include lectures on petroleum technology, on the properties, applications, and examination of petroleum, on the chemical and physical properties of petroleum, and on the applications of engineering, also mechanical drawing; provision is made for those possessing no previous knowledge of experimental science to take the preliminary course of elementary chemistry, elementary physics, and practical mathematics. The record for the session shows satisfactory progress, in the case of the petroleum lectures, Part 1, there being no less than 90 class entries engaged in all for 1343 'student hours.' The report comments on the educational value of kinematograph films of the petroleum industry, two of which were exhibited during the session; such films enable students "to see in true perspective the ramifications of the industry and the difficulties associated therewith." Those responsible for directing the work of this department deserve much credit for the valuable work accomplished in a comparatively short space of time. A strong feature of the organisation is the existence of the consultative committee composed of recognised experts in the industry; this committee is not only of use in advising on work-schedules, but, acting in liaison with the principal oil companies in London, it also ensures what is so vital in all academic treatment of petroleum technology—constant contact with the industry itself.

Contemporary Birthdays.

September 12, 1851. Sir Arthur Schuster, F.R.S.

September 14, 1849. Prof. Ivan Petrovitch Pavlov, For. Mem. R.S.

September 16, 1859. Mr. Basil Mott, C.B., M.Inst.C.E.

September 17, 1859. Dr. Frank Dawson Adams, F.R.S.

September 18, 1854. Sir Richard Tetley Glazebrook, K.C.B., F.R.S.

SIR ARTHUR SCHUSTER was born at Frankfort-on-Main, and he was educated at the University of Heidelberg, and at Owens College, Manchester. Professor of physics in the University of Manchester, 1888–1907, he was a secretary of the Royal Society from 1912 until 1919, and president of the British Association at the Manchester meeting of 1915. As chairman of the executive committee of the National Physical Laboratory for the six years' period, 1919–1925, Sir Arthur rendered important services, not only to the institution, but also to science in general. It is worthy of recall that in his article "Spectroscopy," in the "Encyclopædia Britannica" (11th edit., 1911), Sir Arthur remarks in a footnote that he believes he was the first to introduce the word 'spectroscopy' at a Royal Institution lecture. This discourse was delivered January 28, 1881, under the title, "The Teachings of Modern Spectroscopy."

Prof. I. P. PAVLOV, the distinguished Russian physiologist, is a foreign member of the Royal Society, and he was Nobel laureate in physiology and medicine for 1904. Prof. Pavlov's earlier researches related to the physiology of the circulation, and especially the nerve supply of the blood-vessels. Soon, however, he was concerned in chief with the physiology of digestion, establishing new methods of procedure in the examination of functions, and deducing conclusions which have proved of fundamental importance in the whole study and range of the subject. In 1915 Prof. Pavlov was awarded the Copley medal of the Royal Society.

Mr. BASIL MOTT received his early technical training at the Royal School of Mines. Mr. Mott was president of the Institution of Civil Engineers in 1924.

Dr. F. D. ADAMS is emeritus dean of the Faculty of Applied Science, and Logan professor of geology in McGill University, Montreal. Born in that city, he was educated at the High School there, graduating at McGill. He is Hon. LL.D., Toronto. Dr. Adams has conducted many researches in economic and experimental geology. An account of one of these (in collaboration with Dr. J. T. Nicolson), entitled "An Experimental Investigation into the Flow of Marble," was published in the *Philosophical Transactions* for 1901.

Sir RICHARD GLAZEBROOK, foreign secretary of the Royal Society, was educated at Liverpool College, and at Trinity College, Cambridge, graduating 5th wrangler. Sometime assistant director of the Cavendish Laboratory, he was afterwards principal of University College, Liverpool, from 1898 until 1899, retiring to become director of the newly established National Physical Laboratory, a post which he filled with acumen and distinction for fifteen years. He is now chairman of the executive committee of the Laboratory. Sir Richard was awarded the Hughes medal of the Royal Society in 1909. Author of a number of valuable text-books, the editorship of the "Dictionary of Applied Physics" is his latest service to scientific publications of permanent value.

Societies and Academies.

PARIS.

Academy of Sciences, July 26.—**Gabriel Bertrand** and **M. Mâcheboeuf**: Nickel, cobalt and diabetes. Injections of saline solutions containing small quantities of these two metals in some cases of diabetes proved to be without effect; in others, there was a marked improvement. Administered by the mouth, in one case of diabetes, the amount of insulin injected daily could be reduced by 25 per cent.—**Rateau, Leroux** and **Bourgeat**: The experimental determination of the coefficient of yield of tuyères working with a free flow.—Kyrille **Popoff**: The convergence of series in ballistics.—E. M. **Antoniadi**: Changes recently observed on the planet Jupiter with the 83 cm. telescope of Meudon Observatory. A detailed description of recent changes in the surface of the planet, with two reproductions of photographs.—Léon **Brillouin**: A general type of problems, allowing the separation of the variables in the undulatory mechanics of Schrodinger.—Louis de **Broglie**: Remarks on the new undulatory mechanics.—Lucien **Mallet**: The luminescence of water and organic substances submitted to γ-radiation. Under the influence of the γ-rays, water and certain transparent organic liquids exhibit a marked luminescence. The light from water contains ultra-violet rays of wavelength less than 3000 Å.U.—F. **Wolfers**: A probable action of matter on the quanta of radiation.—Pierre **Auger** and Francis **Perrin**: The distribution in space of the directions of emission of the photo-electrons.—Rodolphe **Berthon**: The projection and reproduction of reticulated photographs.—Pierre **Thomas** and Mlle. Mari **Sibi**: Contribution to the study of the structure of jellies. Organogels obtained with the benzoylacetal of sorbite.—P. **Dumanois** and P. **Laffitte**: The influence of the pressure on the formation of the explosive wave. From experiments ($2H_2+O_2$) with initial pressures from 1 to 6·5 atmospheres, the distance travelled by the flame before the explosive wave is set up diminishes as the pressure increases, at first rapidly and then more slowly.—Michel O. **Samsoen**: The dilatometric and thermal study of glasses composed of silica and soda.—Marcel **Laporte** and Mario A. da **Silva**: The mobility of the negative ions and ionisation currents in pure argon. From the results of earlier work, it was concluded that in perfectly pure argon the saturation current would be obtained with a much lower potential difference than in air: this prediction is now confirmed experimentally. The curves given show that saturation is obtained in highly purified argon at 50 volts, whilst in air, saturation is not reached at 1760 volts. The effect of impurities on the ionisation curve of argon is shown.—Georges **Denigès**: The action of hydrobromic acid and of the alkaline bromides in acetic acid solution on cupric bromide. A new cupric reaction. The reaction is based on the colour produced by the addition of a cupric salt to pure acetic acid containing some potassium bromide.—A. **Travers** and **Malaprade**: The constitution of solutions of molybdic acid. Solutions of molybdic acid contain a condensed acid, $4MoO_3 . H_2O$, which, by analogy with metatungstic acid, may be called metamolybdic acid.—R. **Cornubert** and Ch. **Borrel**: The action of benzaldehyde on cyclanones containing the groups $-CH(CH_3).CO.CHR-$ or $-CHR.CO.CH_2-$.—G. **Bruhat** and V. **Thomas**: The dimagnesium compounds containing the benzene nucleus. An account of the general reactions of compounds of the type $C_6H_4(MgI)_2$.—G. **Vavon** and **Jakeš**: The catalytic hydrogenation of conjugated double bonds. So far as concerns the addition of hydrogen by the catalytic method, the presence of a system of conjugated double bonds does not entail any special ease of hydrogenation, and does not permit partial hydrogenation in the 1 : 4 position. From this point of view, there are marked differences between the catalytic and nascent hydrogen methods of reduction. —**Marcel Sommelet**: A mode of preparation of tertiary amino derivatives of tertiary alcohols.—**V. Ipatief** and **B. Dolgof**: The hydrogenation of triphenylcarbinol and of phenylfluorenecarbinol under pressure. The end product of this reaction is tricyclohexylmethane $(C_6H_{11})_3CH$, the analysis and physical properties of which are given. The product previously described under this name by Godchot is shown to have been impure.—**L. Léger** and **F. Blanchet**: The grit formations of the isles of Port-Cros and of the Levant.—**E. Rothé**, **J. Lacoste** and **Mme. A. Hée**: Earthquakes in France in 1925. There were twelve earthquakes in France in 1925, only half the number in the preceding year. Details of the distribution and intensity are given.—**Lucien Mayet**: The fossil men of the Denise: the masculine frontal bone (the Frontal Aymard of the Crozatier Museum) at the Puy, Haute-Loire. A detailed study of this bone shows it to be clearly of the type *Homo sapiens*, and presents archaic characters in the suborbital region which are only found to-day in the most primitive existing race, the Australian aborigines.—**Michel-Durand**: The physiological rôle of the tannins.—**Antonin Němec**: A chemical method for determining the phosphoric acid requirements of agricultural soils.—**Mme. Anna Drzewina** and **Georges Bohn**: The influence of carbon dioxide on the sperm of the sea-urchin, as a function of the mass.—**Max Aron**: Experimental facts relating to the harmony of growth in the larvæ of frogs.—**Charles Dhéré** and **Elphège Bois**: The comparative study of the fluorescence of some natural and artificial porphyrins.—**Béguet**: The mechanism of agglutination (as regards *Br. melitensis*).—**R. Boyé**: The comparative action of quinine stovarsolate and chlorhydrate in quartian marsh fever.—**F. Rathery** and **Mlle. L. Levina**: The influence of salts of nickel and cobalt on some diabetic patients. Detailed accounts of the treatment and results with eleven patients.

August 2.—**Jean Perrin** and **Mlle. Choucroun**: The parallelism between the fluorescent power and velocity of reaction. Recent views on the production of fluorescence can be brought into line with the theory of Arrhenius (1889) on the existence of activated molecules. The velocity of destruction of a fluorescent body by a suitable reagent should be proportional to the average duration in the activated state, and consequently the probability of destruction of a given molecule should be greater at small concentrations than at high concentrations. Experimenting with methylene blue, it was found that (provided the *p*H remained constant) there was proportionality between the brightness of the fluorescence and the reaction velocity: changing from concentration 1/200 to concentration 1/1500, the brightness was multiplied by 10·5 and the reaction velocity by 11.—**J. F. Ritt**: Simplification of the method of Liouville in the theory of elementary functions.—**Akimoff**: The application of Fourier-Bessel transcendentals with several variables to the development in trigonometrical series of conditionally periodic functions.—**Mandelbrojt**: The trend of functions represented by Dirichlet's series and the growth of analytical functions round a singular point.—**Georges Alexitch**: The values of an analytical function taken on the circumference of the circle with radius unity.—**N. Podtiaguine**: The order of the growth of functions.—**S. A. Gheorghiu**: The theory of correlation.—**Mlle. St. Maracineanu**: Special actions of the sun on the radioactivity of polonium and lead. The experiments described appear to indicate that the solar radiation can cause the reintegration of radium E starting from radium F (Po), a reversibility in the radioactive series.—**Pierre Vernotte**: A regulator of E.M.F. and of current.—**A. Guillet**: The rectifying contact. A discussion of the theories of the action of the detector in wireless telephony.—**A. Dauvillier**: The telephote, an apparatus for television with the aid of vacuum tubes Preliminary experimental results. —**Eugene Laborde**, **Jean Bressolles** and **Léon Jaloustre**: The influence of some radioactive elements on the catalytic activity of certain proteo-bismuth precipitates. The catalytic activity of the radioactive proteo-bismuth compounds (towards solutions of hydrogen peroxide) depends on the nature of the radioactive element present and its concentration in the medium in which the precipitate was formed. Barium alone is not without influence. Some possible therapeutic applications are indicated.—**Mlle. Choucroun**: The radio-chemistry of fluorescent bodies. Certain fluorescent organic substances (such as methylene blue) dissolved in a reducing medium are destroyed when exposed to light. Some irregularities in the velocity of this reaction have been traced to the influence of the *p*H of the medium. On adding a buffer solution (sodium acetate) the irregularities are greatly reduced.—**A. Travers** and **Houot**: The thermal study of electrolytic lead. The allotropy of lead. The dilatometric study of highly purified lead gives results consistent with the assumption that there are three allotropic forms of lead.—**Robert F. Le Guyon**: A new general analytical method: volumetric analysis, using a centrifuge. In volumetric precipitation methods of analysis, for which no suitable colour indicator is available, the use of a centrifuge is suggested. —**J. Orcel**: An attempt at the classification of the chlorites. The classification is based directly on the analytical results, using four characteristic ratios: s, f, a, and c, where $s = SiO_2/R_2O_3$, $f = FeO/MgO$, $a = Fe_2O_3/Al_2O_3$, and $c = Cr_2O_3/Al_2O_3$.—**E. Passemard**: The alluvial terraces of the Euphrates and the prehistoric implements they contain.—**Henry Hubert**: First observations relating to (electrical) atmospheric parasites in Western Africa.—**Mlle. Laura Kaufman**: The effect of the heterogeneous embryonic juice on the rapidity of emigration of the cells and the first stages of growth of cultures of tissues.—**Paul Cambouè**: The prolongation of life in decapitated butterflies.—**Baptiste Roussy**: Unexpected and striking psychic facts manifested by a series of spiders of the genus *Epeira diadema* for keeping their webs in a vertical plane. These spiders attach to a line and lift to a distance from the soil heavy bodies (leaden wire, stones, snails), thus serving the purpose of maintaining the web vertical. In one case the weight of the lead was 0·27 grams and the weight of the spider lifting it was 0·05 grams.—**F. Henrijean** and **W. Kopaczewski**: Researches on the composition of the squill and its tonicardiac principle.

August 9.—**Jacques Chapelon**: The minima of quadratic forms.—**René Lagrange**: Legendre functions of the first species and certain associated functions.—**S. Piña de Rubies**: The arc spectrum of europium. Measurements made at the normal pressure, between λ3500 and λ3100.—**P. Budnikoff**: The activation of the inert varieties of calcium sulphate. Natural anhydrite and the calcium sulphate obtained by dead burning gypsum do not set in contact with water, but can acquire this property if certain catalysts (lime, caustic soda, ferrous sulphate, etc.) are present.—L. **Hackspill** and H. **Pinck**: The displacement of cæsium and rubidium by iron. The method of preparing sodium and potassium described in an earlier communication (heating in a vacuum with metallic iron to a temperature at which the vapour pressure of the alkali metal is of the order of one centimetre or mercury) has now been applied with success to salts of cæsium and rubidium.—F. **Bourion** and E. **Rouyer**: The determination by the boiling point method of the equilibrium constant relating to the formation of the complex compounds formed by mercuric cyanide.—André Job and Antoine **Cassal**: The preparation of a chrome-carbonyl by the intermediary of a magnesium compound. By the interaction of carbon monoxide and phenyl-magnesium bromide in ether solution and in presence of chromic chloride a chrome carbonyl is formed which can be isolated in colourless crystals. Analysis proves the compound to be $Cr(CO)_6$.—L. **Semichon** and **Flanzy**: The pectins of grapes and mellowness of wines.—Mme. Éliane **Le Breton** and Charles **Kayser**: The law of size and the respiration of tissues *in vitro* in the homeotherms.—J. **Pelosse**: The Entomostraceæ of the pelagic fauna of Lake Bourget (Savoy).—A. **Paillot**: Silkworm disease (*flacherie*) and its causes.

WASHINGTON, D.C.

National Academy of Sciences (Proc. vol. 12, No. 7, July).—G. H. **Parker**: (1) The inquiline fish Fierasfer at Key West, Florida. Specimens were found in the cloacal cavities of certain holothurians; the sea-cucumbers averaged 25 cm. in length and the fish about 9·5 cm. (2) The growth of turtles. Turtles, like alligators, show great fluctuations in rate of growth, some of them justifying their reputed slow development. Out-of-door conditions seem to speed up growth.—Edwin B. **Wilson** and Carl R. **Doering**: The elder Peirce's. The Peirce family, descendants of John Pers who arrived at Watertown, Mass., in 1637, has contributed three members to the National Academy of Sciences, a mathematician, a logician, and a physicist. A genealogy was published in 1880 and the present deductions are from it.—Edwin J. Cohn and James B. **Conant**: The molecular weights of proteins in phenol. Freezing-point determinations are invalidated by traces of impurities and of water. It is difficult to remove the last trace of water. Accordingly powdered anhydrous calcium chloride was added to the phenol solution, and it was found, using substances of known molecular weight, that the freezing-point is unchanged so long as the system contains the solid anhydrous chloride in equilibrium with its hydration products. Determinations with zein give no indication of dissociation into units of low molecular weight in phenol, and suggest that the true molecular weights of proteins in phenol, as in water, are high, as found by other methods.—Gilbert N. **Lewis**: The path of light quanta in an interference field. The objections raised by Tolman and Smith to the author's proposed crucial experiment are stated to be inadequate.—K. L. **Hertel**: Effects of an electric field upon the radiating hydrogen atom. The light from hydrogen canal rays is partially polarised, with the electric vector of the stronger component parallel to the beam. The other component is increased where the rays enter or leave an electric field.—H. D. Smyth and C. J. **Brasefield**: The secondary spectrum of hydrogen and the occurrence of H_3^+. Positive ions from a discharge tube are collected by a Faraday cylinder, and graphs can be constructed giving the relative concentrations of H^+, H_2^+, and H_3^+. Simultaneously with the measurements of ionic current, photographs were taken with a constant deviation spectrograph. It is then found that conditions favouring the production of H_3^+ favour the excitation of the Fulcher bands, especially those in the red.—G. W. **Giddings** and G. F. **Rouse**: Ionisation of mercury vapour as a function of the intensity of exciting light. Monochromatic light of wave-length 2536 Å.U. is used, and its intensity varied by fused quartz plates. For low pressures, ionisation varies as the square of the light intensity, suggesting a two-stage cumulative process.—R. C. **Gibbs** and H. E. **White**: Doublets of stripped atoms of the potassium type. The so-called regular and irregular doublet laws are extended to the stripped atoms of scandium, titanium, and vanadium, and the doublets predicted were found.—G. **Breit**: The electromagnetic mass and momentum of a spinning electron. Assuming a rigid surface distribution of charge and that its mass is entirely electromagnetic, the radius of the electron is of the order of 10^{-11} cm.; the peripheral speed may exceed the velocity of light, c, by a factor of 20. For stability and a peripheral speed of the order of c, there is some connexion between h, e, c, and m, showing that, approximately, electric charge is quantised.—F. **Zwicky**: (1) The quantum theory and the behaviour of slow electrons in gases. A formula is given for the deviation from rectilinear motion in the field of force of the atoms. (2) Transfer of energy from electrons to atoms.—G. A. **Miller**: Form of the number of the prime power subgroups of an abelian group.—Carl **Eckart**: The solution of the problem of the simple oscillator by a combination of the Schroedinger and the Lanczos theories. Schroedinger's equation, a quantum condition in the form of a variation principle, gives a set of orthogonal functions, and if these are interpreted as those entering into the Lanczos theory, the matrices of the Born-Jordan theory can be obtained.

Diary of Societies.

SATURDAY, SEPTEMBER 11.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Eastern District) (at Great Yarmouth), at 11 A.M.

TUESDAY, SEPTEMBER 14.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—J. A. Aiton: Steam Pipes for Super-High Pressure.

SATURDAY, SEPTEMBER 18.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern and Yorkshire Districts) (at Whitby), at 12.

PUBLIC LECTURE.

THURSDAY, SEPTEMBER 16.

CORDWAINERS HALL (7 Cannon Street, E.C.4), at 7.30.—H. Bradley: Michael Faraday—A Pioneer of Progress.

CONGRESSES.

SEPTEMBER 12 TO 18.

INTERNATIONAL CONGRESS FOR APPLIED MECHANICS (at Federal Technical University, Zurich).—Lectures by Prof. P. W. Bridgman, Prof. P. Debye, Prof. T. Levi-Civita, Prof. L. Prandtl, and Prof. G. I. Taylor.

SEPTEMBER 13 TO 17.

INTERNATIONAL CONGRESS OF PHILOSOPHY (at Harvard University, Cambridge, Mass.).

SEPTEMBER 14 TO 16.

INSTITUTION OF PUBLIC LIGHTING ENGINEERS (Annual Meeting and Conference) (at Newcastle-upon-Tyne).

September 15, at 9.30 A.M.—R. Davison: Presidential Address.—J. F. Colquhoun: The Improved Lighting of a City.—Major S. Cooke: Motor Traffic in Relation to Lighting (*a*) on the Highway, (*b*) on the Vehicle.

September 16 (Morning).—R. Beveridge: Variations of Hours in Public Street Lighting.—H. Dickinson: Electric Street Lighting in Liverpool.

SEPTEMBER 19 TO 26.

GERMAN SCIENTIFIC AND MEDICAL ASSOCIATION (at Dusseldorf)

SEPTEMBER 22 TO 24.

GERMAN RÖNTGEN SOCIETY (at Dusseldorf).—Discussions on X-ray Treatment of Inflammation, the Compton Effect, and Irradiation of the Ovary and Offspring.

SEPTEMBER 26 TO 29.

INTERNATIONAL CONGRESS OF INDIVIDUAL PSYCHOLOGY (at Dusseldorf).

SATURDAY, SEPTEMBER 18, 1926.

CONTENTS.

PAGE
Invention as a Remedy for Unemployment . . 397
Descartes' "Géométrie." By T. L. H. . . . 400
The Origin of European Culture . . . 401
Chemical Aspects of Life 403
Neoplasms 404
Our Bookshelf 405
Letters to the Editor:
  On the Phosphorescence of Nitrogen.—Prof. J. C. McLennan, F.R.S., H. J. C. Ireton, and K. Thompson 408
  Polarisation of Wireless Waves.—J. Hollingworth 409
  Plastic Deformation of Single Metallic Crystals.—W. E. W. Millington and Prof. F. C. Thompson 409
  The Ionisation Potential of O II.—I. S. Bowen and Prof. R. A. Millikan; Prof. A. Fowler, F.R.S. 410
  The Earliest Human Knowledge of Copper.—Dr. Percy E. Spielmann 411
  The Zoological Names *Simia*, *S. satyrus*, and *Pithecus* and their Possible Suppression.—Oldfield Thomas, F.R.S., and Martin A. C. Hinton . 411
  Lead Hydrogen Arsenate as a Mineral.—Dr. L. J. Spencer, F.R.S. 411
  The Anomalous Flocculation of Clay.—Dr. N. M. Comber 412
  Persistent Solar Prominences.—Albert Alfred Buss 412
  Spraying Crops from Aeroplanes.—G. Fox Wilson 412
  International Code of Zoological Nomenclature.—Dr. F. A. Bather, F.R.S. 412
Seven Decades of Botany. By Prof. F. O. Bower, F.R.S. 413
Power Alcohol and other Petrol Substitutes . . 416
Discoveries in the Gobi Desert by the American Museum Expeditions. By Prof. Henry Fairfield Osborn, For. Mem. R.S. 418
Observations with the Spectrohelioscope. By Dr. George E. Hale, For. Mem. R.S. . . . 420
News and Views 421
Our Astronomical Column 425
Research Items 426
Patent Office Statistics 428
The Royal Photographic Society's Exhibition . 430
Smoke Abatement Conference 430
University and Educational Intelligence . . . 431
Contemporary Birthdays 431
Societies and Academies 432
Diary of Societies and Congresses 432

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Invention as a Remedy for Unemployment.

MODERN industries have been made possible by a constant supply of new inventions, and the relation between invention and industrial prosperity is so intimate that by studying it carefully we may hope to find suggestions for a solution of the unemployment problem. An occasion for making such a study is afforded by the publication of the Report for the year 1925 of the Comptroller-General of the Patent Office, which is reviewed elsewhere in the present issue of NATURE: and we shall take as its basis the acute and convincing analysis of the problem which was given eighteen years ago by Mr. A. F. Ravenshear.[1]

Mr. Ravenshear showed that the two well-known types to which inventions tend to conform have entirely different economic effects. 'Originative' inventions, which create new demands, promote the absorption into new industries of unemployed labour. They only flourish under an efficient patent system, which promises to the pioneer an ultimate reward for the initial outlay and risk involved in their exploitation; and the patents granted for them can be roughly distinguished in statistics by their greater tendency to have a long life. On the other hand, 'intensive' inventions, which merely cheapen the supply for already existing demands, tend in so doing to create unemployment. Patent protection is by no means indispensable to their exploitation, for capital and organisation are already available for them in the industries in which they are to be incorporated; and the patents granted for them tend on the whole to have shorter lives than those for originative inventions, since they are of less value and are subject to more competition from inventions producing equivalent results. Mr. Ravenshear examined individually the patents surviving fourteen years from a sample year, and found that about 71 per cent. of the survivors could be assigned to the originative class.

The distinction may be emphasised by means of an example. The last twelve years have brought forth large numbers of originative inventions connected with wireless signalling: new branches of the electrical industry have arisen to meet the demand thereby created, and large bodies of skilled labour have found employment in consequence. It may be expected, however, that when the wireless art reaches stability, invention will concern itself mainly with the cheapening of the methods by which wireless equipment is produced. Unemployment will result, and if the labour thus set free is to be reabsorbed, some fresh development of the electrical industry will have to be created by means of fresh originative inventions. On the other hand, originative invention, although active in the wireless art, was during the War years largely diverted from the arts of peace. On the whole, therefore, there was a dearth of permanently useful originative inventions during that period, and it is to this circumstance that the present phase of unemployment may be largely attributed. If any doubt is felt on the subject, a comparison with the case of the wireless industry will afford conviction.

---

[1] "The Industrial and Commercial Influence of the English Patent System," by A. F. Ravenshear. (T. Fisher Unwin, 1908.)

This is precisely the situation which can be ameliorated by wise improvements in the patent system, the purpose of which is to foster originative as distinct from intensive invention. Bearing that distinction in mind, we can obtain guidance as to the nature of the innovations needed by examining how far previous enactments have succeeded in promoting the grant of patents destined to live for a long term, as contrasted with those of inferior longevity: for the latter comprise the less successful originative patents together with the majority of the intensive patents. It must be remembered that in the British and German patent systems, as distinguished from the American, the inferior patents are progressively weeded out by renewal fees, which must be paid on an increasing scale from year to year if a patent is to be kept alive throughout the whole of the available term.

The various factors which might be thought to affect patent statistics can be eliminated only by means of an elaborate analysis, too intricate and tedious to be reproduced here. Such an analysis would leave no doubt, however, as to the effect produced by the Act of 1902, which introduced an official investigation as to the novelty of the inventions patented, the investigation being made for the first time in 1905. As regards the patents destined to live fourteen years, this Act had the effect of raising their number from a fairly steady average in the neighbourhood of 500 to a steady average of about 1200 per annum. On the other hand, it had only a small effect on the number of patents sealed annually, and no systematic effect on the number destined to survive for five years but no longer. The accompanying table gives illustrative figures only. It must be read in the light of the fact that the official examination was first made in 1905.

It will be seen, then, that the effect of introducing some sort of official investigation into the validity of patents before grant was precisely that which a patent system ought to have: the production was stimulated of originative patents having sufficient merit to earn a long life, as opposed to intensive patents and those of inferior quality. The Act of 1883, on the other hand, produced, by a general easing of patent fees, an indiscriminate multiplication of worthless as well as of useful patents.

The effect of the official investigation must be attributed to the enhanced value which was conferred upon patents by increased confidence in their validity, and if we wish to encourage originative inventions, and still more to encourage the exploitation in Great Britain of originative inventions, we must clearly seek some further methods of giving the patentee and his patrons an improved assurance that a patent, when granted by the Patent Office, shall not run a really serious risk of being found invalid if it should be tested by litigation.

Year in which patents originated	1902	1907	1913
Number of patents sealed (excluding patents of addition)	15,242	16,172	15,970
Number lapsing after four years	9918	10,625	9385
Number destined to survive for five years only . .	1497	1441	960
Number destined to survive for fourteen years . .	596	1175	[1250]*

* Extrapolated.

At the present day more than 100,000 British patents are actually in force, and of these, fewer than 250 have ever been tested in the Courts. The Patent Office has investigated their validity so far as certain issues are concerned, but it has made no examination whatever as regards other important issues, and it is probable that a very large number of existing patents are bad in law. The Patent Office does not test the novelty of an invention by searching anywhere but amongst British specifications less than fifty years old, nor does it concern itself with 'prior user' or 'quantum of subject-matter.' Since, then, only a negligible proportion of patents ever have their validity fully tested, the effect of the remainder rests upon bluff. Litigation is so expensive that only the richest patentees dare undertake it, and in this situation the advantage lies entirely with the man of wealth and the large industrial companies. Now it usually happens that in the early stages of a new industry capital is hard to come by: the pioneers have no money to spare for fighting actions in the High Court, so that the high cost of litigation tends to defeat the main aim of the patent system. It favours intensive inventions, which abound in well-established and heavily capitalised industries, but it cripples the comparatively poor nascent industries which are based upon new originative inventions.

The Patent Office, then, cannot assure the patentee of the validity of his patent, because its investigation is incomplete: and the High Court will not assure him of it except at a cost which is prohibitive for men of moderate means. Can nothing be done to remedy this state of things? A detailed answer to that question would lead us into a highly technical discussion affecting powerful vested interests and admitting of legitimate differences of opinion, but certain broad lines of reform can be indicated as almost indisputably sound.

There is a gap between the legal area investigated by the Patent Office and that which is relevant to the validity of an invention. This gap can be narrowed by expanding the former or contracting the latter area, or both. To take the latter proposal first: it must be admitted that patents can at present be invalidated on grounds which are purely academic and out of relation with practical requirements. In particular, the mere publication of an idea in some long-forgotten specification or journal in a foreign language will invalidate the monopoly of a manufacturer who wishes seriously to establish plant for the practical exploitation of that idea. The law as to novelty, therefore, requires searching scrutiny and reform: it should be borne in mind that mere academic suggestions on paper are of far less service in the establishment of new industries than are the details of a practical method which has been reduced to a commercial basis by exhaustive experiment. Encouragement must indeed be given to the theoretical inventor: but at present he gets more than his share of encouragement as compared with the practical industrialist.

Confidence in the validity of patents can also be improved by extending the scope of the examination made by the Patent Office. In particular, it has already been shown in these columns (NATURE, July 25, 1925, p. 121; Aug. 1, 1925, p. 157) that the investigation for novelty which is made by the Patent Office examiners could, without any subsidy from the State, be made effective over an area equal to that in which the German and American Patent Offices undertake to search. For this purpose it might be necessary to encroach upon the heavy financial surplus which is realised by the British Patent Office every year, but there is no justification whatever for that surplus. So long ago as July 14, 1891, Sir Michael Hicks Beach admitted on behalf of the Government of the day that "he did not think that the country ought to look to the Patent Office as a permanent source of income," but the country has inadvertently done so ever since. Although it has been obtained without raising the pre-War fees, and by means of the admirably economical manner in which the Patent Office has been administered (see page 429 of the present issue), this surplus ought clearly to be used for the benefit of the patentees themselves. It should be remembered that, far from taxing invention, the United States considers it worth while to subsidise its Patent Office.

In the next place, patent litigation can be cheapened by extending the powers of the Comptroller-General and authorising him to deal with issues at present reserved for the High Court. His decisions would, naturally, be subject to appeal: but the poorer class of litigants could be safeguarded by the grant of certificates of validity which would secure them against heavy costs in the event of an appeal, and consequently against the intimidation which is at present practicable. The information obtained by means of a really extensive search for novelty would be of value to the Comptroller-General in deciding questions of 'prior user,' as to which he should also hear evidence. The issue of 'quantum of subject-matter' is entirely comparable with that of 'manner of new manufacture,' of which he is already empowered to dispose: and he might also settle actions for infringement where the damages claimed lie within some moderate limit. That the Comptroller-General and his agents are qualified to carry out these duties is beyond reasonable dispute.

The reforms which have just been mentioned would tend towards enhanced confidence in the validity of the patents granted by the Patent Office, and would diminish the extent to which the poorer are intimidated by the wealthier patentees. They would, therefore, presumably have an effect similar to that of the Act of 1902 in selectively enhancing the production of long-life patents for originative inventions: in this way they would make for the establishment of new industries based on newly created demands, and so would help to solve the unemployment problem. But this effect is conditional on one consideration of great importance. It is a fact that not much less than half of the patents granted by Great Britain are granted to foreigners (*ibid.* p. 428), and the question arises whether such grants tend, on the whole, to promote the establishment of new industries in Great Britain, or to hamper British manufactures in the interest of imports from abroad. The question is of vital importance, since such a very large proportion of our inventions are under foreign control. Legislation in this connexion is subject to various international agreements, but these do not necessarily affect all the participating nations equally, for Great Britain grants a specially large percentage of her patents to foreigners. The existing law makes apparently ample provision against the abuse of patent monopolies by foreigners; but how far it is evaded in practice, and how far its provisions are understood and utilised by British manufacturers, are questions which demand the most scrupulous and painstaking attention on the part of those who are responsible for the solution of the unemployment problem.

Descartes' "Géométrie."

The Geometry of René Descartes. Translated from the French and Latin by David Eugene Smith and Marcia L. Latham. With a facsimile of the first edition, 1637. Pp. xiii + 246. (Chicago and London: The Open Court Publishing Co., 1925.) 17*s.* 6*d.* net.

RENÉ DESCARTES (1596–1650), philosopher and mathematician, is of course universally regarded as the inventor of the method of co-ordinates in geometry; hence the common name for them, Cartesian co-ordinates. Yet, if it were a question of priority, a good claim could be put forward for Fermat (1601–1665), a contemporary, and an even greater mathematician; for, though Fermat's work "Ad locos planos et solidos isagoge" was not published until much later (1679), it was certainly conceived and perhaps written before 1637, the date of publication of Descartes' "Géométrie"; moreover, the method of co-ordinates comes out much more clearly in Fermat, and his analytical geometry generally is much more like ours than Descartes' is. Fermat's share in the new discovery nevertheless remained unknown until quite recent times, and the whole credit was given to Descartes by no less learned a geometer than Chasles, who, in a eulogy which now seems exaggerated, speaks of Descartes' doctrine as "prolem sine matre creatam" and one "of which no germ can be found in the writings of the ancient geometers." Anticipations of the method of co-ordinates are, however, as is now well known, to be found in Archimedes and Apollonius of Perga; the latter stated, for example, in words (without symbols), the fact that the locus of a point satisfying the equivalent of an equation of the first degree in two unknowns is a straight line, and the form in which he states the fundamental property of each of the three conics is the exact equivalent of the Cartesian equation referred to any diameter and the tangent at its extremity as axes. Descartes' actual achievement—and it was momentous enough—was to remove the impasse to which Greek geometry had come through want of notation, by introducing into geometry the unrestricted use of all the resources of algebra (then recently introduced into France from Italy) as a recognised and even indispensable auxiliary.

A mathematician of to-day who should turn to the "Géométrie" in the expectation of finding some sort of introduction to co-ordinate geometry such as is contained in our text-books would be disappointed. As Prof. Loria has observed in a recent study, there is a greater gulf between Descartes' work and a modern treatise on analytical geometry than there is between an ancient (*i.e.* a Greek) and a modern treatise on any other mathematical subject. Descartes uses his new method mainly for the purpose of investigating *loci* of a higher order than conics; he does not, for example, apply it to the geometry of the straight line or the circle. It is strange that the usefulness of the method of co-ordinates for elementary geometry appears to have occurred to no one for a long time. Lagrange saw it and illustrated it in a work published in 1773, but the first systematic exposition of elementary analytical geometry in our sense seems to have been given by S. F. Lacroix as part of his great work "Traité du calcul différentiel et du calcul intégral" (Paris, 1797).

It is not possible within the space of a review to describe fully the contents of the "Géométrie"; we can only notice a few of the outstanding features. Much of the work centres round "Pappus's Problem." This may be shortly stated thus. Given any number of fixed straight lines ($2n$, say, if the number is even, $2n+1$ if it is odd), suppose that from a point (P) not lying on any of them we draw a straight line to meet each of the given straight lines, at given angles respectively; if the lengths of these straight lines l_1, l_2 . . . are taken, and if (when their number is $2n$) the product of n of them bears a given ratio to that of the remaining n, or if (when their number is $2n+1$) the product of $n+1$ of them bears a given ratio to the product of the remaining n and another given length, it is required to find the locus of the point P from which the straight lines are so drawn. The Greeks solved the case of three and four lines (the locus being in general a conic) and also apparently (according to Pappus) one other case, and that not the simplest possible. Descartes in his second book shows how to solve a particular case of five lines, where four of the given lines are parallel and at equal distances and the fifth is at right angles to them, while they are all met at right angles by the straight lines drawn from the point the locus of which is required. Descartes solves this case by means of a curve constructed in a 'mechanical' way. Imagine a parabola and a point (L) fixed on its axis at a certain distance from the vertex. Suppose the parabola to move bodily in such a way that its axis slides on a given straight line, and suppose a ruler to move at the same time in such a way that it always passes through the point L and also through a fixed point A not lying on the straight line on which the axis of the parabola moves. The intersection of the ruler GL with the parabola at any moment determines a point C which lies on a curve of the third degree.

Descartes shows that the point required in the particular case of Pappus's problem lies on a curve of this kind. Again, he constructs two mean proportionals between two given straight lines, trisects any angle, and solves a cubic and a biquadratic equation by using one *parabola*, along with straight lines and circles, in each case. In his third book (as a final *tour de force*) he solves an equation of the sixth degree in which all the powers of the unknown are present with an absolute term; this he does by means of the intersections of a curve of the kind above mentioned with a certain circle. He does not generally write down or use the equations of the curves as such; like the Greeks, he simply supposes them drawn and then shows that the points of intersection supply a solution of the problem. His solutions, in fact, amount to the Greek procedure carried further by means of the additional resources which the unrestricted use of algebra puts at the disposal of the geometer for the purpose of determining the parts of the figures required. Incidentally, Descartes explains an algebraical method of finding normals to a curve which depends on the principle that, if a circle be drawn with its centre at the point on the axis where the normal meets it and passing through the point on the curve, the circle *touches* the curve at the point instead of cutting it; this means that a certain algebraical equation must have two equal roots, and the use of this fact enables the normal to be determined. Descartes also gives a construction for the normal at any point of the conchoid of Nicomedes without using algebra. He does not say how he discovered it, but it must evidently have been by considering the instantaneous direction of the motion of the point describing the curve, and resolving the motion into two components, in the same way as Archimedes must have determined the direction of the tangent to his spiral at any point, *i.e.* by a sort of anticipation of the differential calculus.

Descartes lays down a number of rules, in regard to the solution of equations, *e.g.* the 'rule of signs,' the method of increasing or diminishing the roots of an equation by any quantity (which enables us to get rid of the second term in an equation), and so on. He explains how, in order to solve a cubic equation, we should first, by considering the several factors of the absolute term, try to find a linear factor, as $x-a$, in the expression equated to zero; and similarly with a biquadratic. In the case of a biquadratic, if the expression equated to zero appears to have no linear factor, it may be possible to separate it into two quadratic factors; by the method of undetermined coefficients Descartes shows that the possibility of this expedient depends on the solution of a cubic in another unknown, y^2, where again we may be able to find a linear factor.

Descartes' notation is interesting. He started the fashion of using the last letters of the alphabet (especially x, y) for unknown quantities. He writes powers from the cube upwards as we do, but generally expresses a^2 or x^2 by aa, xx. He uses the signs + and −; equality he denotes by a sign like that for 'varies as' in algebraical text-books, but turned the opposite way. For the square root he writes $\surd$, for the cube root $\surd C$. A horizontal line above an expression serves as a bracket. Where the coefficient of a certain power of the unknown in an equation contains more than one term he writes the terms vertically, one below the other, with a bracket stretching from the top to the bottom.

We congratulate the Open Court Publishing Company on the idea of including this great classic in their series. We would only warn the reader that the translation must be used with caution, as it is in many places inaccurate and sometimes wholly misleading. Two examples may be given. Descartes says that the ancients (*i.e.* the Greeks) were much hampered in their explanations of things by the fact that they scrupled to use arithmetical terms in their geometry; the translators render "le scruple que faisoient les anciens d'user des termes de l'arithmétique en la géométrie" by "the considerations which forced ancient writers to use arithmetical terms in geometry," giving exactly the wrong sense. In another place Descartes says that, even if a certain change in the conditions were made, "ce point C ne laisseroit pas de se trouver tousiours en une ligne courbe, qui seroit de cete mesme nature," *i.e.* the point C would still always lie ("would not cease to lie") on a curve of the same kind; the translators say "the point C will not always lie on a curve of just the same nature."

The first edition of our treatise was originally published, not separately, but as the last part of the "Discours de la méthode," etc., in which it occupied pp. 297-413. The history of the copy from which the present facsimile was taken is interesting. It was first given by Descartes himself to his friend Letenneur, and it has Letenneur's signature as well as that of Chasles. Chasles gave the volume to Sylvester, who gave it to George Bruce Halsted, who again gave it to C. I. Palmer of Armour Institute, Chicago, by whom it was made over to the publishers. T. L. H.

The Origin of European Culture.

The Dawn of European Civilisation. By V. Gordon Childe. (The History of Civilisation Series.) Pp. xvi + 328. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1925.) 16*s.* net.

ADVANCE in our knowledge of the various stages of prehistoric culture in Europe has never been uniform. This was necessarily the case in the earlier days of archæological investigation, when the material was drawn to a large extent from chance discovery.

Even now systematic exploration can be pursued only to a relatively limited degree, and fortune may at any moment bring to light evidence which will affect fundamentally our conceptions of the course of events in any given area at some particular point of time. It is, however, a remarkable, but not necessarily a surprising, fact that our knowledge of the neolithic and succeeding phases of the prehistoric period, but especially the neolithic, should so long have lagged behind that of the palæolithic stage. It is not surprising, if only because the high antiquity of palæolithic man and the mystery of his phylogeny have appealed strongly to the imagination, and this has tended to stimulate and systematise research. Greater attention, it is true, is now paid to the period immediately following the palæolithic and the break in continuity, which it was once imperative to recognise, has been filled by the culture of the epipalæolithic or mesolithic age. But in the neolithic age itself and in the later periods, although there is no lack of material, frequently the conditions of discovery in surface finds or in isolated hoards and caches have precluded the study of the material in its more precise chronological relations, which is necessary for the full understanding of the lines of development and the trend of events.

The greatest check on progress in the study of later prehistoric times has been the lack of anything like a comprehensive survey of the material as a whole which would have attempted to systematise our knowledge at any given moment, and to indicate the gaps which should be filled by future research. The time is now ripe for some such comprehensive study, if, indeed, it is not overdue. Much is still obscure; and the important investigations of archæologists on sites themselves well known but often isolated, have still to a large extent to be brought into relation. For the epipalæolithic period much has been done, and gradually from the material which is accumulating from North Africa, Spain, southern France, the Baltic, eastern Europe, and even to a limited extent from Great Britain, it is becoming possible to build up a picture of the movements of culture and more dimly of peoples directly ancestral to modern Europe. Further, in the Mediterranean area the researches of Sir Arthur Evans and others in Crete and in Greece, by demonstrating the relations of Minoan Crete to Egypt, to Asia Minor, and to Libya, and between Crete, the Ægean and the Greek mainland, are establishing something like a trustworthy absolute chronology for this area which ultimately will serve at once as a touchstone and a divining rod for the rest of Europe as it becomes possible to work out in detail the interrelation of the various centres of culture.

It has been necessary to dwell at some length upon these conditions in which intensive study of certain areas and sites has been accompanied by too general a lack of correlation of results as a whole in order to emphasise the special merit and the value of Mr. Childe's "Dawn of European Civilisation." It is the first attempt to summarise and evaluate the evidence relating to the various problems of the later stone and early metal ages as a whole. It follows the development of culture as we know it in each of a number of centres—Crete and the Eastern Mediterranean, Hissarlik and the coasts of Asia Minor, the Western Mediterranean, Spain, the Steppes, the Black Earth region comprising the Ukraine, Eastern Galicia and Rumania, the Danube, Scandinavia, "where east and west meet," the Baltic, eastern Germany and Poland, the lake dwellings of Central Europe and the culture of the Alps, the Atlantic seaboard, with its megalithic culture, and Great Britain. Mr. Childe, takes his readers from the epipalæolithic down to about the middle of the Bronze Age. In his preface he gives his reasons for thus setting the limits of his subject and defines his theme as "the foundation of European civilisation as a peculiar and individual manifestation of the human spirit." With the genesis of the common substratum of human culture, therefore, he is not concerned. At once, however, he finds himself confronted with the problem of the origin of this civilisation with which he deals. Does it come from the Ancient East, or are all the elements of this culture to be found in Europe itself? Mr. Childe modestly deprecates the attribution to him of an attempt to present a final synthesis. He lays claim to nothing more than "an earnest attempt to survey all the facts as a whole." In the end he seems on the whole to incline to the former view. The evidence he adduces certainly is in favour of those who look to the East, and it points to south-eastern Europe as the line by which the distinctive forms of early culture have come to the centre and west.

In attaching the importance he does to the culture of south-eastern Europe, Mr. Childe holds what is both strategically and tactically the inner position. His conclusions are to a great extent based upon, and coloured by, his intimate knowledge of the culture of Erősd and neighbouring sites in the valley of the Alt, which is described here for the first time in English. Erősd is a site in the Alt Valley in Transylvania just west of the Carpathians, which lies in the Black Earth country, so called from the fertile deposit which overlies the loess, a site eminently suitable for early agricultural settlers to whom the oldest traces here of postglacial habitation are due. It was explored by the late Dr. Ferencz Laszlo, who brought to light remains of a high civilisation of the type which appears as an intrusion in Thessaly. The people of the Black Earth region produced a painted pottery, the ware of the Tripolje culture, which has led some archæologists to hope that these earliest inhabitants of the area might possibly be linked up with the early peoples of Mesopotamia, Elam, Anau in Turkestan, and their pottery brought into relation with the remarkable and characteristic painted pottery of these sites, which seems to extend as far afield as Honan in China. Mr. Childe holds that the culture of the Alt is the earliest in the Danube basin, and would regard it as the source of the culture known to archæologists as Danubian I. He has, however, no certain suggestion to offer as to the origin of the Erösd culture. So early a civilisation of high standard, with its knowledge of grain, painted pottery, copper and gold, offers a problem to the archæologist which is as dangerously tempting as it is momentous. Mr. Childe is fully alive to the dangers of over hasty attribution of an eastern origin, and with a fine impartiality points out the obstacles in the way—difficulties arising from both style and technique.

It would be tempting to follow with Mr. Childe the spread of Danubian culture along the Rhine into Belgium and France, of the culture of the Mediterranean into Spain, and the spread of the megalith along the Atlantic coast, but enough has been said to indicate the scope and quality of his book. Its extraordinary and, indeed, almost marvellous grasp of an enormous mass of detail, and its breadth and sanity of view in dealing with the larger problems, as well as the acute and critical judgment of the author, combine to make the "Dawn of European Civilisation" a contribution to prehistoric archæology of first-rate importance which will have a profound effect on future lines of study and research.

Chemical Aspects of Life.

Lectures on Certain Aspects of Biochemistry. These Lectures were given in the University of London during the Summer Term, 1925. By Dr. H. H. Dale, Prof. J. C. Drummond, Prof. L. J. Henderson, Prof. A. V. Hill. Pp. viii+313. (London: University of London Press, Ltd., 1926.) 12*s.* 6*d.* net.

THE attempt to interpret the phenomena of life in terms of chemistry resolves itself in practice largely into the study of the mutual reactions between living and non-living matter. Living cells exhibit the remarkable property of exerting chemical action upon certain components of their environment, and of assimilating and ultimately of obtaining energy from them. The terms 'machinery' and 'fuel' are often used—loosely, it must be admitted—to distinguish the assimilator from the assimilated, though there is evidence that the two are to a certain extent mutually replaceable, structural parts disintegrating to supply energy, and energy-holding materials being built up into the structure. The analogy is, however, quite a useful one so long as it helps us not to forget that the chemical phenomena of life are quite as much attributes of a particular physical state of matter as of a particular chemical structure. Both considerations are important, for life, like a flame, is a temporary shape set to an unceasing flow of matter of peculiar properties.

Life as a state of matter involves the conception of conditions of equilibrium which can only be maintained with expenditure of energy . . . it costs us something merely to exist, in more senses than one. The more delicate the state of balance, the more numerous and potent are the conditions which modify it.

The investigation of the chemical relationships of the equilibrium which is life is the main concern of biochemistry; for the equilibrium itself involves chemical reactions, and is subject to modifications by various chemical influences both from without and from within the cell. Advance in biochemistry, as in other sciences, is largely conditioned by the methods which are at hand for its pursuit. It follows, therefore, that while its main objectives are unaltered, certain aspects of biochemistry show periodic developments as a consequence of advances in the cognate sciences, or of special developments of technique which open up new lines of attack upon its central, unalterable, and perhaps insoluble problems.

The central mystery of life, from the chemical point of view, concerns the means by which oxidation and so energy liberation is effected, and it is fitting that such exponents of animal physiology as Dr. H. H. Dale, Profs. J. C. Drummond, L. J. Henderson, and A. V. Hill should present to us various chemical aspects of this fundamental problem. The control of the circulation in the capillary blood-vessels is a subject which owes much to the researches of Dr. Dale and his colleagues. The flow of blood to the tissues is largely controlled by chemical means in accordance with the need of the tissues for oxygen, more or less blood being made available by dilatation or by constriction of the capillaries.

One of the perpetual problems of biochemistry is the manner in which the living cells are enabled to satisfy their energy requirements by carrying out at low temperatures oxidative reactions which in the laboratory often necessitate the employment of high temperatures and powerful reagents. A considerable step in the elucidation, or perhaps, rather, in the transference to a different plane, of this problem, has been made of late, and has been discussed by Prof. J. C. Drummond. Two ideas have been introduced from the realm of pure chemistry, the importance of small amounts of inorganic catalysers, chief among which appears to be iron, and the part which is played by hydrolytic oxidation-reduction reactions and oxidation by dehydrogenation. Closely bound up with both of these questions is the rôle played by glutathione, and by inorganic and organic phosphates.

In the carriage of oxygen and carbon dioxide, the blood has long been known to have essential functions, but it is only recently that the researches of Prof. L. J. Henderson, of Harvard, have shown us by what a beautiful physico-chemical mechanism the functions of the blood in this respect are controlled. In reading his three lectures, one not only finds much new physiology, but one also appreciates that the subject is capable of exact mathematical treatment. The study of the means by which the blood adjusts itself to alterations in the external environment, and thus maintains constancy of the internal environment of the cells, has proved to be a very profitable one indeed, in the physiology of biological integration.

The environment of the living cell is naturally a matter of fundamental importance, and we are often apt to forget, as Prof. A. V. Hill says in his lecture, that in systems of such small dimensions, the alteration of the scale necessitates alteration in other scales, such as the time-scale, as well. Diffusion, for example, which we are inclined to regard as a very slow process, may occur with such relative rapidity as to modify the chemical reactions very considerably. Among the chemical reactions which take place in living cells, the formation of lactic acid, which Prof. Hill discusses in another lecture, is a very fundamental one. There seems to be little doubt that the formation of this substance, and its subsequent oxidative removal, stands in the most intimate connexion with the phenomena of muscular contraction.

Another focal subject in biochemistry is that of growth and nutrition, and the lecture by Prof. Drummond on the phosphates and on the vitamins shows how much has been accomplished in recent years in this direction. The establishment of vitamin D, which plays such an important part in the formation of bone, the relation of this to the action of ultraviolet light, and the part played by phosphates in the calcification of bone, all appear to be connecting up to form a new and most valuable chapter in physiology.

The proper integration of the various functions of the body is effected in various ways, Nature using any means at hand to achieve this result; the chemical co-ordination by means of the hormones is one means of great importance, and Dr. Dale treats of recent investigations of two hormones, the pituitary principles, and insulin.

One leaves this book with the feeling of having not only read matter of first-class importance, but also of having had it presented in an altogether fascinating manner. Biochemistry has certainly done much to deserve the high esteem in which it is held to-day.

Neoplasms.

(1) *The Nature of Tumour Formation: the Erasmus Wilson Lectures delivered before the Royal College of Surgeons of England, on Feb. 23rd, 25th and 27th, 1925.* By Dr. G. W. Nicholson. Pp. xviii+99. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1926.) 6*s*. net.

(2) *Malignancy and Evolution: a Biological Inquiry into the Nature and Causes of Cancer.* By Morley Roberts. Pp. 319. (London: Eveleigh Nash and Grayson, Ltd., 1926.) 18*s*. net.

THE mystery of new growths, their nature, treatment, and the possibility of prevention, has aroused more interest recently than at any other time in the history of medicine. For some years it has occupied the attention of research workers in every field probably more than any other of the great problems of disease. Innumerable facts and data concerning the subject have been recorded, yet we seem to be little nearer its solution than we were at the close of the last century.

(1) Dr. G. W. Nicholson, in the Erasmus Wilson Lectures of 1925 on "The Nature of Tumour Formation," has no new facts to place before us and no fresh discoveries to disclose. He brings what in our present state of confusion is of far more importance, a fresh point of view. Commencing with his own histological observations, which may be confirmed by any one with microtome and microscope, he attempts to establish a sequence of events of which the tumour is the last. He regards neoplasms as malformations arising in previously healthy tissues. All living cells possess the property of growth, and there is evidence that the power of multiplying to an excessive degree is potential in every healthy cell. Dr. Nicholson considers every tumour to be a manifestation of this excessive growth, to which absolutely healthy cells have been stimulated by some change in their environment. He sees in every cell of the new growth an effort on the part of that cell to be normal, *i.e.* physiological, in structure and function, and where it fails to be so, there is some inhibiting accident of position or environment, such as the absence of appropriate physiological stimulus to differentiation. It is in this point that his explanation differs from the theory of growth habit, in which it is postulated that the cells abandon their function for the purpose of proliferating.

In attempting a scientific explanation of neoplasms, Dr. Nicholson has disregarded all theories, perceiving that they are based on pure speculation. It may be alleged from some quarters that he has merely enunciated a new theory, but such a comment would be quite unjust. He has simply shown that in the sequence of events leading up to tumour formation, certain things happen in accordance with the general principles of physiology, biology, and embryology. With the reason for these happenings he is not concerned; little reference, mainly in an appendix to these lectures, is made to the nature of the change of environment which stimulates cells to proliferate, and in this connexion it is of interest to note that parasites are considered to be among the possible factors which can produce such a change.

It is evident in this book that one of the most important reasons for our failure to understand new growths is the lack of co-operation between the pathologist and the biologist. The former is blamed for his ignorance of the biological views concerning the constitution of living matter; the latter is criticised for his lack of appreciation of tissue reaction and adaptability under conditions familiar to every pathologist.

(2) With these censures in mind we turn with interest to the effort of the philosopher, untrained in the medical and allied sciences, to co-ordinate the observations of scientists and by reasoned thought to bring order out of chaos. Mr. Morley Roberts has approached the problem as an expert in no science save sociology, having to work on material provided entirely by others, and being at the outset of his researches quite unfamiliar with the structures and processes he proposed to investigate. Yet these apparently insuperable obstacles have by their very nature given him an enormous advantage over the scientific investigators, who, following their own isolated lines of work and thought in biology, pathology, or physiology, have attempted to solve mysteries requiring for their elucidation a clear perception of all three. We have previously had evidence that Mr. Roberts has mastered the general principles of these subjects, has acquired a sound knowledge of anatomy and histology, and possesses that clarity of thought which enables him to correlate the various features of the problem he sets himself. "Malignancy and Evolution" is a worthy successor to "Warfare in the Human Body."

In this work the author extends the views advanced in his previous book to cover the development of new growths. The aspect of the human body as a community similar to societies and nations, with tendencies to be checked and laws to be obeyed, leads him to conclusions very similar to those advanced in "The Nature of Tumour Formation." Aided by social analogies, he sees variation and disease as a breakdown of settled order, and concludes that disease and repair are essential factors of evolution. Neoplasms are regarded as manifestations purely of growth, resulting from the same mechanism which produces the liver and kidneys In this book we find suggestions as to the nature of the environmental changes causing cell proliferation; it is supposed that the community controlling factors are in a state of unrest and instability by reason of the rapid evolution of the race, and that this naturally results in variation and breakdown as it would in the life of a nation.

The author expresses acknowledgment for assistance in practical details to various scientific workers, including Dr. Nicholson; but the reasoning is entirely independent, and their conclusions concerning the actual mechanism of tumour development are related only in being confirmatory of one another. Mr. Roberts's views are well worthy of the attention of biologists and pathologists, and he is to be congratulated on the result of his efforts to shed light on a question of greatest importance to the human race.

Our Bookshelf.

Emotion and Insanity. By S. Thalbitzer. Translated by M. G. Beard. (International Library of Psychology, Philosophy and Scientific Method.) Pp. x + 128. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1926.) 7*s*. 6*d* net.

Dr. Thalbitzer's book is a psychological essay the material for which is provided by a study of the manic-depressive psychosis. It is a brief attempt to explain certain mental phenomena on a physiological basis. The author first considers the generally accepted division of mentation into the psychical elements of thinking, feeling, and willing, a classification which he rejects in favour of that of intellectual activity, feeling, and psycho-motor innervation. He thus defines the mind as that which thinks, feels, and acts. It is with the element of feeling that this book is mainly concerned. It is submitted that this function must, like the other two specific functions of the mind, have its own centre in the brain, a postulation which involves Dr. Thalbitzer in a very damaging and convincing criticism of Lehmann's dynamic theory of emotion. The suggestion that this localisation is in the occipital lobes, and the evidence offered in support of it, do not carry so much conviction, but they are comparatively minor points.

Dr. Thalbitzer's physiological explanation of emotion is based on three well-recognised physiological laws. The application of the law of specific energy of cells isolates the element of emotion to one definite part of the brain. The law of tonus, or continual functioning of cells, explains the presence in every psychic process of all three elements of the mind, a fact well emphasised in the mood-psychosis, where any of these elements may function to an abnormal degree. The law which limits the variation of function of a cell to increase or decrease confirms the observation that the differences between various feelings are quantitative.

Whatever the view taken of this fascinating explanation, there is one plea in this book which must be whole-heartedly endorsed. It is that psychiatric research should receive much more consideration in the effort to determine the nature of normal mental processes. The services rendered to physiology by pathology are well known; in the sphere of the nervous system and neurology they have been of first moment. Yet, apart from the very dubious conclusions drawn from the study of the hysteric and neurasthenic, psychology has learnt little from observation of the mentally abnormal. Perhaps this reproach applies more to psychology in England than elsewhere; in no other country is better provision made for the care of the insane; the field for research is correspondingly greater. If the hint from the Danish psychiatrist is taken, psychology may make even more progress during the next decade than it has in the last.

The 'Eötvös' Torsion Balance. Pp. 90. (London: L. Oertling, Ltd., n.d.) 21*s*.

WHEN a scientific instrument assumes a commercial value beyond its intended scientific use, trustworthy and detailed descriptions of its construction and of the method of its operation become scant if not altogether inaccessible. This class of instrument includes the Eötvos torsion balance, designed in 1888 by the Hungarian physicist, Roland Eötvös, for analysing the local anomalies produced in the normal gravity conditions by tectonic and geological abnormalities. Of this period, extensive literature is available both as regards construction of the balance and the results of measurements. But since the torsion balance proved to be one of the most useful instruments available for the location of mineral ore deposits, and a considerable refinement has been achieved in its design, trustworthy sources of information and details, from which an independent judgment could be drawn, have been deplorably lacking. The commercial necessity of secrecy by users of the torsion balance renders valuable observational data inaccessible for an indefinite period. The present book is the first comprehensive treatise on the balance published in any language, and it presents a host of informative details.

The subject is treated in two parts. Part 1 presents the theory of the balance, the derivation of working formulæ, the method of making observations, the relationship of the quantities derived, the classification of gravitational effects and computation and elimination of normal, terrain, and topographical effects. The second part embodies notes on the practical employment of the balance and recommends itself particularly to the physicist operating the instrument. These two parts, which comprise three-fourths of the book, constitute a concise and broad treatment of the balance and apply to any model of the instrument. The third part gives a description of the Oertling model, in which instrumental details are described and illustrated with commendable candour.

This book is no touchstone whereby, with the aid of the instrument, valuable mineral deposits or oil domes can be located in a trice. The collection of observational data is routine after a preliminary training, but the rational elimination of effects extraneous to those of the deposit sought and the correct interpretation of the results thus obtained are problems of considerable difficulty calling for skill and extensive geological experience. Yet even in these difficult matters, this book offers a safe and instructive preliminary guide. Messrs. Oertling and the authors are to be congratulated on producing this well-bound, well-printed and arranged pioneer text-book on the Eötvös torsion balance, a subject the treatment of which on the lines here adopted has been long overdue.

E. R. F.

A Psychological Study of Immigrant Children at Ellis Island. By Dr. Bertha M. Boody. (Mental Measurement Monographs, Serial No. 3.) Pp. vi+163. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 18*s*. net.

EXAMINATION of immigrants at Ellis Island has been stimulated by fervid political propaganda maintaining that north-western Europe is better than south-eastern, and by sob-stuff propaganda dilating the hardships of those rejected by the apostles of eugenics. Mental measurements now permit exact inquiry.

Those more than sixteen years of age are expected to read. The Army 'Alpha' test seems to show the superiority of the north European, but in terms of Army 'Beta' the Latins are less inferior. The problem has been to invent new forms of performance tests which can be set in dumb show to a mixed group "of an Arab, a Greek, an Italian, a Welsh boy, an Armenian and a Russian. The members of such a group do not talk together; but they laugh together and spur each other on" (p. 103). The invention of such tests running smoothly and in silence without pencil or interpreter has been the great achievement (p. 132). Picture completion, form board, button holes, drawing stars, Binet weights, card sorting, bow knot are among the tests used.

The conditions of the examination are not ideal. Imagine a crowd of children of all ages, unequally seasick, exhausted, frightened, excited. What "recognition of the general emotional upset" would they demand? Attendance at the Island school is optional, and there is much interruption.

The tentative conclusion is that there are great differences, but that these differences are individual and not traceable to ancestral race or state nationality. But the numbers tested—27 Germans, 22 Armenians, 27 Hebrews, 15 Poles, 19 Italians, etc., of divers ages—seem too small to admit of any conclusion.

Chinese, Japanese, and Indians do not appear on the eastern seaboard. If the immigrant Irish are a mixed sample, it must not be assumed that they are a fair sample of those left behind in Ireland or that the sampling will not change as they segregate and settle industrially.

The direction of progress seems to be in examination at the home port of departure, maintaining exclusion of lunatics and deficients, and reliance on mental measurements rather than national quotas.

The book may be commended to schoolmasters, missionaries, and employers of native labour.

HUGH RICHARDSON.

Directions for the Dissection of the Cat. By Prof. R. P. Bigelow. Pp. xii+47. (New York: The Macmillan Co., 1925.) 4*s.* net.

THE directions for the dissection of the cat are here so arranged that the whole operation may be carried out on a single specimen, and the aim of the book is to give the student a clear survey of the organism as a whole and not as a system of organs. With this end in view, the dissection starts with the skin and muscles of the ventral body wall and works steadily through to the spinal cord and brain. Organs and structures are dealt with as they appear in the course of such a dissection and not in systems. The directions are clear and concise; necessary emphasis on particular points is given by heavy type, and the drawings which it is desirable for the student to make are indicated in their proper place and sequence. A useful introductory chapter gives valuable information on the preservation, embalming, and injection of material. The author believes that the dissection of the cat is a very desirable introduction to a course of human anatomy and physiology, and would be a valuable part of pre-medical studies; also that the size of the animal and the ease with which it can be obtained make it a favourable object for such studies. In such circumstances this book would be of considerable service, but the absence of any figures limits the value of the book and necessitates its use only in conjunction with standard works on the anatomy of the cat which are adequately illustrated.

The History of Arithmetic. By Prof. L. C. Karpinski. Pp. xii+200. (Chicago and New York: Rand McNally and Co., 1925.) n.p.

THE purpose of Prof. Karpinski's book is to present the development of arithmetical knowledge as a vital part of the history of civilisation. Particular attention is paid to the material of arithmetic taught in American elementary schools and to the historical phases of that work with which the teacher of arithmetic should be familiar. The book also contains a bibliography of the early American text-books of arithmetic printed before 1800, and refers to many of the early popular treatises on the subject used in England.

The volume is mainly intended to appeal to a popular audience desiring some acquaintance with the development of arithmetic from the earliest times. Prof. Karpinski gives a very entertaining account, based on the larger treatises of T. L. Heath, T. E. Peet, and D. E. Smith, of the progress of arithmetical knowledge from ancient Egyptian times until the present day. He also gives many carefully chosen diagrams which add interest to the theme. Most school libraries would be enriched by a copy of the book.

A Practical Handbook on Rat Destruction. By C. Leopold Claremont. Pp. vi+180+6 plates. (London: John Hart, n.d.) 3*s.* 6*d.* net.

THIS book deals in an exhaustive and essentially useful manner with the problem of the rat. A brief introductory chapter on the characters and habits of the brown and black rats is followed by an account of the destruction of rats by trapping, hunting, and the use of gas, and of the various poisons most effective for the purpose. These chapters are very exhaustive and of great practical value. The author then deals with the Rats and Mice (Destruction) Act of 1919, and discusses in detail its various clauses and the responsibilities of owners, local authorities, and the Ministry of Agriculture in carrying out its provisions. He pleads for more whole-hearted co-operation between these parties in combating the rat menace. Chapters on the relation of the rat to public health and disease, and on a general survey of what has been done and what may be done in the matter of rat control, conclude a very useful book, which should be of great service, particularly to those officers of local authorities whose duties include the enforcement of the laws relating to the destruction of these pests.

Travel and Travellers of the Middle Ages. Edited by Prof. A. P. Newton. (The History of Civilization Series.) Pp. viii+223+7 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 12*s.* 6*d.* net.

THE contents of this volume, which is one of the series appearing as "The History of Civilization," is a course of lectures delivered in the University of London. The book does not profess to be a complete survey of the subject, but several of the lectures have been expanded and the editor has added an introduction on the conception of the world in the Middle Ages. The twelve chapters are by various writers, including Prof. M. L. W. Laistner, Prof. Claude Jenkins, Sir T. W. Arnold, Baron A. F. Meyendorff, Prof. E. Prestage, Sir E. D. Ross, Prof. A. Mawer, and Dr. E. Power. Those on Christian pilgrimages, Arab travellers, the routes to Cathay, and Prester John may specially be noted. Prof. Mawer, whose contribution on the Vikings has no references to authorities, apparently accepts the Norse voyages to Vinland, and does not mention the researches of Nansen and others with their conclusion that Vinland was a myth. The book has a few illustrations, but only two maps.

The Borderland of Music and Psychology. By Frank Howes. Pp. x+244. (London: Kegan Paul and Co., Ltd.; J. Curwen and Sons, Ltd., 1926.) 6*s.* net.

"ART and intellectual speculation are the two exceptional realms of the mind of which the psychologist finds it most difficult to give an account" (p. 147). Too much has been expected from psychology since it presumed to stand in its own right as an experimental science. Many who looked to it for immediate solution of age-long problems disappointedly turn away as from a charlatan. In doing so the valuable little that it already has to give is lost. The author, with sympathetic knowledge of current musical and psychological theories, has given a capable preliminary survey of an interesting no-man's-land lying between suspicious armed camps. If at times he laughs at both from the exalted heights of philosophy, we forgive him, for he never loses himself in the realm where the problem is of more importance than its solution, but ever returns to his theme with notes such as: "But this is not science, nor even musical criticism" (p. 142); "We step beyond psychology when, after saying what musicians and audiences do, we ask, 'What is music?'" (p. 40). R. J. B.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

On the Phosphorescence of Nitrogen.

BY the use of a tube of a type recently designed by Dr. Coolidge of Schenectady, and kindly shown in action by him to one of us, we have recently been enabled to extend our knowledge of the spectrum of solid nitrogen made luminescent by bombardment with swiftly moving electrons. The tube we used was provided with a window of thin nickel foil through which electrons under a potential of 125,000 volts were projected into the vacuum space of a german silver thermos flask of special design. The nitrogen was deposited and solidified on the inner wall of the thermos flask within the vacuum space, and the refrigerant used was liquid hydrogen.

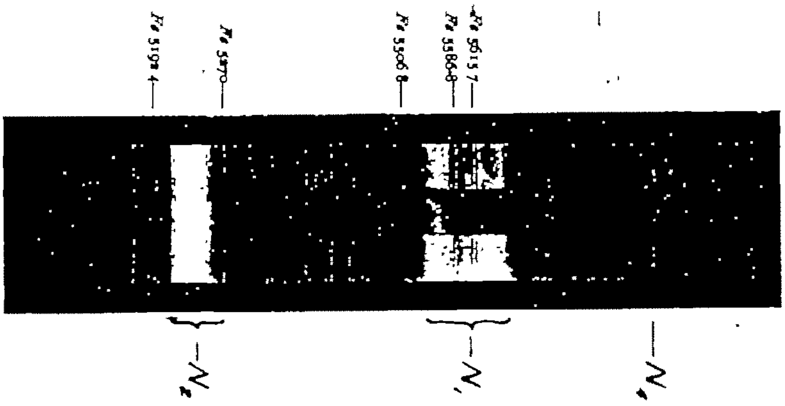


FIG. 1.

The luminescence of the solid nitrogen was observed in our experiments through a fluorite window in the outer wall of the thermos flask, and its spectrum was photographed with glass quartz and fluorite spectrographs. All wave-lengths measured and given below are in Ångström units.

Photographs of the spectrum of the light emitted while the solid nitrogen was being bombarded showed:

1. A single sharply defined narrow band (N_4) at λ 5945.
2. Three broad diffuse bands (N_1) shading each into the other with mean wave-lengths of approximately λ 5554, λ 5617, λ 5658.
3. A series of eight clearly defined bands (N_2) with the wave-lengths λ 5204·4, λ 5210·4, λ 5214·3, λ 5220·4, λ 5224·4, λ 5228·8, λ 5235, λ 5240; and
4. A number of faint diffuse bands each shaded off towards the red in the blue and violet spectral region between λ 4500 and λ 2460. Very approximate wave-lengths of the heads of these bands were found to be λ 4575, λ 4500, λ 4270, λ 3990, λ 3725, λ 3510, λ 3385, λ 3155, λ 2960, λ 2785, λ 2615, λ 2460. As regards these bands, some have been observed by Vegard already, and some, at least, appear to belong to the well-known second positive band spectrum of nitrogen.

Among a number of interesting results obtained by us, four are worthy of special note:

1. We failed to record on our plates, with twenty hours' exposure, any trace of a group of wave-lengths designated by Vegard as N_3 that were found by him to include one band at λ 6569, and one with its maximum intensity between λ 6320 and λ 6420. In this connexion it might be stated that our plates were highly sensitive up to λ 7000.
2. When the tube was in action and the solid nitrogen was strongly luminescent, we always found by visual observation that when the bombardment was interrupted, the wave-lengths of the group N_1 immediately disappeared from the radiation emitted by the luminous nitrogen, while the red band N_4 and the bands N_2 between λ 5204·4 and λ 5240 persisted some minutes, often very brilliant, but with slowly weakening intensity. Vegard has suggested that the groups N_2 and N_4 belong to the phosphorescence spectrum of solid nitrogen, and, as will be seen from the results given above, our experiments confirm this view.
3. As to the group of three bands N_1, we found that they were relatively strong when the solid nitrogen under bombardment had been freshly deposited. But with prolonged bombardment of a given layer of solid nitrogen, the intensity of the group of wave-lengths N_1 rapidly weakened and finally was scarcely sufficient to make the radiation observable. The intensities of the band groups N_2 and N_4, on the other hand, appeared to be unaffected by prolonged bombardment. Since exposures of long duration were required in photographing the complete luminescence spectrum, it was necessary therefore to deposit a fresh layer of solid nitrogen approximately every half-hour.

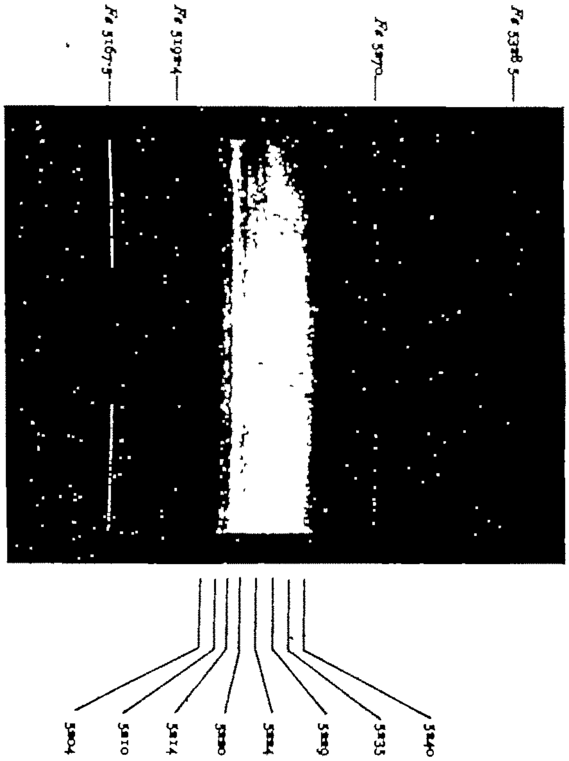


FIG 2.—Band N_2.

From these results it is clear that two spectra are obtainable from solid nitrogen, one of which includes the band group N_1, and the other the bands N_2 and N_4. This would go to show that solid nitrogen can exist in two forms A and B, the one, A, emitting the radiation constituting the band N_1, and the other, B, the radiation constituting the band groups N_2 and N_4. Our experiments support the view that the solid nitrogen is initially deposited in the form A, and that under electronic bombardment, and possibly otherwise, it is soon transmuted into the form B, this form B being the one that exhibits the phenomenon of phosphorescence.

4. The band group N_2 as originally observed by Vegard and by McLennan and Shrum, consisted of a single sharply defined narrow band at approximately λ 5230. This band has been found, however, to be more extensive than was originally supposed, for, as shown above, it is now known to consist of at least eight strong and well-defined members. Since no band of anything like this character has ever been shown to be a feature of the spectrum of the aurora, in the neighbourhood of λ 5230, it would appear that Vegard's theory that finely divided solid nitrogen exists in that portion of the upper atmosphere where auroral displays originate is not tenable.

The bands N_1, N_3, and N_4 are shown in Fig. 1, and the bands N_2 in Fig. 2.

J. C. McLennan.
H. J. C. Ireton.
K. Thompson (Student of Canadian National Research Council).

The Physical Laboratories,
University of Toronto, August 20.

Polarisation of Wireless Waves.

It is now generally accepted that many of the phenomena of wireless reception are caused by the interference between two waves, one of which has received reflection or refraction in the upper layers of the atmosphere. Considerable evidence is also now forthcoming of a fact which was suggested in earlier days; namely, that the reflection is not simple but that a vertically polarised incident wave may be returned with polarisation of a much more complex form. On this are based explanations of night variations in bearing, fading, and similar phenomena; and the subject has also been discussed theoretically by Appleton, Hulbert, and Nicholls and Schelling.

These investigators have confined their attention chiefly to wave-lengths of a few hundred metres at most, and there have been doubts as to whether the longer waves were affected in a similar manner. In a previous paper (*Journal I.E.E.*, No. 353, page 587) the present writer has referred to the elaborate but regular intensity variations occurring at medium distances on long waves during the sunset period, and recent experiments have shown that the cycle given by the transmissions from Sainte Assise (UFT) on 14,350 metres at Slough on page 587 is regularly accompanied by a definite cycle of bearing variation differing slightly in intensity from day to day, but always possessing the same general form. Variations of bearing of as much as 35° have been observed at times, showing that the departure from vertical polarisation must have been large.

Measurements were, therefore, made to see if any quantitative deductions could be made from these results.

Although it is theoretically possible to make use of bearing variations for such a purpose, the accuracy of observation is low owing to the non-silent minima which often occur, and it was found preferable to take three measurements of absolute electrical intensity: (*a*) in the plane of propagation; (*b*) in a vertical plane at right angles to this; (*c*) in any convenient intermediate plane from which the results can equally well be deduced.

In some cases it has been found that the intensity (*b*) actually exceeded the intensity (*a*) for short periods.

Now, in the general case of elliptic polarisation these results do not admit of any further solution, but by making the further assumptions: (i.) that second reflections are not present; (ii.) that the downcoming wave remains plane polarised but that the plane of polarisation is rotated, it is possible to deduce figures for this angle of rotation and for the coefficient of reflection.

Observations taken at Slough and Exeter under these conditions show that during the sunset period a rapid rise in the coefficient of reflection occurs and also a rotation of the plane of polarisation of at least 90°, most of which persists throughout the night. It remains to be verified whether assumptions (i.) and (ii.) are justifiable, though there is evidence in their favour; but the two chief facts which emerge from the tests are independent of them. These are:

I. Long waves as well as short may be elaborately polarised by refraction in the upper atmosphere during the night.

This effect is also present, though in a less degree, during daylight in the winter, and occasionally even during daylight in the summer.

II. The effect persists during the hours of darkness, remaining fairly steady after the sunset period is over; and consequently it cannot be caused by the mere temporary displacement of the reflecting surface from its normal horizontal position owing to the ionic recombination which occurs at sunset; but must be an essential feature of the mode of refraction.

Further experiments on this point are in progress, but as the solution requires the construction of a vector triangle the conditions have to be very carefully chosen in order to avoid indeterminate figures due to the limitations of the geometrical process. The experiments referred to above were carried out for the Radio Research Board of the Dept. of Scientific and Industrial Research. J. Hollingworth.

National Physical Laboratory,
Teddington,
August 31, 1926.

Plastic Deformation of Single Metallic Crystals.

Nature has published two letters from Mr. S. J. Wright and Dr. Goucher respectively (June 26 and July 31) in reply to ours of May 22 on the wedge formed when a single crystal of a metal is broken in tension. We desire in reply to stress most strongly the fact that our analysis of such a wedge is concerned with the final position of an atom after movement and has no reference to the path or the mechanism by which it arrived there. This concerns directly both of the communications.

Mr. Wright's insistence on the fact that the wedges examined by him were bounded by curved surfaces, means no more than that the ultimate displacement of the atoms of his test-pieces was greater in some localities than in others and has no bearing whatever on the validity of our treatment. His remarks *re* hard spheres are similarly wide of the mark, since we have not made assumptions of any kind as to the mechanical properties of the atom in its response to the stress.

Dr. Goucher's letter, however, is worthy of more serious consideration. His statement that our formula presupposes a type of slip which is inconsistent with experimental fact is surprising, since throughout our letter it was Dr. Goucher's own experimental results which were considered. It may be well, however, to review what assumptions were made. They were two, namely, that for a perfect wedge the atoms slipped on equidistant parallel planes and that the movement on these planes was equal. The only possible alternative to these assumptions would be that the slipping occurred on planes at different distances apart, but that then the extent of the displacement was in all cases proportional to the thickness of the slab of metal between one plane of slipping and the next. Such a supposition is so absurd as to carry its own refutation with it. Unless then all present ideas of the plastic deformation of metals are entirely inaccurate, and the displacement does not occur by slip, there is no alternative to the only two assumptions we have made.

Our analysis was concerned with one part of the wedge only, and there is no question of a difference in wedge angle between one half of the fractured test-piece and the other. Dr. Goucher emphasises what he had already found, namely that the wedges had an included angle of 39° or more than 50°. We are quite unable to see why he should imagine there is any difficulty in this, since not only have we considered the fact but have even offered a reasonable explanation of why it should be so. He complains further that we have not taken into consideration the fact that the larger wedge angles were found only with test-pieces whose {112} planes were slightly asymmetric with regard to the direction of the stress. The reply is clear. We have not been concerned with the explanation of the deformation of the crystal. All we attempted to do was to discover, when a certain deformation had been produced, what was the nature of the atomic displacement in the final wedge. That asymmetry of crystal is necessary for the production of a blunt wedge is merely an experimental fact which has no bearing on our analysis of the deformation when it had actually been effected.

We would point out again that our letter offered a reasonable explanation and, incidentally, the only comprehensive one yet suggested, of all the experimental results which Dr. Goucher has obtained in his most excellent experimental work. Until, therefore, something more satisfactory is offered it must take precedence over an explanation which, as a result as it seems to us of a perfectly arbitrary assumption, is capable of explaining half the results only, leaving the remainder as inexplicable anomalies.

May we in conclusion point out that in the formula in our original letter a misprint occurs, and that $2/\phi$ should be $\phi/2$?

W. E. W. MILLINGTON,
F. C. THOMPSON.

Manchester, August 24.

The Ionisation Potential of O II.

PROF. A. FOWLER has worked out (*Proc. Roy. Soc.*, 110, 476, 1926) with much elaboration the main spectral characteristics of O II, but has not been able to obtain the fundamental levels because the jumps to them produced lines which were below 700 Å.U. With our high resolution hot-spark spectroscopy for the extreme ultra-violet and assisted by the new methods of identification of multiplet structure recently worked out by Russell, Hund, Heisenberg, and Pauli, and applied by R. H. Fowler and D. R. Hartree (*Proc. Roy. Soc.*) to the classification of Fowler's O II terms, we have succeeded in accurately fixing these fundamental levels as is shown in the accompanying table. Russell assisted us in this search by placing at our disposal his unpublished identification of the quartet p'' level, which should replace the x_2 level in Fowler and Hartree's classification.

The knowledge of this ionisation potential of O II should be useful in fixing the temperatures of certain stars.

I. S. BOWEN.
R. A. MILLIKAN.

Norman Bridge Laboratory of Physics,
California Institute of Technology, Pasadena.

TABLE I.

Series Lines of O II.

Int.	λ I.A.Vac.	ν	Δν	
		Quartet System.		
1	429·97	232574·4		$as - p''$
3	539·067	185505·7	157·1	$as - ap_3$
2	539·524	185348·6	107·5	$as - ap_2$
1	539·837	185241·1		$as - ap_1$
		Doublet System.		
0	440·51	227010·		$x - bp''$
1	441·97	226260·		$x - cd'$
2	481·56	207658·		$x - bd'$
2	484·00	206612·		$x - ap''$
2	485·56	205948·		$x - f$
4	616·325	162252·	185·	$x - 2p_2$
4*D*	617·030	162067·		$x - 2p_1$

Term Values.

$x(p' \text{ or } d) = 256202\cdot$

Assuming $ap_2 = 97100\cdot$[1]

$as = 282605\cdot9$

This corresponds to the ionisation potential 34·88 *volts.*

To the foregoing interesting communication, I think it may be usefully added that the designations and values of all but one of the doublet terms, apart from x, are those given in the paper by myself to which reference is made, namely:

$$\begin{cases} ap_2'' = 49590\cdot80 \\ ap_1'' = 49476\cdot81 \end{cases} \quad \begin{cases} bd_3' = 48618\cdot42 \\ bd_2' = 48565\cdot45 \end{cases} \quad \begin{cases} 2p_1 = 94132\cdot52 \\ 2p_2 = 93952\cdot53 \end{cases}$$

$$\begin{cases} bp_1'' = 29231\cdot39 \\ bp_2'' = 29229\cdot03 \end{cases} \quad \begin{cases} cd_3' = 29974\cdot67 \\ cd_2' = 29972\cdot55 \end{cases}$$

The f term ($= 50273\cdot5$) was afterwards provisionally identified as such by Fowler and Hartree from lines which I had somewhat doubtfully indicated as involving a term xd_3'. The writers of the letter appear to have overlooked the fact that Fowler and Hartree had already identified my x_2 term as the unresolved first p'' term of the quartet system.

While the value indicated for the as term is probably not much in error, it should be understood that the value of ap_2, on which it depends, remains somewhat uncertain. A Rydberg formula for ap_2 and bp_2 gives $ap_2 = 98850$, but this can only be regarded as an approximation, since only the first two terms of the sequence are known. A more trustworthy value would result if intercombinations between the doublet and quartet systems could be traced.

A. FOWLER.

---

[1] A. Fowler assumes $ap_2 = 100{,}000$. We have changed to the foregoing value in order to bring the Ritz formula for the sequence of ap and bp terms into better agreement with that for the corresponding terms of N I.

The Earliest Human Knowledge of Copper.

THE first discovery of metals by man is usually described as having resulted from the association of the necessary materials in the construction of a primitive hearth on some chance occasion. At best, this explanation does not contradict our accumulated knowledge about the habits and conditions of early human life.

There seems to me to be quite another possibility, not necessarily antagonistic to the earlier one, which is the outcome of a recent communication from Sir Flinders Petrie (*Ancient Egypt*, June 1926) on the Egyptian Paradise. He directs attention to the remarkable similarity of the place-names, the geography, and the "lakes of fire . . . in the midst of the paradise of cultivation" in the "Book of the Dead," with those of a definite region in the Caucasus —that along the rivers of the Iora and Kura. Then, following the normal lines of archæological argument, Sir Flinders suggests the possibility of the earliest Egyptian immigrants having come from that region.

It is known that some later arrivals, the earliest dynastic peoples, suddenly appeared in Egypt, equipped with a written language and with a knowledge of the working of metals, and of agriculture. If these constituted a later wave of wanderers from the same locality—just as there were several eruptions of tribes out of Arabia—they would bring with them knowledge naturally obtained from their home surroundings.

Copper occurs widespread throughout the Caucasian area. So also does petroleum; and the very locality in which Sir Flinders Petrie locates two lakes of fire and "a place of purification, probably by fire" from indications in the "Book of the Dead," is to-day occupied by an area of considerable richness in petroleum.

At one spot in a recent map ("Handbuch der regionalen Geologie," vol. v. pt. 5, heft 25, "Kaukasus," by v. Stahl, 1923) copper and petroleum are shown as being to-day in close proximity. But there must be and must have been innumerable seepages of oil over the whole area, so that many other points of intimate contact between copper and petroleum must have existed since remote times.

This being so, when a petroleum spring or lake became ignited, as is known occasionally to have happened, there is the greatest likelihood of the adjacent copper being reduced by the high temperature of the reducing flame to the metal itself, to be discovered by man at some later date.

This suggestion is supported by the fact that copper was in use very early in the history of the country that is now known as Iraq; this is also a petroliferous region, as is shown by the presence and use of bitumen from the earliest times.

It would be interesting to speculate on local results when other minerals were smelted in the same natural fashion, including the effect of the liberation of large quantities of arsenic or arsenic oxide over the surrounding country. PERCY E. SPIELMANN.

The Athenæum, August 19.

The Zoological Names *Simia*, *S. satyrus*, and *Pithecus* and their Possible Suppression.

UNDER the above heading in NATURE of July 10, p. 49, Dr. C. W. Stiles gives a summary of the argument in support of a proposition to re-open the case of *Simia* before the International Commission on Zoological Nomenclature. Although in agreement with most of the general principles enumerated in his summary, we dissent from the view that the names *Simia*, *S. satyrus*, and *Pithecus* are ambiguous and "so confused in zoological literature as to preclude hope of reasonable uniformity in their use in zoological, bacteriological, serological and public health work."

With regard to *Simia* for the orang, the name is supported by the many mammalogists who signed the list of "Nomina Conservanda" published in the *Proc. Zool. Soc.*, London, 1924, p. 345. It is consistently used by naturalists in general. To suppose that bacteriological and medical writers (at all events those on this side of the Atlantic) would accept and use such a completely unknown name as '*Pongo*' for the orang is to show ignorance of the mentality and prejudices of the very workers for whose benefit the argument is professedly framed. For such writers, past, present, or future, *Simia satyrus* is the name of the orang, free from all ambiguity whatsoever, and with that widely signed "Nomina Conservanda" list to support them they would certainly regard '*Pongo*' as 'Jazz'—and go their old way.

The fact that Dr. Elliot, in his bulky work on Primates, has used another name, would seem to have unduly influenced those who framed the argument outlined by Dr. Stiles; but unfortunately that work is so full of errors that as a standard of nomenclature it is repudiated by systematists in general.

The same has to be said about *Pithecus*, which is the technically correct name of the langurs, but has been wrongly used in another sense—for the macaques by Dr. Elliot alone among mammalogists. This wrong use has received no acceptance whatever, and cannot be said to render the name *Pithecus* ambiguous or unsuitable for acceptance by medical and other writers.

We would therefore reiterate our opinion that *Simia satyrus* for the orang, and *Pithecus* for the langurs fulfil the demand for names which are "thoroughly unambiguous and suitable."

Moreover *Macaca*, for which, according to the letter of Dr Stiles, *Pithecus* would be abolished as the name of the macaques, should be, and is, used for these very animals, side by side with *Pithecus* for the langurs.

Arguments in favour of *Simia* for the orang are to be found in the Fiat lists above referred to, and for *Pithecus* in a paper by Thomas in the *Ann. Mag. N. H.* (8) xvii. p. 179, 1916. OLDFIELD THOMAS.
MARTIN A. C. HINTON.

British Museum (Natural History),
Cromwell Road, London, S.W.

Lead Hydrogen Arsenate as a Mineral.

A SPECIMEN from the Tsumeb mines in the Otavi district, South-West Africa, recently acquired for the Mineral Collection of the British Museum, shows colourless transparent crystal plates with brilliant lustre, which had been labelled 'lanarkite.' The largest of these are 1 cm. across with a thickness of 1 mm. They rest on a crust of bayldonite pseudomorphous after mimetite (chloro-arsenate of lead), chessylite, and large crystals of anglesite ($PbSO_4$). The crystals are monoclinic ($a:b:c=0{\cdot}8643:1:0{\cdot}7181$, $\beta=84^\circ\ 36'$) and show a development of sixteen crystal-forms. These forms have been listed to show the angles from each to the three axial planes; and it is believed that such a method of tabulation may effect a compromise between the method of giving interfacial angles in zones and that of longitude and latitude (ϕ and ρ) angles employed in two-circle goniometry. The crystals are optically positive, and the optic axial plane is perpendicular to the plane of symmetry and direction of good cleavage. The refraction ($n_\gamma = 1{\cdot}9765$ for sodium-light), birefringence, and dispersion are all high.

A chemical analysis made by Mr. E. D. Mountain on a quarter of a gram of carefully selected crystal fragments agrees closely with the formula $PbHAsO_4$. It was then found that the crystallographic data agree with those previously determined for artificial crystals of this substance. A copy of E. S. Fedorov's "Tables for Crystallo-chemical Analysis" not being available, it was not possible to identify the substance from the crystallographic data alone. Artificial crystals of lead hydrogen arsenate had been prepared and completely determined crystallographically by the late Baron A. de Schulten (a political refugee from Finland, who worked in the chemical laboratories of the Sorbonne in Paris) in 1904. He also prepared a series of other compounds isomorphous with the mineral monetite ($CaHPO_4$), with strontium, barium, or lead in place of calcium, and arsenic in place of phosphorus. Of these only $CaHPO_4$ has been hitherto known to occur in nature. For the compound $PbHAsO_4$ occurring as natural monoclinic crystals the mineral name *schultenite* is suggested. The "lead arsenate" of commerce is the same substance. This is used as an insecticide, especially in America in sprays for fruit-trees; and being practically insoluble in water it is no doubt responsible for the retention of arsenic in apples.

A detailed account of the new mineral, so far as this can be completed from the single specimen, will be given in the December issue of the *Mineralogical Magazine*. There are no doubt other specimens of this mineral in collections amongst the rich series of crystallised material that has come from the Tsumeb mines.

L. J. SPENCER.

British Museum (Natural History),
South Kensington.

The Anomalous Flocculation of Clay.

IN a letter to NATURE of May 1, 1926, Dr. Joseph and Mr. Oakley allude to some experiments which have convinced them that the alleged anomalous flocculation of clay does not exist. The anomalous flocculation of clay is said by them to be the accelerating influence of hydroxyl ions on flocculation by calcium salts when compared with the retarding effect of hydroxyl ions on flocculation by sodium salts. I should like to submit, however, that the behaviour of calcium ions in alkaline medium is not regarded as anomalous by comparison with the behaviour of sodium ions in alkaline medium. Flocculation of clay by calcium salts is anomalous when considered in the light of prevalent theories, and not necessarily when compared with the behaviour of other ions. As I understand the anomalous flocculation of clay, the most that could be claimed by Dr. Joseph and Mr. Oakley is that the sodium flocculation of clay is also anomalous.

One realises, of course, that within the limits of a letter a description of experimental detail is not possible, but it is crucially important to know what precisely is meant by a "highly purified clay." The significance of the results in question is entirely dependent upon the complete removal of both adventitious and absorbed calcium in the clay. A highly purified clay suspension would ordinarily be taken to mean a suspension of clay in which there was no appreciable amount of the coarser particles, but such a clay suspension would still contain absorbed calcium, and on the addition of sodium salts that calcium would come into solution. Soils containing absorbed calcium can ordinarily be flocculated by the addition of a sufficient amount of alkali, but according to some incidental observations made on soil suspensions in these laboratories by S. J. Saint (*Proc. 2nd Comm. Intern. Soc. of Soil Science*), when the absorbed calcium has been completely replaced by sodium, no amount of sodium hydroxide will bring about a flocculating effect.

N. M. COMBER.

The University, Leeds.

Persistent Solar Prominences.

IN NATURE for July 24, page 131, reference is made to a large prominence formation on the sun's north-western limb on July 16. Apart from the interest in this display as to grandeur, consideration is enhanced by the fact of the many repeated appearances of this particular display. My records, which cover 71 observing dates since June 1, show that the first appearance of this exceptional formation was on June 18, in the north-west quadrant, in the north-east quadrant on July 2 and 3, again in the north-west on July 16, in the north-east again on July 29 and 30, once more in the north-west on August 12, and, although reduced somewhat, once again in the north-east on August 25 and 26.

We have thus 2½ complete synodic revolutions of the sun, during which this formation was preserved practically to the full extent for two complete synodic rotations, the display being easily recognisable, not only by its large extent, but also by the particular form which the various constituents retained, mostly magnificent tree forms, with bright trunks spreading into an elaborate tracery of interlacing branches. On the last appearance the trunks only seemed to be left, although faint overhead festoons and filaments were still visible.

ALBERT ALFRED BUSS.

Lee-Observatory, Chorlton-cum-Hardy,
Manchester, August 27, 1926.

Spraying Crops from Aeroplanes.

IN NATURE for August 14, p. 239, it is recorded that the first attempt in Great Britain to utilise the aeroplane for spraying operations took place in Lincolnshire in August 1926. It is to correct an error that the present communication is made. The first record of powder spraying by aeroplane in Britain is made in the *Fruitgrower*, June 29, 1922, and of which no reference can be found in NATURE of that year.

The experiment took place at Portobello Farm, Kingsdown, near Sevenoaks, owned by Major R. F. Bartlett, on an eighteen-acre cherry orchard badly infested by caterpillars. The material used was a proprietary dust ('Belumnite') manufactured and supplied by Messrs. W. J. Craven and Co., Evesham. The lessons learnt at this initial experiment are published in the *Fruitgrower*, July 13, 1922.

It should be placed on record that Major Bartlett was the first in Great Britain to use the aeroplane for the control of orchard pests, although the recorded facts of the efficiency of the method leave much to be desired.

G. FOX WILSON.

Dept. of Entomology, R.H.S. Laboratory,
Wisley, Surrey, August 27.

International Code of Zoological Nomenclature.

DURING this year I have so often been asked how this Code could be obtained that I hasten, with your permission, to announce that the Washington Biological Society has just published a reprint at the price of one dollar. Prof. C. W. Stiles, secretary to the Commission, says: "I would suggest that, if your colleagues wish copies, it would expedite matters to order a number at once." The address of the Society is at the Bureau of Entomology, Washington, D.C., U.S.A.

F. A. BATHER.

46 Marryat Road, Wimbledon,
London, S.W.19.

Seven Decades of Botany.[1]

By Prof. F. O. Bower, F.R.S.

> "The future of Biology lies not in generalisation but in closer and closer analysis."—Bateson (Birkbeck Lecture, 1924).

Death sudden and wholly unforeseen has stepped between Section K (Botany) and the president of its choice. Dr. Bateson had presided over the whole Association at its meeting in Australia, and partly on that account he had been specially selected for the chair of this Section in Oxford. From him we might have expected a broad outlook upon biological science. His address would have been instinct with wide experience in both of the branches of living things, the interests of which interweave in enthralling and often most perplexing ways. We should have heard a fearless statement of his mature views. Something constructive would certainly have justified the congratulations with which some of us had already welcomed his nomination. A great figure has been taken from the arena of biological science. A career still full of the promise of further achievement has closed prematurely.

This is not the time or the place for any comprehensive obituary of Bateson. I will only allude briefly to four leading events in his scientific career. He felt in early life the lack of facts bearing on variation, and sought to extend their area in his great work "Materials for the Study of Variation," published in 1894. This was the year when the British Association last met in Oxford. I do not remember that its contents came into the discussions in Section D, though the book centred upon the vital question of continuity and discontinuity. The second event was the publication in 1902 of "Mendel's Principles of Heredity," in which, though essentially a controversial statement, Bateson perceived latent in the rediscovered writings an expanding vista of advance. "Each conception of life," he says, "in which heredity bears a part must change before the coming rush of facts." In a third stage of his work Bateson expanded this theme into a fuller statement under the same title, and it was published in 1909. Passing from this period of high hopes to the fourth phase of 1924, we see in his address at the Birkbeck Centenary a chastened attitude. He there remarks: "We must frankly admit that modern discoveries have given little aid with the problem of adaptation," and that, much as Mendelian analysis has done, "it has not given us the origin of species." But that analysis having "led to the discovery of transferable characters, we now know upon what to concentrate. . . . Henceforth the study of evolution is in the hands of the cytologist acting in conjunction with the experimental breeder. Every appeal must ultimately be to the mechanics of cell-division. The cell is a vortex of chemical and molecular change. . . . The study of these vortices is biology, and the place at which we must look for our answer is cell-division." I would ask you to mark that last word. It is cell-division, not nuclear division; and earlier in his address we find the pregnant sentences: "As to what the rest of the cell is doing, apart from the chromosomes, we know little. Perhaps the true specific characters belong to the cytoplasm, but these are only idle speculations." Such extracts from Bateson's latest public pronouncement may suggest to you what the Section has lost by his death. They show the mind still elastic and perceptive: still both constructive and critical.

Any address that follows such a tragedy of disappointment as the Section has suffered can only fall short of what we had hoped to hear. Instead of attempting to fill the broad biological rôle that naturally fell to Bateson, I propose to centre my remarks upon three dates when the Association has met in Oxford, namely, 1860, 1894, and 1926. It happens that these dates mark approximately periods of transition in the progress of biological science, and particularly in botany.

1860.

I need scarcely recall that the meeting in Oxford of 1860, the year after the publication of the "Origin of Species," witnessed the clash between the new view and the opposition it was certain to arouse. The story has been often told of the aggressive attack and the crushing retort. But it is not sufficiently recognised that, though Huxley bore the first brunt of the fight, a large part in the contest was taken by Hooker. The meeting closed after he had spoken, and in his own words he was "congratulated and thanked by the blackest coats and the whitest stocks in Oxford."

Two generations have passed since the Oxford meeting of 1860: and still the "Origin of Species" holds its place as a great philosophical pronouncement. As the methods of research passed into greater detail, the area of fact has been extended through the labours of an ever-growing army of inquirers, and naturally divergences of view have arisen. Some authors appear to demand that for all time the "Origin" must cover every new aspect of biological inquiry, or else the whole theory crumbles. That is to demand a prophetic vision for its author. We need not for the moment follow these or other criticisms, but rather recognise that the theory rested essentially on facts of heritable variation, without defining their magnitude, limitations, or origin; and that it explained a means of their summation so as to produce progressive morphological results.

Before we leave the historical aspect of evolution a moral may be drawn from the lives of its four protagonists of 1860. Darwin, Wallace, Hooker, and Huxley were all equipped for the battle from the armoury of personal experience in the great world. The theory of evolution was born and bred of foreign travel, and upon foreign travel quite as much as upon quiet work at home its future still depends. We should not for a moment minimise the great developments of laboratory study and of breeding experiment in recent years that bear upon its progress. But it is not thence alone that the fullest achievement can be anticipated. The cytologist and the breeder, just as much as the abstract theorist, should know Nature face to face, not merely through a glass darkly. To those who believe in the close relation between environment and variation, which is to me the very core of evolution, this seems essential to any well-balanced view. The open forest, the sea-coast, steppe, and mountain-side should be regarded as the natural complement to the laboratory and the breeding-station. No one, morphologist or physiologist, should hold himself equipped for research or fully qualified to teach unless he have at least some experience of travel through wild Nature. This can best be acquired in the tropics.

---

[1] From the presidential address to Section K (Botany) of the British Association, entitled "1860—1894—1926," delivered at Oxford on August 5.

What, however, do we find? In 1886 a committee of the British Association was appointed to assist the visits of botanists to Ceylon for study. Several well-known botanists availed themselves of its aid; but after a few years the scheme flickered out through inanition. In 1909 I visited the Cinchona Station in Jamaica, and again a scheme for continued use of the station by British botanists was initiated; but it has since died out for want of consistent support. Why did these efforts fail? We may set these failures down to under-valuation of the importance of foreign, and particularly of tropical, study; and the lack of full perception that open Nature is the greatest laboratory of all. Our future botany seems in danger of becoming myopic by reason of study being concentrated at too short focus. To correct this, young aspirants should travel early, as free lances, hazarding the fortune of the wild, as Darwin and his fellows did.

HOMOPLASY.

I have already alluded to the tempestuous meeting of 1860 in Oxford. Shortly after it an undergraduate came up to Christ Church who, before he was of standing to take his M.A. degree, had himself made a real contribution to the philosophy of evolution. It was Ray Lankester, who in 1870 published a short paper "On the Use of the term Homology in Modern Zoology, and the distinction between Homogenetic and Homoplastic Agreements." Its author was only twenty-three years of age, and its date barely a decade after the publication of the 'Origin.' This short paper went far to clear up the vague ideas surrounding the term 'homology' in the minds of early evolutionists. Lankester introduced the idea of 'homogeny,' substituting in a more strict sense the word 'homogen' for 'homologue.' He also suggested, to avoid confusion, the use of another new term, namely, 'homoplasy.' He defined homogeny as simply the inheritance of a common part, while homoplasy depends upon the common action of evoking causes or of a moulding environment upon homogonous parts, *or* upon parts which for other reasons offer a likeness of material to begin with.

This definition was at once adopted in the morphological study of animals, but Lankester did not himself apply it at the time to the morphology of plants. In point of fact the conception of homoplasy and the use of this clarifying term made its way but slowly into botanical literature. There is reason to believe that we are as yet only beginning to recognise in the evolution of the plastic plant-body how far-reaching has been the influence of homoplasy, not only upon external form, but also in the internal evolution of tissues. We are only now beginning to realise how far-reaching have been its results in plants as we see them. On the other hand, such realisation when well assured cannot fail to react upon our estimates of affinity of the organisms in which homoplasy appears. It may be going too far to trace all such results as consequences of the meeting of 1860; but the initiative was certainly given by Lankester in the years that followed.

1894.

Passing from the stormy period of 1860, when the whole outlook of biological science was being transformed by the advent of evolution, to 1894, we see that the atmosphere had cleared. One result was that the evidence of descent tended to become too definite in the minds of some enthusiasts, and there was even a disposition to argue deductively from the accepted position, a tendency that is much too prevalent to-day.

The outstanding feature of the Oxford meeting of 1894 was Strasburger's generalisation on the periodic reduction of chromosomes. This shed a new light on the vexed question of alternation, which, based on the brilliant results of Hofmeister, by this time held the field not only as an objective fact but also as an evolutionary problem. The effect of Strasburger's communication was to establish the chromosome-cycle as general for plants that show sexuality. It provoked comparison with a similar cycle in animals. The recognition of both cycles took its origin in the discovery by van Beneden in 1883 that in sexual fusion the number of chromosomes is the same in both of the conjugating nuclei. Later observers have confirmed this in a multitude of instances, and disclosed the correlative reduction, or meiosis. The existence of a nuclear cycle alike in animals and in plants cannot, however, be held as establishing any homogenetic unity of the two kingdoms. Comparison of the simpler forms of each indicates that the divergence of the kingdoms, if they ever had a common origin, was very early indeed, and probably antedated sexuality in either. Such similarities as they show in propagative detail, and particularly in the nuclear cycle, would be homoplastic, not homogenetic. If this be so for the two kingdoms of living things, may it not be equally true for the several phyla of plants that show sexuality; for we are not justified in assuming that sexuality arose but once in plants?

Historically this generalisation of Strasburger fell like a bomb-shell into the midst of the old controversy between the rival theories of alternation, styled in the words of Celakovsky 'homologous' and 'antithetic.' But it must be remembered that at the moment there was no complete demonstration of a cytological alternation in any one Alga, though the facts soon followed for Fucus and for Dictyota. We need not recite again the arguments for and against that old discussion. It soon lost its intensity in face of the obvious deficiency of crucial facts, which alone could lead to some final conclusion. Loose comparisons between organisms not closely allied are but the long-range artillery of morphology. Comparisons between organisms closely related are its small arms. The discussions of the 'nineties of last century on alternation were all engagements at long range, which could not be decisive without the use of close comparison. As the necessary facts were not then in our hands, those premature engagements might be held as drawn; and it was open to both parties still to entertain their own opinions.

Before discussing the relation of somatic development to that cycle, it will be well to revise the terminology then in use. It would be well to drop those old terms, which are neither exact nor explicit, and to support a more general use of the words 'interpolation theory' in place of 'antithetic' and 'transformation theory' in place of 'homologous.' These words accord better with current views, and are explicit.

1926.

From the time that the periodic reduction of chromosomes was recognised as general in organisms showing sexuality, the nuclear cycle has formed a natural foundation for the comparison of the life-histories of plants. The normal cycle may be figured to the mind as a closed circular thread with two knots upon it, syngamy and reduction. Between those knots beads may be strung, one or more than one, or none. These represent somatic developments, which are normally diploid between syngamy and reduction, haploid between reduction and a fresh act of syngamy. They follow in alternate succession in any normal cycle, but either may be repeated indefinitely by vegetative propagation.

Certain questions arise with regard to the evolution of these somata as we see them. The first is, how far are the diploid and haploid somata of the same cycle comparable one with another? The reply will turn upon the constancy of the events of syngamy and reduction throughout descent. If they were constant, then it appears a necessary consequence that the alternating diploid and haploid somata must have been distinct throughout their history; and any similarity which they may show, as in Dictyota or Polysiphonia, would be homoplastic. It would indeed appear natural that they should be alike in Algæ, since they are parts of the same organic life and live in identical circumstances. It has, however, been suggested that reduction may not be a fixed but a movable event in the individual life: liable to be deferred or carried over to a later phase, in which case a diploid generation might arise by transformation from an already existent haploid phase. The monospores of the Nemalionales have been cited as possibly convertible in other red seaweeds into tetraspores, by some sudden deferring of the act of reduction.

I am not aware that this has been advanced by close comparison beyond the position of tentative suggestion, though the existence of a diploid gametophyte and of a haploid sporophyte in certain abnormal ferns would indicate the possibility of the suggestion being true. Pending the advance of a closely reasoned argument it is best to keep an open mind. Meanwhile the weight of facts hitherto known from plants at large may be held to support the stability of the events of syngamy and reduction during normal descent. The two generations of the same life-cycle would, in the absence of a carry-over of reduction, be homoplastic, not homogenetic.

No one has yet made out a closely reasoned case for the descent of the Archegoniatæ from the green, the brown, or the red algæ. The old view that they originated from the green algæ has never recovered from the blow delivered by Dr. Allen, when he showed that the reduction in Coleochæte takes place in the first divisions of the zygote, and that the presumed primitive sporophyte is really haploid, and not cytologically a sporophyte at all. It is a perfectly tenable position to hold that the Archegoniatæ sprang directly from none of these groups, as we know them. In the absence of definite comparative evidence, the field appears to be open to an origin of alternation in the Archegoniatæ by interpolation of a sporophyte *de novo*, developed not in water but in relation to a land-habit.

Devonian Fossils and a Land Flora.

Palæobotanical discovery has been greatly advanced within the period under review. The features of the vegetation of Mesozoic time are becoming clearer than ever before under the hands of Prof. Seward. The Carboniferous flora has been richly presented to us by Williamson, Scott, Oliver, and Kidston in Britain, and by continental workers such as Renault, Zeiller, Bertrand, Nathorst, and Solms-Laubach. We are now able to substitute something positive in place of vague surmisings. Not only do the new facts illuminate our knowledge of plants now living, but they also apply a check upon theories as to their origin.

Latterly a vision is becoming ever more and more real of a Devonian flora, revealed by Kidston and Lang in Britain, and by other workers in Scandinavia, in Germany, and in America. Given more extended collecting, an improving technique, and the fortune of finding more material as well preserved as that at Rhynie, who knows but what the coming decades may see the land of the Devonian period clothed before our eyes by a flora no less stimulating and even more suggestive than that of the coal? But though Devonian lands are the earliest yet known to have supported a sub-aerial flora, the highly advanced structure of such a fossil as *Palæopitys Milleri* suggests that we are still far from visualising the actual beginnings of land vegetation. Moreover, the mixture in the Rhynie Chert of algal types with vascular land-plants presents at the moment a problem as perplexing as it is ecologically strange.

It is always difficult to estimate justly the times in which we live; but we may well believe that the future historian of botany will note the present period as one specially marked by successful study of the floras of past ages, and by the increasing cogency of their comparison with the vegetation of the present day.

The *Annals of Botany* as an Historical Document.

Perhaps too much time has been claimed for morphological questions, which are closely related to the dates of the three meetings of the British Association in Oxford. The brief space that remains may be devoted to a more general survey of the period which these dates cover. In this we could not do better than to take as an index the pages of the *Annals of Botany*, for the existence of which we owe a deep debt to the Oxford Press. In 1860 there was no organised laboratory teaching of botany in any university in Britain; and as yet there was no journal of the nature of the *Annals*. But the revival of close observational study in botany under Huxley and Thiselton-Dyer at South Kensington in the early 'seventies, recorded last year by various writers in the *New Phytologist*, was beginning to take effect in 1881, when the British Association met in York. There the outstanding feature was the address of Hooker on geographical distribution. This and the papers by Bayley Balfour on Socotra and by Baker on Madagascar were all that really mattered botanically, and almost all the contributions were systematic or regional in subject. The revival of the laboratories had not yet fructified.

At this time all the work that was done in laboratories was called 'physiology,' as distinct from systematic botany, which was conducted on dry specimens in the herbarium. In 1887, six years after the York meeting, the *Annals of Botany* was founded through the activity of the late Sir Isaac Bayley Balfour, and a small committee of guarantors whose personal security induced the Clarendon Press to make the venture. From the start that journal has paid its way. The forty stately volumes form a record, between the pages of which may be read the history of botanical progress in Britain, and in some degree also in the United States, for American botanists have always been with us in its pages.

In the first issues of the *Annals*, morphology and systematic botany preponderated, and from the proceedings of the meeting of the British Association in Oxford in 1894 we see that this was still so. That meeting witnessed a crisis in the affairs of botany in Britain. A newly established Section I of Physiology assumed that the functional activities of plants would be swept, together with those of animals, into its hands. Up to this time Section D had been the undivided section of Biology. An irregular cleavage of interests was set up by this claim, for the zoologists were mostly willing to give up their physiology, but the botanists were not. Their refusal to accept divorce of form from function contributed to, or at least coincided with, the foundation of a separate Section K of Botany, and has dictated the policy of British botany ever since.

As we pass from 1894 to the current period we perceive a marked shifting of the interest of botanists from the study of form to that of the intimate constitution and functional activity of plants. Whole fields of colloidal chemistry and physics, of quantitative physiology, of cytology and genetics, of ecology, of fungology and bacteriology, have been opened up. The present century has been specially marked by the extension of opportunities for physiological research, by better equipment of departments in the universities, and by the foundation of independent establishments carrying on experimental inquiry in its broadest application. This is rapidly bringing the science into closer relation with Imperial and social aims.

It is needless to specify, but the effect of it all is plainly written in the pages of the *Annals*. Experimental results have gradually taken the preponderant place over description and comparison, as is amply shown in the last January number. 'For better, for worse,' the pendulum has definitely swung over from the extreme systematic position of half a century ago, through a phase of prevalent morphology (or perhaps we should better say of organography), to an extreme physiological position at the present time. Some may even have felt that this address is in itself an anachronism, in that it has not touched upon the moving physiological questions of the day. While I may claim none the less to sympathise with physiological aspirations, I do not assent to any ultra-physiological aspect of botany that would degrade or minimise the comparative study of form. *Medio tutissimus ibis* is still a true maxim. The laboratory physiologist, dealing with the things of the moment, cannot safely detach himself from the things of the past as recorded in heritable form. He should not allow himself to be immersed in statistics and neglect history. The pendulum has gone full swing, within a period of about half a century; but we may confidently anticipate a return towards some middle position.

Power Alcohol and other Petrol Substitutes.

ALTHOUGH opinions differ concerning the extent of the world's petroleum reserves, it is generally agreed that if the consumption of petrol continues to increase at its present rate, available supplies will soon become inadequate. Thirty years ago, it is said, there were but four motor cars in the United States; to-day there are nearly twenty million, and the consumption of petrol in that country has risen to about 900 million gallons a month. The demand for aviation shows every sign of expanding, and when we consider that petroleum is very unequally distributed in the earth's crust, and that economic independence is still a watchword in international politics, we can readily understand the vigorous efforts that are being made to produce liquid fuels by artificial means.

So far as we can see to-day, there are not many possible alternatives to petrol. There are, indeed, immense supplies of liquid fuel lying dormant in the oil-shales that are so abundantly distributed over the earth, but until methods of extraction and purification are devised that are both technically and economically successful, we shall continue to look to other fossil fuel, coal or peat, to vegetable matter, and to the mixture of carbon monoxide and hydrogen known as 'water-gas,' to supplement our present supplies of petrol, and to replace them when the day of extinction draws nigh.

Benzol is an excellent motor-fuel, but its production is comparatively small; and it is required for other purposes: for example, for dyes and explosives. Acetone is the ideal liquid for mixing with other motor-fuels, but at present it is too costly to compete with them, although its commercial production through the acetic acid made by fermenting cellulose may be achieved at an early date, and so bring it into the foreground. Alcohol is of especial significance, because the raw materials of its manufacture, cellulose and sugar, are renewed incessantly by a bountiful Nature, and also because its value as a motor-fuel, particularly in admixture, has been proved beyond a doubt. Hydrocarbon oils of low boiling-point, such as are produced by 'hydrogenating' coal and peat, or by passing water-gas over heated catalysts, are among the most likely substitutes for petrol; from the technical standpoint the elaboration of such processes will be comparatively easy; the whole issue lies in their economy. Though the raw materials—coal, peat, air, water—are cheap, heavy capital expenditure upon plant appears to be unavoidable, and in some instances a considerable amount of energy has to be expended in promoting the chemical reactions concerned.

Of a different order are the processes for producing alcohols (and acetic acid) from cellulose or sugar by fermentation, for they require neither a high temperature nor a high pressure. Here again the problem is essentially an economic one. The raw material may be very cheap, especially if it grows wild, but it may cost a great deal to collect and transport. A few years ago there was much talk of utilising the Indian mahua flower as a source of power alcohol, but the proposition was soon found to be uneconomic, mainly on account of the cost of collecting the flowers. Cultivated sugar-cane and sugar-beet are necessarily more costly than wild vegetation, and they cannot be grown everywhere. Moreover, they contain an essential foodstuff, and the world-price of sugar rules them out as sources of power alcohol unless their production is subsidised by the State. Molasses, being a by-product, is in a different category. Although it is produced in considerable quantity (constituting about 30 per cent. of the weight of raw sugar manufactured), supplies of it would not cover more than a fraction of the world's requirement of light motor-fuel in the event of a petrol famine; its production is confined to sugar-growing countries, and it is in great demand by manufacturers of rum and cattle-cake. The production of fuel-alcohol from molasses is now being undertaken on a large scale in Queensland, Australia, states Dr. W. R. Ormandy (*Journ. Soc. Chem. Ind.*, Aug. 13, 1926), where, with the aid of the Queensland Government, a plant is being erected to produce two million gallons of alcohol per annum, and three additional plants are projected. This enterprise will be assisted by the existence of a thriving sugar industry, and by the total absence of petroleum deposits in Australia.

Among post-War developments the initiation of a State-subsidised beet-sugar industry in Great Britain is one of the most interesting. A flourishing industry of this kind would have far-reaching effects, especially upon agriculture; and the view being held in certain quarters that agriculture would benefit more if beets were grown for the distillery than for the beet-sugar factory, the Government appointed a small committee, consisting of two chemists and one physicist, to inquire into certain economic aspects of the question. The report,[1] which was issued in July, is a short document of a few thousand words. In reply to the questions put to it, the Committee estimates the cost of raw material per gallon of alcohol (taken throughout as 95 per cent. by volume) to be 5 per cent. of the price per ton of beet, due allowance being made for the value of residual products. Cost of conversion or manufacturing cost is given as 9*d*. per gallon of alcohol, so that, excluding other charges (*v.i.*), the cost per gallon net naked at works would be 1*s*. 9*d*. or 2*s*. 9*d*., according as the price of sugar-beet is taken at 1*l*. or 2*l*. per ton. The yield of alcohol from one cwt. of sucrose is 8 gallons theoretically, 6·8 gallons in practice. With the aid of these figures, and taking 28*s*. per cwt. as the commercial price of sugar and 1*s*. 6*d*. or 2*s*. per gallon as the probable price of power alcohol, the Committee calculates that with the same rate of subsidy in both cases (19*s*. 6*d*. per cwt. for sugar and 2*s*. 10½*d*. per gallon for alcohol), the subsidy would amount to 70 per cent. of the commercial price of sugar, and 191 or 144 per cent. of the commercial price of alcohol.

The economic case against subsidising the sugar-beet industry for producing power alcohol is really stronger than these figures suggest. The Committee ignores (wittingly) charges for denaturing, packing, transporting, and selling. Assuming a wide distribution, these charges would amount to about 1*s*. per gallon; hence the subsidy would really represent 258 or 221 per cent. of the commercial price of the alcohol. Furthermore, it must not be overlooked that the present rate of subsidy is very high and will diminish as time goes on. Last season the price paid to English growers was about 56*s*. per ton of beet, and the subsidy per ton was about equal to the price received by Dutch growers for their produce; in other words, the English beet-sugar manufacturers practically obtained their raw material for nothing.

The Committee was also asked to report upon the prospects of producing power-alcohol by synthetic processes. Its reply is to the effect that the present position of such processes is obscure, and that reliable statements of costs will not be available for some time. Nevertheless, a useful appendix is inserted containing remarks on the chief processes that are potentially important for making alcohol and other liquid fuels from sugar, cellulose, coal, and water-gas.

Preparation through ethylene appears unlikely to provide alcohol in quantity, and synthesis from calcium carbide is regarded as improbable in view of the abandonment of carbide manufacture in this country owing to economic considerations. The use of water-gas for making liquid fuels, whether alcohols or hydrocarbons, is held to be promising, although but little has been done in this direction in Great Britain. Processes involving the use of high pressures, like those of Patart and Fischer, are referred to, but no specific mention is made of Fischer's work on producing hydrocarbon liquid fuel from water-gas without employing high pressures. In some quarters this development is regarded as a great advance, but it should not be overlooked that the saving effected by dispensing with the costly high-pressure plant is quite counterbalanced by the cost of the very much larger plant required for working with gases at ordinary pressure. A few reasons are given for and against the use of methyl-alcohol as a motor-fuel, but the Committee issues no verdict on this head. Actually methyl-alcohol is a very inferior fuel, not only because it has a low calorific power, but because it causes serious 'pinking' in the engine. The Committee thinks well of the possibilities of the improved Classen and Prodor processes for converting the cellulose of wood, or waste-wood, into sugar and alcohol, especially in countries where wood is abundant. There is, however, little prospect for making alcohol from waste sulphite-liquors in Great Britain, whilst production by fermenting cellulose is more likely to be developed in the overseas dominions than in our own country.

---

[1] Power Alcohol Production, being a report to the Minister of Agriculture and Fisheries of the Departmental Committee appointed by him in connexion with the Manufacture of Alcohol for Power Purposes from Sugar Beet. (London: H.M. Stationery Office, 1926.) 6*d*. net.

The outlook for producing motor-fuel from coal is considered to be favourable, but not by the low-temperature carbonisation process, which, the Committee states, cannot yet be worked on a large scale at a profit, and when it can be so worked it would not provide more than a fraction of our requirements in heavy and light fuel-oil. The Bergius process (for the investigation of which the Government has recently granted the sum of 25,000*l.*) is stated to be the only one which could satisfy our requirements, but in view of the difficulty in constructing plant, some years must elapse before really commercial data concerning it can become available. In its remarks upon this process the Committee gives some quantitative data which are not up-to-date. The statement that at least one ton of coal must be burnt for every ton put through the process should read "one ton of coal is burnt as fuel for every *two* tons put through the process"; and the yield of light fuel is not 15 gallons but from 20 to 25 gallons per ton, according to the quality of the coal treated. Further, the remark that "65 per cent. of the weight of the coal may be converted into a kind of oil," would be more accurate in the form: "85-93 per cent. of the coal substance is converted into oil."

In its summary of this interesting section of the report, the Committee states that of all the processes not involving the distillation of fermented foodstuffs, the most likely to be adopted in Great Britain are those based upon the use of water-gas as raw material, and those by which fermentable sugars are obtained in high yield from wood. It is, however, strongly open to doubt whether the latter processes could be worked economically in Britain, where wood is scarce and expensive, and where wood-waste can only be collected and transported at prohibitive cost.

Discoveries in the Gobi Desert by the American Museum Expeditions.[1]

By Prof. HENRY FAIRFIELD OSBORN, For. Mem. R.S.

IN 1799, William Smith, then a young man of thirty, who was born at Churchill in Oxfordshire, dictated his now classic document, "The Order of the Strata," including a map showing the successive and characteristic fossils of southern Britain and the Oxford clay underlying this great University, with its Jurassic deinosaur Cetiosaurus. In the century and a quarter which has intervened before the present meeting of the British Association in Oxford, the twin sciences of geology and palæontology have reached a degree of precision which enables us, after our relatively brief and intensive surveys of the past four years, to declare 'the order of the strata' of Mongolia. Included in the Gobi Desert is a stratum equivalent in age to the Oxford clay of William Smith, containing the giant sauropod Asiatosaurus, a first cousin of the Oxford Cetiosaurus.

Meanwhile, physicists have extended the life-history period of the earth from the momentary 5000 years of Usher to the 1,000,000,000 years of Rutherford. This allows a comfortable margin of 400,000,000 years' time for the wonderful procession of evolutionary advance recorded in the twenty-four chapters of Mongolian prehistory, beginning with the equivalent of the Purbeck and Oxford formations of Upper Jurassic time, continuing with the appearance of man in the Old Stone Age, ending practically with the dominance of Ghenghis Khan, and followed by the decline of Mongolia to its present desert and relatively uninhabited state.

In the meantime, this now arid 'roof of the world' has been the scene of a whole succession of animal dynasties, fertile, productive, with a relatively temperate and invigorating climate, sometimes arid, sometimes pluvial, from first to last the homeland of waves of migrating land reptiles and mammals, which successively spread into every other continent (Fig. 1). It is a singular fact that this first and greatest of all life-centres (7) of prehistory was the last to be discovered, following by a half to three-quarters of a century the discoveries of great life-centres in Australia, in North and South America, in northern Africa, and in southern Asia. Although each of these great centres contributed its quota to the prehistory of the earth, none played a part at all comparable to that of central Asia.

With this introduction we may proceed to show by means of photography the contrast between the present geography of Mongolia and its palæogeography as recently revealed, and exhibit a new palæogeographic map of the world (Fig. 1) prepared especially for this discourse, showing that by placing North America on the east, Asia in the centre, and Europe on the west of an equal-area projection, we have a complete solution of all the animal migratory routes from Upper Jurassic time to the six great waves of human migration which swept over northern Asia into North America in late Pleistocene time.

PRESENT GEOGRAPHY OF MONGOLIA.

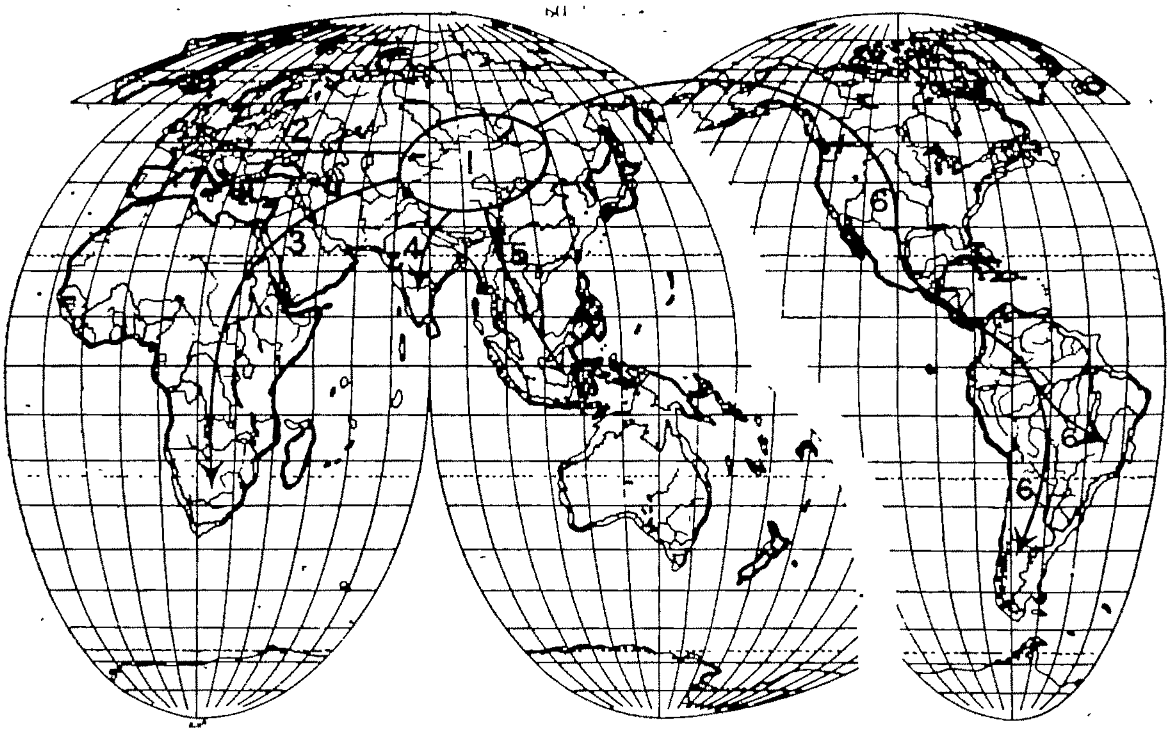
The position of Mongolia in Asia as shown in the map of Perthes may be projected areally on a map of the United States along lines of the 40th parallel; and there at once appears the remarkable similarity between the Mongolian fauna and that of the Rocky Mountain region throughout the entire period from Jurassic to recent times, the parallelism varying in closeness from epoch to epoch, at times Europe being closer than the United States. To the north of the hypothetical 'Gobia' lies 'Angara,' to the south the 'Gondwana' of Suess.

---

[1] From an evening discourse delivered to the British Association at Oxford on August 9. For further information regarding these expeditions reference should be made to "Methods and Results of the American Museum Expeditions in the Gobi Desert, 1922–25" (NATURE, August 7, 1926, pp. 198, 199), a lecture delivered to the Geological Society of London, June 23, 1926.

PERSONNEL AND TRANSPORTATION.

It has been estimated in the United States Geological Survey that as much was accomplished in three years by the American Museum survey as had been accomplished in the first fifty years of discovery in the corresponding Rocky Mountain region, namely, from 1850 until 1900. This was due to prolonged palæontological experience in America and to the combination of slow camel transport and rapid automobile transport, under the guidance of ten Mongols, ten Chinese, and an equal number of Americans trained in the western desert region. These rapid modern methods were rendered possible by the approval of the Mongol Government, but neither aeroplanes nor radio were allowed admission. Over the great level stretches now traversed by wild asses and gazelles, the camels advanced fifteen miles a day, the automobiles a hundred and fifty miles a day, or ten times as rapidly.



[J. Bartholomew and Son, Ltd

FIG. 1.—1: New Central Asiatic continent. 2–6: Migration lines of the great reptilian Sauropoda—to Europe (2), to South Africa (3), to India (4), to Malaysia (5), to North and South America (6).

The routes and discoveries of three seasons (1922–1925) may be summarised as follows:

(a) Peking, Kalgan, Pang Kiang, Irden Manha, Houldjin, Iren Dabasu, Tuerin, Urga (the main and only telegraph line in Mongolia).

(b) North-west Uliassutai route: Shara Murun, Ardyn Obo, Sair Usu.

(c) Altai route, travelling southward to Kolobolchi, Ondai Sair, Oshih (Ashile), Djadokhta, Gashato, Golobol'n Olæ.

(d) Northward on the main route to Urga through Irden Manha, Houldjin, to Iren Dabasu.

Excepting Peking and Kalgan, all these localities yielded fossils, often in enormous quantities. At Houldjin we found the very spot where Obruchev discovered the single rhinoceros tooth, hitherto the only fossil vertebrate found in all Mongolia. At Iren Dabasu Andrews pointed out to me distant fossil beds of the Wealden age on the horizon, a rich Lower Cretaceous level. Each of the watering stations mentioned in the above routes, where wells are sunk for the camels, now gives its name to a more or less great geological horizon or formation contemporaneous with the great horizons of western Europe or of the United States.

Nothing could exceed the fidelity and ability of the Mongols and of the Chinese; the former were found to be true to their word on every occasion, and the latter were not only faithful but also became extremely expert in the discovery of fossils; and many of them are now engaged in working the fossils out of the rock in our Peking laboratory.

THE UPPER JURASSIC CONTINENT AND FIVE LIFE-ZONES OF UPPER MESOZOIC TIME.

It is an interesting coincidence at the present meeting of the British Association that the oldest horizons, known as Ondai Sair and Oshih (Ashile), are of sub-Wealden age and at present appear to be close to the Purbeckian and Oxfordian horizons of England. They contain primitive short-headed iguanodonts. Above them lies the Iren Dabasu, probably of Wealden age, containing large iguanodonts, ostrich deinosaurs, and megalosaurs. Still more recent are the famous Flaming Cliffs of the Djadokhta, which have no terrestrial equivalent in England; here were found the skulls of five small Cretaceous mammals and a host of deinosaurs, herbivorous and carnivorous, including the now famous Protoceratops with its supposed enemy, the Oviraptor or egg-snatching deinosaur. From the lower Ashile level the giant sauropods, Asiatosaurus, may have wandered to all the great continents except Australia. The fascination and the perils of fossil hunting among the Flaming Cliffs of Djadokhta for the eggs and skeletons of deinosaurs were recorded by instantaneous photography.

SUCCESSIVE LIFE PHASES OF THE AGE OF MAMMALS.

Even closer and more continuous is the remarkable succession of Gobi formations starting with the basal Eocene Gashato, of the same age as the Thanet sands of England and rising through beds of the age of the London clay to the Hordwell and Headon of the Isle of Wight, where England's terrestrial formations are interrupted, presenting a series of extraordinarily close parallels with the great Rocky Mountain succession from basal Eocene to Miocene time. In the creodonts, uintatheres, and titanotheres of the Gobi region we discover close generic and almost specific affinities to their distant American cousins. But the giant Baluchitherium, which had ancestors in Upper Eocene time and attained its gigantic size in Upper Oligocene time, seems to have had a monopoly of the central and south Asiatic region, because it has never been found elsewhere. In the Miocene and Pliocene phases of the Gobi there are some breaks which will doubtless be filled by future discovery, but in the Middle Miocene, and again in the Upper Pliocene, we discover close kinship to Western Europe and North Africa, especially in the arrival of the proboscideans or mastodonts of remote African ancestry. Thus the high plateau region of central Asia, including, doubtless, Chinese Turkestan, Tibet, and Mongolia, is firmly established as the previously missing area of origin not only of the terrestrial life of the entire northern hemisphere, but also of life which wandered into the extremities of Africa and of South America as well.

Scientific truth is far stranger than scientific fiction: Gobia takes the place of the mythical Atlantis and other imagined continents as the source of most of the animal civilisations and probably also of most of the vegetal civilisations of the northern hemisphere.

DISCOVERY OF THE OLD STONE AGE IN 1925.

At least four periods in the Old Stone Age of man were recognised in the campaign of 1925, namely, in descending order, Azilian-Campignian, (?) Mousterian, Acheulean (much more doubtful), and (?) Eolithic. Directly opposite the Flaming Cliffs of Djadokhta was discovered a great human culture level believed to be of late Palæolithic, Campignian, and Azilian age, with thousands of implements, to the north-east of the Mousterian horizon discovered by Licent at Ordos in north China. Above this closing Old Stone Age level occurred, in order, traces of Neolithic, of Bronze, and of Iron ages, ending in traces of pre-Mongol peoples which are succeeded by burial-places of the Mongol race that ended with the warrior race of Ghenghis Khan and the conquest of all southern Asia by Kubla Khan.

Thus are written twenty-four new chapters in the prehistory of the earth by the expansion and elaboration of methods of research first introduced to the world of science by William Smith of Oxford in his chart showing the companionship of geology and palæontology, and in the most unexpected manner connecting Mongolia with England and, especially, with Oxfordshire.

Observations with the Spectrohelioscope.

By Dr. GEORGE E. HALE, For. Mem. R.S.

THE spectrohelioscope described in my article on "Some New Possibilities in Solar Research" (NATURE, July 3, 1926) has been provided with new oscillating slits and driving mechanism and an improved parallel-plate line shifter and micrometer for setting various parts of the $H\alpha$ line on the second slit during observations, with divided arc indicating the exact wave-length employed. In this form the spectrohelioscope not only discloses the most delicate details of structure shown on the best Mount Wilson spectroheliograms, but has also served for the detection and measurement of some new and interesting phenomena.

Three cases observed on August 15 may be mentioned, all in the hydrogen vortices associated with the large spot group which on that day was near the central meridian of the sun. The first two were noticed south of the following spot of the pair. By rocking the parallel glass plate back and forth, thus showing the change in form with wave-length of two slender curved flocculi, their dark heads were seen to advance toward the spot as the $H\alpha$ line was moved across the second slit from its centre toward the red. At a slit position about 1·3 angstroms from the centre of the line, the curved flocculi had disappeared, but their point-like extremities were still visible, projected against the outer boundary line of the penumbra. If we assume this effect to be caused by the rapid descent of the hydrogen in the vortex above the spot, the radial velocity was about 65 km. per second. Another slender flocculus south of the preceding spot behaved in the same way. A similar observation on August 16 gave a maximum radial velocity of 56 km. per second for the descending point. These velocities are of the same order as those of knots in prominences moving toward spots, measured by Slocum and Pettit on photographs of the sun's limb made with the Rumford spectroheliograph, and observed visually by myself with the spectrohelioscope.

Although I confirmed the new results on August 17, the day I left Pasadena for a month's absence, I wish to check them more completely before expressing a final opinion as to their interpretation. It now seems probable, however, that the spectrohelioscope can be used for a more complete analysis than has previously been possible of the hydrogen vortices surrounding sunspots. These vortices involve the prominences as well as the chromosphere, and a means of measuring the velocities of the hydrogen, seen in projection against the disc as well as in cross-section at the limb, should prove of great service.

If we may interpret another group of observations in the same way, the parallel plate micrometer will also make it easy to distinguish eruptive jets, rising near spots and descending at some distance after following a long-arched trajectory, from the true vortex structure with which they are likely to be confused on spectroheliograms. At their source these apparent jets often appear as bright flocculi, seen on the violet side of Hα, which seem to become dark absorbing streams at a higher level and finally descend at a velocity sufficient to produce a marked displacement to the red, beyond the normal boundary of the Hα line.

Bright hydrogen flocculi include those of the quiescent or slowly changing type and those of short life, which change rapidly in form and intensity. These short-lived bright flocculi are themselves of two kinds: eruptions, shown by the spectrohelioscope, when near the centre of the sun, to give a displacement of the bright Hα line to the violet; and bright flocculi which are receding or stationary in the line of sight. From my recent visual observations, it appears probable that the short-lived stationary or receding bright flocculi are often due to the descent of comparatively cool hydrogen, which appears dark at high levels but turns bright as it falls. The distinction is important, as terrestrial magnetic storms and auroras will probably be found to result from the presence near the middle of the sun of bright flocculi of the eruptive type, which emit charged particles at velocities sufficient to carry them to the earth.

Spectrohelioscopes capable of distinguishing such eruptions, if they could be built at small cost and used systematically at a sufficient number of stations well distributed in longitude, should aid materially in determining the exact relationship between these solar and terrestrial phenomena. After considering several possible designs, and making a variety of preliminary tests, I am now building a solar telescope and spectrohelioscope which promise to be both inexpensive and powerful. From tests already completed, I find that a single plano-convex lens of 3 inches aperture and 18 feet focal length, used with a simple heliostat or cœlostat just large enough to fill it with light, will serve very well for the necessary solar telescope. In the spectrohelioscope a single prism, twice traversed by the sunlight, will take the place of a grating. Its dispersion will be adequate with a focal length of 13 feet, or by the use of additional prisms the focal length can be reduced. For general use, fixed monochromatic telescopes of the above type will be less expensive and probably more satisfactory than those carried by an equatorial mounting. Moreover, I have designed a spectrohelioscope for attachment to equatorial telescopes, but have not yet found opportunity to build and test it.

Continued use of the spectrohelioscope has strengthened my hope that in the hands of amateur astronomers it may contribute materially to our knowledge of the solar atmosphere. As another indication of its service, I may add that on June 26 last I observed a phenomenon recorded but once, and then incompletely, in the entire collection of Hα spectroheliograms obtained on Mount Wilson since the beginning of such records in 1908. This unique case was the sudden engulfment, on June 3, 1908, of a large dark flocculus (prominence) by the vortex associated with a sunspot, illustrated and described in "Solar Vortices," *Astrophysical Journal*, vol. 27, September 1908. The phenomenon of June 26 was very similar in appearance, and although the parallel plate micrometer was not then completed, I was able to see its final stage, which was necessarily missed in the earlier record. This was the appearance of a black dot, after the large dark flocculus had been sucked into the vortex, exactly upon the outer (preceding) boundary line of the penumbra, as in the observations of August 15 and 16. This could be seen only when the second slit was on the red side of Hα, indicating the rapid recession of the hydrogen. The detailed observations will be given later. The point to be made here is that many interesting and unfamiliar phenomena of the solar atmosphere, including cases of this kind, can be observed by any one who cares to equip himself with the simple and inexpensive apparatus required. A full description of the instruments now under construction will be published soon after the final tests have been completed.

News and Views.

There have just been placed on exhibition in the Geological Department of the British Museum (Natural History) the remains of a Stegosaur or armoured deinosaur, obtained by the late W. E Cutler from the Belly River sandstone of the Red Deer River, Alberta Baron Nopcsa, who will soon publish a description of the specimen, believes that it represents a new genus; but in any case it is closely allied to Panoplosaurus (Lambe) and Ankylosaurus (Barnum Brown) from the same beds, and is not very unlike Polacanthus (Owen) from the Wealden of the Isle of Wight. The chief interest of the specimen lies in the preservation of the plated skin still in position over the greater part of the skeleton. The bony plates range from large broad-based spikes, presumably covered with horn in life, to minute specks in the wrinkled skin of the neck. The skin of the under surface has left no trace and was no doubt relatively thin. The vertebræ of the back lie in a straight line, and the ribs were probably fused to them, as in Ankylosaurus. The sacral vertebræ are fused to one another. The vertebræ of the neck and tail were movable. The limb-girdles are clearly shown, and the large bones of the left fore-limb clearly retain their natural position, indicating a squat posture with a bend at the elbow, so that the height at the shoulder was only about three feet. The left hind-limb has been bent over the belly, and is almost complete. The skull is missing. The length of the fossil is 15 feet, and its breadth 6 feet. In the absence of jaws and teeth, the feeding habits must be inferred from those parts in allied forms. Baron Nopcsa holds the view that the creature roamed a sandy desert and lived on occasional swarms of locusts; the museum labels adopt the more usual interpretation of the Stegosaur teeth as adapted for vegetable food.

THE Trustees of the British Museum have recently placed in the Central Hall of the Natural History Museum a case illustrating the tragic effect on sea-birds of the waste oil which is allowed to escape from ships or is pumped out with bilge-water. The scene shows a portion of a beach on the south coast shortly after the turn of the tide, the sand in the foreground being still wet from the sea. At the high tide level lie six dead birds just as they have been washed up by the waves, together with the usual flotsam, while a little higher a guillemot, with glazing eye and panting breath, is evidently on the point of death. The feathers of the living and dead are heavily befouled with the thick dark liquid. A realistic touch is added by the two large flies which have already scented the dead bodies. Guillemot, razorbill, and red-throated diver are the three diving birds represented. The scene reproduces with exact fidelity an actual group of dead birds which were washed up on the Isle of Wight. Such sights are, however, by no means confined to the shores of the English Channel, and may be seen in crowded waters all over the world where oil-burning vessels congregate. The prevention of the oil nuisance was considered at an international conference held at Washington this summer, and it is hoped that as the result stricter regulations will be enforced by the several maritime nations which will lead to an abatement of the nuisance. What precisely is the action of the oil on the birds which leads to their destruction is uncertain.

THE town council of Swindon has decided to purchase for the sum of 2150*l.* the small farmhouse and land adjoining the Marlborough road at Coate, about one and a half miles from the town, which was the birthplace of Richard Jefferies. Jefferies died in 1887, and, since his death, his name, which meant so little to his neighbours during his lifetime, has attained to a certain immortality in the big railway town The small house in Victoria Street, in which the early days of his married life were spent, is marked with a tablet recording that fact. There is a 'Jefferies Club' amongst the young people of the secondary schools, and the Field and Camera Club, as well as the flourishing branch of the Workers' Educational Association, regard him more or less as their patron saint. But as with so many others, so too with Richard Jefferies: he was no prophet to his neighbours whilst he lived, and only became one when he died. In truth, to country people the "common objects of the country" are so common that they do not appeal to them, as they do to the dwellers in towns. The study of natural history has its strongholds in the large towns and not in the country districts; and this is probably even more the case now than it was fifty years ago. But the influence of Richard Jefferies, for all that, lives to-day. It was he who for tens of thousands of town dwellers discovered the beauty of the Downs and the hanging wood of the chalk escarpment, which are the characteristic features of the country that he loved so well. He was not a scientific naturalist. He troubled himself not at all as to the minute points of distinction between sub-species and varieties, so beloved by many specialists of the present day; but he was a great observer, and what he saw he set down on paper and taught others to see too, and so may rightly claim to have been one of the chief founders of that 'Nature Study' which is now regarded as a necessary means of education.

A NOTEWORTHY event of the seventy-second meeting of the American Chemical Society, held on September 6-10 in Philadelphia, was the great pilgrimage of chemists to the grave and former home of Joseph Priestley at Northumberland, Pa. It was there, on the pleasant banks of the Susquehanna River, that Priestley, in 1794, then aged 61 years, joined his sons after religious persecution had made his life intolerable in England; and it was there that he spent the remaining ten years of his life engaged mainly in the study of theology and philosophy. He never became naturalised, saying that "as he had been born and lived an Englishman, he would die one, let what might be the consequence." The house which was built by Priestley at Northumberland in 1796 has acquired additional fame from the fact that it was the meeting-place of a band of American chemists who assembled there in 1874 to celebrate the centenary of the discovery of oxygen, and to found an association which two years later developed into the American Chemical Society, now the largest chemical society in the world. In 1920 the house was in a sad state of decay, having been used during the War as a boarding-house for immigrant labour, but owing to the enterprise of the G. G. Pond Memorial Association it was purchased at public auction, thoroughly renovated, and a museum was erected on the lawn, which still bears two pine trees planted by Priestley himself.

THE ceremonies held at Northumberland on September 5 comprised a visit to the grave where Priestley, his wife, and seventeen descendants he buried; an inspection of the house and of the museum containing original apparatus and other personal effects of Priestley; and a short meeting on the lawn at which addresses were delivered, by Dr. W. H. Walker on the history of the house, and by Dr. C. A. Browne, of the U.S. Bureau of Chemistry, on the life of the famous 'pneumatic' chemist, whose great-granddaughter, Mrs. Frances Priestley Forsythe, took part in the proceedings. Although England lost what America gained when Priestley emigrated to Pennsylvania, English chemists will always be grateful to their American colleagues for the way in which they have honoured and preserved his memory. Not all of them, however, will endorse the official reference to Priestley as "the founder of modern chemistry," great as his experimental achievements undoubtedly were The number of famous chemists in different lands who have been awarded the title of 'founder' or 'father' of the science tends to become embarrassing, and it almost seems time to invoke the

Code Napoléon and put a ban on any further "recherche de la paternité."

IN a recent paper before the American Chemical Society, Dr. W. Blum, electro-chemist to the U.S. Bureau of Standards, stated that the manufacture of metal tubes and sheets by electrolytic means is fast becoming a reality. Although no details are given in the announcement before us, Dr. Blum is reported to have said that the possibility of continued manufacture on a commercial scale was not yet proven. In the past large sums of money have been spent on working out such a process, but the results have hitherto been disappointing, largely owing to the difficulties experienced in obtaining impervious deposits and uniform distribution of metal of the required structure and quality. These obstacles are now stated to have been overcome. Advantages claimed for the new process are ease in making complicated forms, and, unlike the rolling and drawing processes, thin-walled tubes are cheaper to manufacture than heavy ones.

THE future of petroleum supply is a problem that is interesting many countries to-day, and none more than the United States, which has been the chief producer and consumer since the industry began, and, it is said, is likely to be the first to have the wolf at the garage door. Nineteen years has of late been the accepted probable life of the known petroleum deposits in that country, but a more pessimistic view was expressed by Dr. A. C. Fieldner, chief chemist to the Pittsburgh Department of the U.S. Bureau of Mines, in a recent address to the American Chemical Society at Philadelphia. According to this authority, the United States owns five-sixths of all the motor cars and trucks in the world, and consumes 80 per cent. of all the motor-fuel, mainly petrol. The oil-wells of proved extent are estimated to contain 5 billion barrels of readily available petroleum, a quantity which, at the present rate of consumption, would last only until 1936; the amount left in the oil-sands, which may be recovered when ordinary pumping is finished, is about 26 billion barrels. Supplies of proved extent could be made to last until 1943 if the yield of petrol from 'cracked' oils were increased from the 35 per cent. obtained in 1925 to 55 per cent., which is regarded as a likely figure; and they could also be conserved by using engines with a higher compression-ratio than that now in vogue in the United States (about 4 : 1). Looking to the future, Dr. Fieldner foresees the use of alcohol, derived from vegetation or obtained by synthesis, for mixing with petrol, but ultimately, he thinks that oil-shale, soft coal, and lignite will be the main sources of motor-fuel. Failing these, we may have to use a light electric storage-battery, or revert to Diesel's original idea and use coal-dust in our motor-engines.

PROF. SCHWARZ, in an undated volume, "The Kalahari or Thirstland Redemption," proposed an ingenious scheme for the development of the Kalahari Desert by flooding depressions to the west and east of Lake Ngami by dams across the Cunene River and the Chobi River above its confluence with the Zambezi. The southern Kalahari was expected to benefit by two overflow channels from the projected lake near Ngami to the Orange River, and the whole climate of South Africa to be improved by the moistening of the atmosphere by evaporation from the large water surfaces. To test this project the South African Government last year sent out an expedition under Dr. Du Toit, whose opinion will carry much weight. His report, of which an abstract was published by the *Times* of September 10, declares Prof. Schwarz's scheme impracticable, and emphatically rejects its axioms that there has been a progressive desiccation of South Africa within the last century, and that the reduction in the size of Lake Ngami was the result of that change. The new report concludes that the climate has not altered appreciably within historic times. Owing to heavy rains Lake Ngami, according to recent reports, is as large as it has been ever known

THE Commission concludes that owing to the high rate of evaporation the water supplies on which Prof. Schwarz relies would be inadequate, and that for the establishment of any extensive permanent lakes the main flow of the Zambezi would have to be diverted by the erection of a dam 60 ft high across the Zambezi at Katombora, which would submerge 4,600 sq. miles. A rejoinder by Prof. Schwarz severely criticises the report on the unconvincing grounds that the expedition did not go near the Kalahari and was not led by an engineer. He declares that damming the Zambezi is "not practical politics," as the submergence of half Barotsiland and some native towns would be opposed to the Colonial Office insistence that there must be no interference with native rights. Considering, however, what has been submerged by the Nile dams, the transference of native settlements would not be a serious objection to any scheme for the better utilisation of the waters of South Africa, especially as due compensation to the natives, apart from the improved value of the rest of their land, would no doubt satisfy the Colonial Office stipulations as to native rights. The report of Dr. Du Toit, as one of the leading geologists and geographers in South Africa, will doubtless receive careful consideration.

IN the *Wireless World* for September 1, Col. Crawley gives a survey of the overseas radio services in Great Britain. He proves that, so far as radio communication is concerned, the position is satisfactory. We are now on the eve of a complete system of Imperial radio communication. The control of all the overseas commercial messages is in the hands of the Government and the Marconi Company, but the military messages are controlled by the three fighting services. The Post Office services are operated from the London General Post Office, on the roof of which eight receiving aerials are installed. To obviate the effects of local electrical interference, however, this receiving station will shortly be transferred to St. Albans. The messages received are relayed to the recording machines in the same building. These machines are placed alongside the transmitting machines which actuate the sets at Rugby, Oxford, Northolt, Stonehaven, Dollis Hill, and Caister. When the St. Albans station is ready the received signals will be relayed to the General Post Office.

THE Rugby station, with a frequency of 16 kilocycles, transmits messages to stations and ships all over the world. It is hoped also to inaugurate shortly long-range radio telephone services. The station at Leafield, near Oxford, communicates with Halifax and Cairo, both by an electric arc (24·21 kilocycles) and by a valve set (6000 kilocycles). The station at Cairo is operated by the British Post Office and communicates with Oxford, Germany, France, Italy, and Basra. At Northolt there are two aerial systems, one a valve set and the other an arc set. This station communicates with Czecho-Slovakia, Italy, and Hungary. Stonehaven communicates with Germany, Norway, Iceland, Poland, and Esthonia. Caister communicates with Holland when the cable service is interrupted, but it is normally closed. Dollis Hill is the Government experimental station. Last year the Post Office point-to-point services dealt with over ten million words of paid traffic. The Marconi Company operate an alternator station at Carnarvon and a group of valve stations at Ongar. They have a large receiving station at Brentwood. Considerable extensions are in progress. They erect the beam sending and receiving stations for the Post Office; the transmitting station at Bodmin and the receiving station at Bridgwater are practically completed.

THE Royal English Arboricultural Society held its summer meeting recently at Newcastle, with Mr. Leslie S. Wood as president and Mr. Gerald W E. Loder, vice-president. The secretary, Mr. Edward Davidson of Haydon Bridge, had arranged a programme of excursions to Middleton Hall, Chopwell, and Healey. The woodlands were evidence of the energy of those responsible—Messrs. Gerard F. T. Leather, A. D. Hopkinson, and W. St. A. Warde-Aldam. Outdoor discussions were shared by foresters, estate agents, timber merchants, nurserymen, and university lecturers. South country visitors were surprised to see little planting of ash, elm, sycamore, though these with birch and mountain ash come by natural regeneration. The timber merchants' control demands conifers for pit props, especially larch. Sitka, Douglas, Corsican, Japanese larch are being tested by the acre. Pre-War plantations are thriving. Even in war-time some planting was achieved. Post-War planting has struggled against increase of rabbits and a legacy of forst weeds, gorse, bracken, and bramble. Gorse has been twice cut, and the trees may now outgrow it. Bracken has grown apace this year, cutting seems necessary. The blackberry-picking problem is accentuated when the forest is on the edge of an unemployed mining village. One estate was remarkable for continuity of management—only three foresters in a century; another for the high qualifications of its officers although their reigns have been short; a third for the skilfully arranged economies of an estate railway, sawmill and woodwork shops, the engine fed by gas generated from scrap and sawdust.

A REMARKABLE find of Mycenæan treasure is described by Mr. A. J. B. Wace in the *Times* of September 10. The Swedish Archæological Expedition to Greece, in excavating a beehive tomb near the village of Dendra, which lies at the foot of the acropolis of the Homeric Midea in the neighbourhood of Nauplia, has discovered four grave-pits, two of which are undisturbed. This is the only untouched burial hitherto found in a beehive tomb, excepting that at Vaphio from which the famous Vaphio cups were obtained. In one of the undisturbed pits lay two extended skeletons, one male, the other female. In the second was a female skeleton. The 'king' was covered almost from head to foot with gold, silver, and other riches. On his breast was a magnificent golden cup, 18 cm. in diameter, cunningly chased with what is described as "almost . . a submarine seascape," the figures including argonauts, dolphins, and four octopuses. Artistically and technically the cup is a masterpiece. In the cup were the king's seals, and on or by his body were bronze swords with hilts of gold, or ornamented in gold, silver vases, a gold cup sheeted with silver, a bronze vessel, knives and spearheads. With the 'queen' lay a splendid gold cup sheeted outside with silver inlaid in gold, bronze, and black silver. Other treasures were a necklace of 61 gold beads, a lamp of steatite and a vase of ostrich-egg with applied ornament in gold, silver, and bronze. The 'princess' was less richly supplied, but had a gold ring, a necklace of 38 gold beads of rosette form, and the remains of a girdle. All the finds, excepting the 'king's cup,' are of a comparatively late date, on the ceramic evidence scarcely earlier then 1350 B.C. The older cup, it is suggested, may be an instance of the burial of an heirloom or antique, in which case, Mr. Wace points out, it indicates caution in accepting theories recently put forward that the beehive tombs should be dated much earlier than they usually are.

PROF. V. H. BLACKMAN, Prof. F. G Donnan, and Prof. F. A. Lindemann, have been appointed by Order of Council dated August 20, 1926, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, in succession to members who have retired on the completion of their terms of office

THE ninth International Congress of Zoology, held at Monaco in March 1913, decided that the tenth Congress should take place in 1916 at Budapest, with Dr G. Horváth, Hungarian National Museum, Budapest, as president. The War rendered the meeting impossible. The international situation, however, has now so much improved that the Congress need no longer be postponed. After due consultation with members of the permanent committee of the international congresses of zoology, Dr. Horváth is able to announce that the tenth Congress will meet at Budapest on September 4-9, 1927, and he cordially invites all zoologists and friends of zoology to attend. The detailed programme of the Congress will shortly be issued and sent to all who are interested.

A SERIES of Sunday afternoon addresses under the general title of "The Contribution of Science to Human Life" is to be given during the autumn at the Guildhouse, Eccleston Square, London, W. The lectures are free, and no tickets are required. The lecturers and their subjects are as follows: Oct. 3, Sir Richard Gregory, the worth of science; Oct. 10, Dr. Bernard Hollander, sound and unsound mind; Oct. 17, Sir Sefton Brancker, the scientific problems of commercial aviation; Oct. 24, Dr. W. A. Bone, the economic aspects of coal; Oct. 31, Prof. H. H. Turner, the fight against fear; Nov. 7, Dr. W. H. Eccles, the influence of wireless on modern life; Nov 14, Dr. E. E. Fournier d'Albe, eyes and ears of the future; Nov. 21, Dr. G. C. Simpson, meteorology in the service of man; Nov. 28, The Right Hon. Viscount Haldane, the wider meaning of relativity; and Dec. 5, Sir George Newman, the contribution of medical science to human life.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant in the anatomy department of the University of Aberdeen—The Secretary (September 27). A head master for the Eye Grammar School, graduate, science preferred (with agricultural bias)—W. E. Watkins, Hon. Clerk to the Governors, County Hall, Ipswich (September 29). A joint keeper of archæology in the National Museum of Wales and lecturer in archæology in the University College of South Wales and Monmouthshire—The Director, National Museum of Wales, Cardiff (October 16). A senior lecturer in zoology and physiology at Huguenot University College, Wellington, Cape Province, South Africa—The High Commissioner for South Africa, Trafalgar Square, W.C.2. A laboratory attendant for histology in the anatomy department, University College, London—Prof J. P. Hill, Anatomy Department, University College, Gower Street, W C.1.

Our Astronomical Column.

THE METEORIC PHENOMENA OF SEPTEMBER 6.—Mr. W. F. Denning writes that a large number of observations have been received of apparently two large fireballs which illuminated the sky in many parts of England on the evening of September 6 at about 20^h 30^m and exactly at 20^h 45^m G.M.T. respectively. The data collected have not yet been thoroughly discussed and will necessarily take some time. The first meteor appears to have travelled from a southern radiant northwards and was observed at places so distant as Wanstead, near London, Durham, the south-west of England, and Sunderland. It gave a considerable light and some persons mistook it for lightning, but its motion to north dispelled the idea.

The second meteor made its apparition about 10 or 15 minutes later, and was no doubt the most brilliant object of the pair. Its path was also to the northwards, and it terminated its career by a series of loud detonations when it was some miles south of York. This meteor appears to have given several flashes of dazzling brilliancy; for some observers compared its light with that of the sun. For a moment or two it illuminated the landscape as it is at noonday. Some fragments of this object may possibly have fallen to the ground unobserved in the north-east region of Yorkshire, but no evidence of actual stonefalls has been received. In the district of Selby, and Goole, Yorkshire, the height of the fireball was about 26 miles, and it was decreasing.

The first object seen on September 6 appears to have been of very unusual size and aspect. Did it represent anything of similar nature to the auroral beam which passed over England on November 17, 1882?

THE UNIFORMITY OF THE EARTH'S ROTATION.—M. Bigourdan, of the Paris Observatory, contributes an article to *Comptes rendus de l'Académie des Sciences* for August 30, in which he points out that the comparison of the clocks of a large number of observatories by the aid of wireless time-signals distributed from Bordeaux-Lafayette, Saigon, Honolulu, and Washington, should afford a very delicate test of the uniformity of the rotational movement. It is not even necessary for this purpose to await the determination of the errors of the different clocks, provided that their daily rates are uniform to 0·01 sec. or thereabouts. Comparison of 100 such clocks will permit the testing of the uniformity of rotation to the order of 0·001 sec. The present time is particularly appropriate, as the International Astronomical Union has arranged for a general series of wireless longitude determinations to be made between October 1 and November 30 next.

A very large number of signals will be recorded at each observatory, but a small number will suffice for M. Bigourdan's purpose, and he asks that observers will communicate to him the Bordeaux-Lafayette signals Nos. 113-122 and 235-244, that is, those just preceding 20^h 3^m 0^s and 20^h 5^m 0^s of Universal Time. The uncorrected clock times of reception of the signals will suffice, and they need only be sent for the period of 30 days, commencing on October 15. It will be remembered that many astronomers, including Prof. E. Brown, now attribute the unexplained irregularities in the moon's motion to changes in the earth's rate of rotation. The inequalities that M. Bigourdan wishes to examine are of much shorter period than these, but analogy leads one to expect that if inequalities are present at all they may have many different periods.

MR. WILK'S COMET ANNOUNCEMENT.—It has now been confirmed that a motion among the stars of a degree in 4 minutes of time was the correct interpretation of the telegram from Cracow Observatory referred to last week, p. 388. Since no further observations have been received, it is evident that the material is insufficient to pronounce definitely in favour of the cometary nature of the object. It may have been a patch of aurora or the trail of a meteor in the upper atmosphere.

Prof. Perrine and his assistants observed a somewhat similar object at Cordoba in May 1916. In that case also its nature remained doubtful, but Miss Glancy showed that, if a comet, it must have approached very near to the earth (even closer than the moon).

Research Items.

THE MAGLEMOSE CULTURE.—Some interesting observations on the genesis of the Maglemose culture were made by the Abbé Breuil in a communication to the Institut Français d'Anthropologie, and are now published in *L'Anthropologie*, T. 36, Nos. 3-4, *à propos* of a characteristic harpoon from Béthune, dated 1849, now in the British Museum. Similar harpoons from the Béthune marshes and from Isbergues near by are recorded. Deer's antlers, pierced and ornamented, from the Somme and Paris described by Acy afford further incontestable evidence of Maglemose influence. Several examples of Maglemosian harpoons have come from Belgium; but in the Musée d'Histoire Naturelle of Brussels are a number of unpublished harpoons found by M. Lequeux in mixed Tardenoisian-Maglemosian sites, and quite recently investigations still going on have brought to light harpoons in which the barbs are made of Tardenoisian triangular implements. A harpoon ornamented in Maglemosian style has also been found at the proto-Tardenoisian level of the Remonchamps site. The opinion already expressed, though not accepted by Scandinavian archæologists, that while Maglemose is related to the Magdalenian, but not directly descended from it, being rather a result of a combination of Magdalenian and eastern elements coming from the direction of the Urals, has received support from the discovery at Wercholensk, near Irkutsk, of an Upper Palæolithic site with harpoons. While the harpoon is a link between Magdalenian and Maglemose, the difference in the decorative art precludes close connexion. Even the style of the harpoons found on the peripheral Magdalenian sites of Central and Eastern Europe, like the decorative art, have distinctive characters indicating important ethnic differences. A composite origin for Maglemose is therefore suggested, including provincial Magdalenian of Central Europe, oriental (decorative motives and Campignian forms), a Southern or Mediterranean influence (Tardenoisian), and possibly a late Palæolithic from Scandinavia when Norway was free from ice during the latest oscillations.

PHYSICAL ANTHROPOLOGY OF THE JAPANESE.—A study of the cephalic index and the stature of the Japanese, by Akira Matsumura, is published by the Imperial University of Tokyo as Vol. 1, Pt. 1 of Section 5, Anthropology, of the *Journal of the Faculty of Science*. The chief point that this study serves to emphasise is the marked differences in head form and stature which are to be found among the population. The Japanese, both men and women, are brachycephalic, the men slightly less so than the women, but the mean values of the cephalic index according to locality differ from province to province. The variability in head measurements also differs from province to province. On the whole, the south-western district, which has received the benefits of culture from ancient times, is more variable than other parts where civilisation arrived later. In head-length, head-breadth, and cephalic index, the Japanese differ from the Ainu and Koreans. They appear to resemble closely the people of eastern Siberia and south China. As regards variation, however, the Japanese are less variable than the Koreans in head measurement; but sensibly more so than the Ainu. The stature of men and women has shown a tendency to increase slowly during the last ten years. The variation in stature as between provinces is marked, but not so much as is the cephalic index. The relation of stature to cephalic index is also different for each province. As in the case of head-form, the Japanese in stature resemble the peoples of eastern Siberia, south China, and Indo-China, and not the Koreans or the Ainu. By combining the stature and cephalic index, grouped according to the significance of the differences between means, it is found that the Japanese fall into nine different local groups.

THE EFFECT OF THE GROUP ON MENTAL WORK.—In the *Indian Journal of Psychology* (vol. i. No. 2) N. N. Sen Gupta and C. P. N. Sinha report an interesting piece of research on mental work done in isolation and in the group. Five subjects took part in the experiments and the test employed was the well-known cancellation. The same column taken from a number of copies of a daily paper was given to each subject and he was asked to cancel all the 'a's' and 'e's' for a period of three minutes. Each subject did the test several times alone and also as a member of the group. The writers exercised the frequently neglected precaution of securing that adequate practice had taken place beforehand. The results show a significant difference in favour of working in the group. The reasons for this result cannot yet be given. It would be necessary to know whether other subjects gave the same result, how long such group stimulation could operate, whether different types of people reacted differently. It is a commonplace in industrial occupations that some people prefer to work alone while others dislike it. From the statistical point of view, we would suggest to the writers that the standard deviation or probable errors should be inserted. In this case all the details are given and the reader can work them out, but with larger numbers that would not be possible.

TERTIARY MOLLUSCAN FOSSILS FROM KOREA.—Comparatively little is known concerning the Tertiary invertebrate fauna of Korea, but Jirô Makiyama is now able (*Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, vol. 2) to add somewhat to our knowledge regarding the mollusca. His specimens came from beds in the neighbourhood of Meisen, North Kankyô-dô, which have been divided by the Japanese geologists into two groups: a lower, or Ryûdô group, which contains a rich flora of the so-called 'Arctic Miocene,' and an upper or Meisen group. This last is further subdivided into three members: in ascending order, the Heirokudô, the Kanchindô, and the Mankodô. These J. Makiyama, from their fossil molluscan contents, is lead to infer belong respectively to the Upper Eocene, the Oligocene, and the Lower Miocene. The author comments on the fact that some of the Korean forms recall corresponding ones from Europe, from Nigeria, and California, but none resembles those from the Eocene of either India or Java. The main part of the paper contains the descriptions of the sixteen new species, which form the bulk of the material, and are figured on two well-executed photo-litho. plates.

LAND MOLLUSCA OF PANAMA AND COSTA RICA.—Considerable interest attaches to the land molluscan fauna of southern Central America on account of the light its study should yield as to the region where the typical North American assemblage gives way to that of South America. Dr. H. A. Pilsbry (*Proc. Acad. Nat. Sci.*, Philad., vol. 78) describes and gives a catalogue of all the Panamic land mollusca, including that of the Canal Zone. Seventy-seven species and three subspecies, including nine new species and five new subspecies, referable to thirty-one genera are now known from this area. Their geographical relations are set forth in a table with indications of the northern and southern limits of the genera and species. It results that thirty-four species have been found only in Panama and the Canal Zone; twenty-four also occur northward; thirteen both north and south; and six species only southward. From these and other statistics it appears that while the transition between the South American and tropical North American faunas is gradual, some genera of each region penetrating far within the other, the change is most rapid in a comparatively short section of the isthmus at and immediately east of the Canal Zone. Some modification, however, may be expected with further research, which may even double the present number of species. Appended are notes on the classification of snails from Mexico to Columbia, referred by authors to Microphysa and Thysanophora. Four new genera, six new subgenera, and three new species result from this investigation. The foregoing is followed by descriptions by the same author of Costa Rica land shells collected by A. A. Olsson. It is a short communication, but yields one new genus, four new species, and one new subspecies. Excellent figures throughout the text and on three plates illustrate the two papers.

A SMALL ULTRA-VIOLET SPECTROSCOPE.—For the convenience of those using ultra-violet light, Messrs. R. and J. Beck have introduced a small quartz prism spectroscope which can be held in the hand and requires no source of light other than that to be observed. The spectrum is formed on a fluorescent screen so that the lines are visible. The scale is in Ångström units and extends from 2000 to 4500, each 100 units being marked.

INTERMITTENCY IN PHOTOGRAPHIC EXPOSURES.—Mr. Raymond Davis, photographic technologist in the Bureau of Standards, Washington, finds that if the exposure is intermittent, such as is produced by the rotation of a sector wheel in the incident light, an equivalent exposure, as compared with the effect on development of a continuous exposure, may give either a gain or a loss (or an intervening zero effect) in the resulting density, according to the intensity of the illumination. That a more intense light gives a gain "has not been heretofore brought out." As an explanation of this result he suggests that the action of light on the silver haloid is not a single step or simple conversion into the developable image, but that there are two actions going on simultaneously which produce respectively a lessening and an increasing of the recipient exposure effect, the more intense light favouring the increase and the feebler light the decrease, during the intervals of nonexposure of an intermittent exposure. These results vary with the nature of the emulsion and the illumination, as well as with the number and duration of the intervening nonexposure periods. The experiments suggest that with illumination intensities higher than 4-candle metres, the growth of the exposure effect during the intervals would probably exceed the fading in all cases.

GASEOUS COMBUSTION AT MEDIUM PRESSURES.—Experiments by R. W. Fenning on air-fuel explosions in closed vessels have been in progress at the National Physical Laboratory during the last five years, and the results relating to carbon monoxide and methane have been published in No. 998 of the Aeronautical Research Committee's reports and memoranda. Two investigations are described, the first deals with the effect of hydrogen-air mixtures and water vapour on carbon monoxide-air explosions in a closed vessel, and the second relates to explosions of methane and air over a range of temperatures and pressures. The report includes tables of explosion temperatures and pressures, and the results are illustrated by reproductions of indicator diagrams under various conditions.

COPPER HYDRIDE AND ITS CRYSTAL STRUCTURE.—The *Journal of the Chemical Society* for July 1926 contains an interesting paper by H. Müller and A. J. Bradley on copper hydride and its crystal structure. *Cuprous* hydride was prepared by a method similar to that of Wurtz, namely the interaction of hypophosphorous acid and copper sulphate. The ratio of copper to hydrogen was determined by combustion, or by a method analogous to the Schiff nitrogen estimation, and was found to agree with the formula CuH. X-ray diagrams were obtained by the Debye powder method and the crystal structure was shown to be hexagonal close-packed with an axial ratio of 1·59-1·60. The X-ray spectrum of the substance obtained by the reduction of copper oxide with hydrogen, or the action of hypophosphorous acid on copper sulphate and copper oxide, which was considered to be *cupric* hydride, corresponded exactly with the spectrum of a mixture of copper and copper oxide. In conjunction with other evidence, the results of these experiments cast considerable doubt on the existence of *cupric* hydride.

THE CATALYTIC DECOMPOSITION OF NITRIC OXIDE.—When exposed to heated platinum wire at temperatures from 1000°-1500°, nitric oxide decomposes into nitrogen and oxygen; and if the products are allowed to cool before the reaction is complete, nitrogen peroxide is formed from the unchanged nitric oxide. This involves a diminution in volume, and the maximum contraction occurs when the oxygen produced is sufficient to combine with all the residual nitric oxide. A paper in the July issue of the *Journal of the Chemical Society* describes the temperature and pressure measurements made by T. E. Green and C. N. Hinshelwood, which prove that the order of the reaction $2NO = N_2 + O_2$ is unimolecular with respect to nitric oxide. It is uninfluenced by nitrogen but retarded by oxygen. Jellinek has shown that the ordinary thermal decomposition is bimolecular; this is, therefore, an example of a reaction which is bimolecular in the gas phase becoming unimolecular at the surface of the catalyst.

ACTIVE NITROGEN.—There are two views as to the nature of the active modification of nitrogen which is produced when an electrical discharge is passed through the gas at low pressures: that it consists either of atoms or of metastable molecules in an excited form. E. J. B. Willey and E. K. Rideal conclude from their experiments on the heat of formation of active nitrogen, which are fully described in the *Journal of the Chemical Society* for July 1926, that metastable molecules are the cause of the activity. The heat of formation was calculated by measuring the rise in temperature in a calorimeter, first when active nitrogen reacted with nitric oxide and secondly when the gas underwent catalytic decay in the presence of the air. By means of a calibrated heating coil in the calorimeter, the temperature changes observed in these experiments were reproduced and the heat equivalent of the reactions obtained. The mean value for the energy content of the active nitrogen was found to be 42,500 cals. per g.-mol.

Patent Office Statistics.

THOSE who are interested in the industrial applications of science will find much that is worthy of their attention in the recently published report of the Comptroller-General of the Patent Office for the year 1925. The report consists entirely of statistics, so that, in the absence of any official commentary, an attempt to analyse some of the figures and to compare them with those given elsewhere may perhaps be of value, for the relation between invention and industrial prosperity is an intimate one Further, it is of interest to assess the quality of the services rendered to the State by the Patent Office, not only because this is essentially a scientific department, but also because it has been felt for some time past that the Patents Acts cannot be left where they are: and the question whether the desired improvements are practicable is one which depends in great measure on the degree of efficiency with which the existing system is being administered.

The number of applications for British patents filed during 1925, namely, 33,003, exceeded the numbers filed during 1923 and 1924 by 1·1 per cent. and 5·2 per cent. respectively, the corresponding excesses in the case of the United States being 4·3 per cent. and 4·2 per cent. respectively. Too much importance should not be attached to these figures, however, for fairly wide fluctuations are common even in normal times. In fact, when averaged over several years, the annual input of patent applications appears to depend, for countries having comparable patent and industrial systems, mainly on the population of the countries considered: thus, the number of applications per 10,000 of the population is, under normal conditions, roughly 7·5 in Great Britain, 7·3 in the United States, 7·2 in Germany, and 8·7 in Switzerland. In France, however, which is more extensively agricultural and has a backward patent system, the corresponding figure is only 4·8. It is contended by the United States Commissioner of Patents that fluctuations in the input of patent applications are in some sort an index of fluctuations in national prosperity: and though his contention would require considerable qualification before it could be generally accepted, the upward trend of inventive enterprise in Great Britain is satisfactory so far as it goes. The number of patents actually sealed in 1925 was about 52 per cent. of the number of applications filed, and 88 per cent. of the number of complete specifications filed. These figures indicate the extent to which worthless patents are weeded out by the official examination and various other causes, but no figures are given which would enable us to judge the effect of the official examination on the drafting of the specifications finally issued; nor is any information given as to what the United States Commissioner calls the 'gain in dates.' In the United States, the average time which an applicant had to wait for the first official action was reduced in the course of the year from 4·5 to 2·6 months, and the delay in dealing with amendments from 3 or 4 to 2·3 months. Promptness in the issue of patents is of such importance that it would be of interest to the public to know how far the British office has been able to make good the ground lost during the War. It is to be noted that the examining staff has been reduced in strength from 260 in 1913 to 241 in 1925: such economies are desirable in themselves, but the 'gain in dates' is of greater importance, and the public might with advantage be allowed to know how this matter stands.

As regards the nationality of applicants for British patents, it is to be noted that the percentage of these residing in Great Britain fell from 75 per cent. in 1923 to 69·8 per cent. in 1924 and 68·1 per cent. in 1925: at the same time the percentage residing in the United States rose from 8·2 per cent. to 8·9 per cent. and then to 9·6 per cent. Further, it must be remembered that only the best of the foreign inventions will be considered worth patenting outside their country of origin, and consequently the great majority of applications coming from abroad lead to the actual grant of patents. Thus in 1923 (the latest year for which complete data are available) 16 per cent. of the patents actually granted (as distinct from mere applications) were granted to persons residing in the United States, and only 57 per cent. to persons residing in Great Britain: for the previous year the corresponding figures were 15·5 per cent. and 59 per cent. respectively. Of the patents issued by Germany in 1923, 80 per cent. were granted to Germans, 2·1 per cent. to Britons, and 2·8 per cent. to Americans, while Germans took 6·5 per cent. of the British patents and 2 per cent. of the United States patents. These figures are not likely to change greatly, in the absence of unforeseen causes, for they must be ascribed mainly to differences in population between the countries concerned: thus, in the year 1923, while 3 out of every 100,000 Britons took United States patents and 2·3 took German patents, 2·5 out of every 100,000 Americans took British patents and 1·2 took German patents, and 1·6 out of every 100,000 Germans took British patents and 2·4 took United States patents. Out of every 100,000 Frenchmen, 2·5 took British patents.

For the year in question, 6615 or 43 per cent. of the British patents were taken by foreigners, while the corresponding figures for the United States were 4465 or 12 per cent., and for Germany 9127 or 20 per cent. The German patent is thus the most popular among foreigners, as judged by the absolute figures, and its popularity is not due to abnormal economic causes. In 1912, for example, when Germany issued fewer patents than now, 4251 or 32 per cent of these were granted to foreigners. (The German '*gebrauchsmuster*' are excluded from the preceding figures.) But when we consider *percentages* we find that not much less than half of the monopolies which Great Britain grants for the manufacture and sale of goods within her borders are granted to persons residing outside the country: and we find that this state of things, depending as it does on differences of population, is likely to continue. It is to the advantage or the disadvantage of British industry according as the monopolies granted will be used for the purpose of developing new industries in Britain, or for the purpose of obstructing British manufacture in favour of imports. Examples can be cited in which each of these effects has been produced, but no general statistics are available for ascertaining the balance of good or ill which at present results from the grant of patents to foreigners. The Acts provide that where a patent is being obstructively used, an interested party may apply to the Comptroller-General for the compulsory grant of a licence to work the patent, or for its revocation. but in 1925 *only two such applications were made, and one of these was withdrawn*. It may be mentioned in passing that of the patents granted by Canada, about 70 per cent are held by persons residing in the United States.

While the Patent Office is not empowered to make an exhaustive investigation into the validity of the patents which it grants, it does make an investigation of limited scope which is relevant to validity: and the Comptroller-General has powers which constitute him a court of first instance for the trial of certain legal issues. It is of interest, therefore, to see with what degree of efficiency the Patent Office discharges its legal functions. The report before us shows that in 1925 the Comptroller-General, or rather three senior members of the corps of examiners who appear to have acted for him, gave decisions in over 2000 'hearings' under various sections of the Patents Acts, and in 84 'oppositions' brought by interested parties against patents provisionally granted. The quality of the work done in these cases can best be gauged by reference to the decisions of the Law Officers of the Crown, to whom a cheap appeal lies from the findings of the Patent Office. It appears that 27 appeals against the 'opposition' decisions of 1924 and 1925 were disposed of during the year, the official decision being vindicated in 20 cases (including 4 cases of withdrawal), varied in 2 cases, and reversed in 5. The appeals against 'hearing' decisions which were disposed of during the year numbered 42: the official decision was vindicated in 34 cases (including 3 cases of withdrawal) and reversed in 8. Actual figures for the number of hearings held during the year are given for only three sections of the Acts: the number of hearings under these sections was 2088, of which 0·33 per cent. gave rise to successful and 0·86 per cent. to unsuccessful appeals. As regards the work of the corps of examiners as a whole, it is to be remarked that while 19,434 complete specifications were examined and 17,199 patents sealed during 1925, the official actions taken have now been accepted by all concerned except in the case of 11 successful and 5 outstanding appeals, unless any further question should arise upon them in the High Court.

In the financial section of the Comptroller-General's report the tables of receipts and expenditure are fairly complete, and take account of such items as depreciation of buildings, the estimated value of pension rights, and the upkeep of the public library; but a more precise statement of the distribution of the staff would be of interest when it is desired to estimate the cost of changes in the patent system. Of the revenue 82 per cent. is derived from Patents fees, 2·4 per cent. from Designs fees, and 9·9 per cent. from Trade Marks fees. The total of Patents fees, namely, 391,677*l*., is made up of items which may be divided into three groups. The first group comprises items which are likely to give a fairly constant yield in future years, namely, the initial filing and sealing fees (28 per cent. of the whole), renewal fees for the 5th, 6th, and 7th years (24 per cent.), and miscellaneous fines and fees (9 per cent.). The total of these, accounting for 61 per cent. of the yield of patents fees, may be regarded as normal. Renewals for the 8th to the 11th year (of war-time patents) are affected by the War, and their total (18 per cent.), being abnormally low, will improve during the next few years. Renewals for longer periods (21 per cent.) do not yet show the effect of the War, and their yield will therefore fall off for a few years to come. On the whole, therefore, revenue is likely to be stationary, and in the absence of new expenditure the inventor will continue to pay large sums in relief of general taxation. The surplus was 75,203*l*. in 1924 and 88,540*l*. in 1925, after accounting for all imaginable charges and meeting the deficit on publications and the upkeep of the library, which represents a service to the general public. The United States Treasury, on the other hand, subsidised the American Patent Office to the extent of 81,720*l*. in 1924 and 68,150*l*. in 1925, so that the United States subsidises invention to nearly the same extent that Great Britain taxes it.

The financial section of the report is also relevant to the degree of efficiency with which the Patent Office is administered, for under the prevailing conditions the most rigid economy is incumbent, as a patriotic duty, upon public departments. It is extremely difficult to find a standard by means of which administrative economy may be measured, but we can obtain some idea as to how far an economic spirit prevails at the Patent Office by comparing its present scale of staffing with that which obtained before the War, with that which obtains in the United States, and with that which obtains in other comparable Government Departments in Great Britain. We find that whereas the number of patent applications per annum has increased by 10 per cent. as compared with 1913, the strength of the corps of examiners has decreased by about 8 per cent., so that each member is on the average dealing with 20 per cent. more applications now than before the War. The salary bill for this section of the staff is not distinctly shown, but if we estimate the cost-of-living bonus from the average salary and then assume that (in accordance with the Ministry of Labour index) 1*l*. in 1925 was equivalent to 0·57*l*. in 1913, the 'real' or purchasing value of the salary bill appears to have decreased by 6 per cent. As regards the auxiliary staff, there is no sign of any increase in strength or cost disproportionate to the increase in work done, the 'real' salary bill for the whole office being 2 per cent. more than that for 1913. The staffing is roughly on the same scale as that of the United States Patent Office. In each case there are 130 to 140 patent applications per annum per member of the corps of examiners, and the duties in the two cases, though not identical, are probably comparable. Our third comparison may conveniently take the form of a table, the contents of which have been compiled from the Estimates (Class II.) for 1926–7:

Department.	Total staff.	Number of posts with salaries rising to a maximum of		Total of higher posts.	Percentage of higher posts.
		1000*l*. to 1800*l*.	2000*l*. and more.		
Treasury	331	21	11	32	9·7
Foreign Office	839	25	3	28	3·3
Ministry of Transport	524	11	2	13	2·5
Board of Trade (Head Office)	667	8	5	13	1·9
Ministry of Agriculture	1197	14	3	17	1·4
Patent Office, with Trade Marks and Designs Branches	685	4	0	4	0·38

From the point of view of economy, attention may also be directed to the large amount of judicial work performed by the Hearing Officers, as set out above. For men who doubtless have other important duties to perform, the record of 2172 hearings and oppositions is a remarkable one.

The outstanding inferences to be drawn from the Comptroller-General's figures appear, then, to be that an enormous proportion of British patents is held by foreigners, while manufacturers take no advantage of the existing facilities for the grant of compulsory licences; that the legal work of the Patent Office is admirably performed; that the Office is administered in a spirit of economy which deserves particular attention; and that a large annual surplus is available for the improvement of the patent system when this step is considered desirable.

The Royal Photographic Society's Exhibition.

THE Royal Photographic Society's Annual Exhibition is now open at the Society's House, 35 Russell Square, London, admission being free; and it closes on October 9. In the Scientific and Technical Section the items that seem to be the most novel or the least often seen are some results obtained by a combination of the cinematograph and microscope, and a photograph of the ultra-violet spectrum of silicon by Prof. A. Fowler, of the Imperial College. This is done in sections, from wave-length 2820-2420 Å.U. on ordinary plates, from 2250-1840 Å.U. on plates smeared with a fluorescent oil, and from 2150-1250 Å.U. on Schumann plates using a vacuum grating spectograph.

Cinematography is more fully represented than it has been before. Dr. S. Bayne-Jones shows the life-history of the Penicillium, taking the pictures at the rate of two per minute by means of an automatic mechanism which also turns on the light. Dr. S. E. Sheppard and Dr. R. H. Lambert, of the Kodak Research Laboratory, have photographed the electrophoresis of rubber latex particles, the film showing the Brownian movement of the particles and their movements in an electric field. Mr Loyd A. Jones, also of the Kodak Research Laboratory, has studied the growth of crystals using elliptically polarised light and the 'Kodachrome' process, and he contributes films of six different substances in very realistic colours. There are several other films of the more usual type and also a collection of historic films, including the famous train film of Lumière Bros., which was the first ever exhibited to a paying audience (in 1895). Photo-micrography is associated with colour processes in the four autochromes of Dr. C. F. Elam, of the Royal School of Mines, which show at a magnification of × 100 various crystalline forms of silver nitrate taken between crossed Nicols. Dr. L. F. E. Johnson, besides two slides taken in a similar way, has two illustrations of fabrics as they appear under the microscope when illuminated by Rheinberg's differential colour stop, which shows the warp red and the weft blue.

Of the numerous photo-micrographs taken in the usual manner we would direct attention to Dr. G. H. Rodman's series of 24 which illustrate the various forms of hairs occurring on plants which are recognised as liable to produce mischief (sting, etc.) in those who come in contact with them; Mr. J. H. Pledge's 9 photographs (× 10) of an Indian mistletoe that has no leaves; cultural types of meningococci and gonococci from the Lister Institute of Preventive Medicine; and a series of the rabbit embryo in utero and rabbit placenta, each showing various stages in its development, by Mr. G. S. Sansom. There are many others of considerable merit and interest, and a large collection that shows the present results of metallography obtained in numerous laboratories where it is practised, including the National Physical Laboratory. Viewing the photo-micrographs as a whole, the difficulty of getting good results at certain rather low magnifications seems to have been entirely overcome, and they indicate that no more detail is obtained by increasing the magnification above about × 2000.

Radiography and photographic printing in colours are as well represented as ever. The structure of emulsions, and the changes produced in the silver bromide grains, are shown by Mr. L. F. Davidson and the British Photographic Research Association, and Mr. L. E. Jewell shows the advantage of what he calls 'relief illumination' in photo-micrography, that is, the mirror in the vertical illuminator is considerably decentred so that there is a mixture, in regulatable proportions, of oblique specular and diffused light. The General Motors Corporation of Michigan, U.S.A., contributes prints of its Midgley Optical Gas Engine Indicator, which records as curves the character of the combustion in automotive engines. Of the various trade exhibits, those that impressed us most were Messrs. Ross's rapid speed photographs of the last test match taken with a 40-inch *f*/8 Teleros lens from outside the ground, and Messrs. Ilford's illustrations of the method of making and testing their light filters

Smoke Abatement Conference.

A CONFERENCE on smoke abatement was held in Birmingham last week, organised by the Smoke Abatement League of Great Britain, in connexion with an exhibition of apparatus and methods bearing upon fuel economy and the abolition of smoke. The conference was divided into two main sections, one of which dealt with the industrial, and the other with the domestic, smoke problem. On the morning of September 7, Mr. J. Robson read a paper dealing with smoke in Bengal, describing the action taken to prevent undue emission. A special smoke commission was appointed, and it was stated that, since 1906, 90·8 per cent. of the smoke from factory chimneys had been abolished—a remarkable achievement. In an evening address on the same day Sir John Robertson, Medical Officer of Health of Birmingham, emphasised the injury done by smoke in obstructing the sun's rays, more particularly the ultra-violet. This affects children especially, and results in a failure to deposit lime salts in the bones and teeth, thus causing rickets and dental decay. It was stated that the exposure of rickety children to sunlight is an almost certain cure if the disease has not progressed too far.

In the conference Dr. Fishenden gave a general summary of the position relative to the low temperature carbonisation problem, and the general trend of the discussion showed that the real difficulties in producing a low temperature coke, suitable for domestic use, are financial and economic rather than technical. Nothing new or of outstanding interest was brought forward in connexion with the industrial side of the smoke problem, but there was a general agreement that the real reason why industrial smoke still remains a serious evil in Great Britain is not any technical impossibility in preventing it, but rather the absence of any special effort to do so on the part of many manufacturers.

On the domestic and housing side of the conference there were several interesting papers—one by Mr. E. D. Simon and Miss Marion Fitzgerald. This gave valuable statistics of the steps taken in different places in connexion with new housing schemes. The Ministry of Health was criticised somewhat severely for "totally ignoring" the recommendation in the Interim Report of the Departmental Committee on Smoke Abatement that "the central housing authority should decline to sanction any housing scheme submitted by a local authority or public utility society unless specific provision is made in the plans for the adoption of smokeless methods for supplying the required heat." This criticism was afterwards replied to by Mr. Poynton-Taylor, chief assistant architect of the Ministry of

Health, who endeavoured to show that they had done as much as they could.

A paper by Messrs. R. Unwin and Poynton-Taylor, chief and chief assistant architects respectively of the Ministry of Health, dealt with the problem of the domestic fire and set out the methods at present available. In the discussion on this there was an expression of opinion against the 'all-electric' house as a possible solution of the smoke problem, owing to the high cost of electricity and the absence of the ventilating effect with electric heaters. Messrs. Unwin and Taylor described the theory of 'zoning,' whereby the factories in a new town should be located outside the town, and on that side where the prevailing wind would blow the smoke away from the living quarters. Dr. Owens criticised the soundness of this principle, suggesting that it is the light anti-cyclonic, rather than the strong turbulent south-west, prevailing wind which should govern the position of factories; concentration and low drift of smoke are characteristic of the former, while dilution—owing to high velocity and turbulence—with the latter makes smoke of less consequence. He therefore suggested that factories should be so situated that the light easterly anti-cyclonic wind does not blow smoke over the living quarters.

Dr. Leonard Hill gave to the conference a paper on ventilation and heating, in which he stated that the most healthful form of heating is by a bright, visible source. He said, "We want, then, an elastic system of heating, not plenum or stove heating with windows all sealed up, but a fire which can be made up or let down, and an open window." Radiant heat and cold air are his ideals of healthful heating.

The chief interest in the conference centred round the domestic heating problem and the need for a cheap, smokeless, solid fuel which, apart from ordinary gas coke, is not available in sufficient quantity at present to help materially. Probably the most valuable effect of the conference was to keep before the public the importance of smoke abatement rather than any specific contribution towards the solution of the problem.

University and Educational Intelligence.

Cambridge.—The commemoration of the tercentenary of the death of Francis Bacon will take place on October 5. The University is conferring honorary degrees upon Sir Ernest Rutherford and Prof. William Holdsworth. A reception at Trinity College will be followed by a lecture upon Bacon, by Dr. C. D. Broad. In the evening, Trinity College will entertain a number of guests to dinner.

An interesting programme of lectures has been arranged by the British Institute of Philosophical Studies for the forthcoming session, beginning October 4. In the Michaelmas term the Hon. Bertrand Russell will give two courses of lectures: (1) on the problems of philosophy, (2) on mind and matter. Dr. T. W. Mitchell will deliver ten lectures on medical psychology. Prof. G. Dawes Hicks will deliver ten lectures on the development of philosophy since Kant. A course on general psychology, by Prof. C. W. Valentine, should appeal to a wide audience. In the Lent term Dr. C. Delisle Burns will lecture on the philosophy of social life, and Prof. J. S. Mackenzie on social values. The Very Rev. Dean Inge, Dean of St. Paul's, has promised to give a course of six lectures on the philosophy of religion, in the Summer term. A full syllabus of lectures can be obtained on application to the director of the Institute, 88 Kingsway, W.C.2.

Contemporary Birthdays.

September 21, 1867. Rt. Hon. Lord Bledisloe K.B.E.
September 23, 1850. Prof. W. Mitchinson Hicks, F.R.S.
September 23, 1863. Mr. William Lutley Sclater.
September 23, 1850. Prof. Richard von Hertwig.
September 25, 1843. Dr. Thomas C. Chamberlin.
September 25, 1866. Prof. Thomas H. Morgan, For. Mem. R.S.

Lord Bledisloe was educated at Sherborne and Eton, graduating at University College, Oxford. Until lately he was chairman of the Lawes Agricultural Trust Managing Committee. In 1922, at the Hull meeting of the British Association, he was president of Section M (Agriculture), delivering an informing, if pessimistic, address on efficient organisation in agriculture and the means of its development. Lord Bledisloe is now Parliamentary Secretary to the Ministry of Agriculture and Deputy Minister of Fisheries.

Prof. Hicks, born at Launceston, was educated at Devonport, graduating 7th wrangler at St. John's College, Cambridge. He was principal of and professor of physics in the University of Sheffield from 1883 until 1905. At the Ipswich meeting of the British Association in 1895 he was president of Section A (Mathematics and Physics). The Royal Society awarded a Royal medal to Prof. Hicks in 1912 for his contributions to hydrodynamics and those on vortex motion. He is Hon. D.Sc., Victoria.

Mr. Sclater, bearer of a name much honoured in the scientific annals of a past generation, was educated at Winchester and Keble College, Oxford. He was a science master at Eton College, 1891–95; afterwards director of the South African Museum, Cape Town, from 1896 until 1906.

Prof. Richard von Hertwig, distinguished as a zoologist, emeritus professor of zoology and comparative anatomy in the University of Munich, and director of the Zoological Institute, was born at Friedberg, Hesse. He has specially studied the Radiolaria and the Rhizopoda, whilst he contributed two monographs on the Actiniaria to the reports of the *Challenger* Expedition. Prof. Hertwig is Hon. Sc.D., Cambridge, and a foreign member of the Linnean Society.

Dr. Chamberlin, the veteran geologist, was born at Mattoon, Illinois, U.S.A. He graduated at the University of Michigan. Professor of natural science in the State Normal School, Whitewater, Wisconsin, 1867–1872, he held afterwards the chair of geology in Beloit College from 1873 until 1882, transferring then to a similar chair in the University of Chicago, retiring in 1919. Dr. Chamberlin has rendered valuable geological service to the State of Wisconsin. He acted as geologist in the Peary Relief Expedition of 1894. He is a foreign member of the Geological Society.

Prof. T. H. Morgan, occupant, since 1904, of the chair of experimental zoology in Columbia University, N.Y., was born at Lexington, Kentucky. He was educated at the State College of Kentucky and Johns Hopkins University. Prof. Morgan is a foreign member of the Royal Society. In 1924 the Society awarded him its Darwin medal for his researches in biological evolution, variation, and inheritance. He is the author of "The Mechanism of Mendelian Heredity" (1915) and "The Physical Basis of Heredity" (1919).

Societies and Academies.

PARIS.

Academy of Sciences, August 17.—**A. Lacroix**: The crystalline schists containing dumortierite and lazulite of Madagascar.—**Charles Moureu, Charles Dufraisse,** and **Marius Badoche**: Autoxidation and antioxygen action. The catalytic actions of various nitrogen compounds. Eighty-three nitrogen compounds of various types have been studied and from the results obtained certain general conclusions can be drawn. The amino group possesses marked antioxygen properties, but the amido group is only slightly active. The aminophenols are especially active, one part in 10,000 completely protecting acrolein from oxidation.—**G. Pólya**: Linear functional operations exchangeable with the derivation and on the zeros of the polynomials.—**Silvio Minetti**: The radius of convergence and the singularities of certain Taylor developments and the analytical functions which they define.—**Carl A. Garabedian**. A disc of constant or variable thickness in uniform or accelerated rotation.—**N. Boneff**: The arrival in the solar system of a foreign star A theoretical study extending the conclusions given in a recent paper by Chazy.—**A. Piccard** and **E. Stahel**: Michelson's experiment, realised in a free balloon. Details of four experiments carried out at an altitude of 2500 metres and another series at an altitude of 4500 metres. The accuracy of the measurements was not sufficient to confirm or refute the experiments of Miller at Mount Wilson, but it can be said that if Miller's ether wind exists it does not increase with altitude.—**A. Korczynski** and **B. Fandrich**: The preparation of nitriles by the diazo reaction. Experiments to determine to what extent nickel chloride with potassium cyanide can replace cuprous cyanide in the preparation of nitriles. It was proved that the nickel reaction could be generalised and that the yields were better than when cuprous salts were used in the Sandmeyer reaction.—**Jacques Bourcart**. Preliminary observations on the tectonic of the Bouches de Cattaro.—**V. Agafonoff**: The podzolic process in the sandy soils of the Landes.—**Gabriel Guilbert**: The visibility of the atmosphere. There is no connexion between the presence of haze in the air and hygrometric state and various explanations put forward to explain the nature of haze are considered by the author as unsatisfactory.—**E. Lacroix**: The use of coccoliths by the arenaceous Foraminifera for building their shells.—**G.** and **R. Moussu**: Normal glycemia in cattle. Glycemia and vitular disease in cows in milk.

ROME.

Royal National Academy of the Lincei, June 20.—**O. M. Corbino** and **T. Levita-Civita**: Doppler's principle and the ballistic hypothesis of light. According to the ballistic theory of light, the velocity of the light emitted from a source moving relatively to the observer is represented by the vectorial sum of the normal velocity of the light and that of the source This would indicate the existence of a Doppler effect of velocity and also a Doppler effect of acceleration, which would be capable of reaching values considerably greater than the former. The consequences of this conclusion are, however, untenable, and the ballistic hypothesis is hence incompatible with the ordinary postulates of classical physics.—**Leonida Tonelli**: Certain properties of a polynomial of approximation.—**A. Russo**: The two sexual cycles of *Cryptochilum echini* Maupas take place with two classes of individuals, which divide and regenerate in different fashions.—**Silvio Minetti**: Radius of convergence of the Taylorian development $\Sigma a_n x^n$ where $a_n = g(n)$ for n wholly positive with $g(n)$ wholly transcendental.—**Vladimiro Bernstein**: Interpolation by means of holomorphic functions in a semi-plane.—**Filippo Burzio**: Mayevski's law for ballistic precession.—**Giulio Krall**: Conditions for the stability of elastic equilibrium.—**Glauco de Mottoni**: A new method for measuring microscopic and ultramicroscopic distances by means of diffraction gratings. Ronchi has recently devised a stellar interferometer based on a new application of rectilinear and circular dioptric gratings. It is now shown that the application of such gratings to the microscope admits of approximately sixfold increase in the resolving power of the instrument.—**Francesco Vercelli**: Results of the cruise of the (Italian) naval ship *Marsigli* in the Straits of Messina. The influences of physicochemical factors on the currents in the Strait are considered —**Alberto Pirovano**: The possibility, by means of ionolysis, of hybridising species having little affinity.—**Giulio Cotronei**: Morphology and ecology in the study of Petromyzon.—**Ettore Remotti**: Reactions to luminous stimuli and their probable relation to morphological arrangements in the salmon during development.

Diary of Societies.

SATURDAY, SEPTEMBER 18.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern and Yorkshire Districts) (at Whitby), at 12.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Eastern District) (at Rural Council Offices, Epsom), at 2.30.—T. E. Ware and others: Discussion on Epsom Rural District.

TUESDAY, SEPTEMBER 21.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting) (at Institution of Civil Engineers), at 10 A.M.—Report of Advisory Committee on Education, presented by F W. Goodenough.—Fifteenth Report of the Gas Investigation Committee: Methods of Testing Products of Combustion from Gas Appliances.—C. H. Rutter: The Development and Reconstruction of the Portslade (Brighton) Gasworks.—Sixteenth Report of the Gas Investigation Committee: Studies in Carbonisation. Part I. Influence of Size of Coal.

WEDNESDAY, SEPTEMBER 22.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting) (at Institution of Civil Engineers), at 10 A.M.—T. F. E. Rhead: Investigation of some of the Factors affecting Carbonisation in Continuous Vertical Retorts.—Report of the Refractory Materials Joint Committee, presented by J P. Leather.

THURSDAY, SEPTEMBER 23.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting) (at Institution of Civil Engineers), at 10 A.M.—A. W. Sumner: The Distribution of Gas at High Pressures

FRIDAY, SEPTEMBER 24.

INSTITUTION OF FUEL ECONOMY ENGINEERS (at Royal Society of Arts).—Dr. A. E. Dunstan: Liquid Fuels.

CONGRESSES.

SEPTEMBER 19 TO 26.

GERMAN SCIENTIFIC AND MEDICAL ASSOCIATION (at Dusseldorf)

SEPTEMBER 22 TO 24.

GERMAN RÖNTGEN SOCIETY (at Dusseldorf)—Discussions on X-ray Treatment of Inflammation, the Compton Effect, and Irradiation of the Ovary and Offspring.

SEPTEMBER 24 AND 25.

READING AND DISTRICT TEACHERS' ASSOCIATION (at Reading University).—Discussion on Education and Life

September 24.—Prof Winifred Cullis: The Teaching of Biology in Schools.

September 25.—Mrs. A H. Radice: The Changing Child.—N. Richmond: The Physiological Basis of Change.

SEPTEMBER 26 TO 29.

INTERNATIONAL CONGRESS OF INDIVIDUAL PSYCHOLOGY (at Dusseldorf).

SEPTEMBER 26 TO OCTOBER 2.

CONGRÈS DE CHIMIE INDUSTRIELLE (at Brussels).

SEPTEMBER 27 TO 30.

ALL RUSSIAN OPHTHALMOLOGICAL CONGRESS (at Moscow).

SEPTEMBER 30 TO OCTOBER 2.

GERMAN SOCIETY OF UROLOGY (at Vienna).

OCTOBER 13 TO 26.

GERMAN SOCIETY FOR THE STUDY OF DISEASES OF DIGESTION AND METABOLISM (at Berlin).

OCTOBER 25 TO 28.

ITALIAN CONGRESS OF SURGERY (at Padua).

SATURDAY, SEPTEMBER 25, 1926.

CONTENTS.

PAGE
East African Research 433
The Theory of the Gene. By Prof. R. C. Punnett, F.R.S. 435
Optics—Pure and Applied. By Dr. L. C. Martin . 437
Direct Realism 438
Our Bookshelf 439
Letters to the Editor:
On the Oxygen Spectral Line $\lambda = 5577{\cdot}35$ Å.U.—Prof. J. C. McLennan, F.R.S., J. H. McLeod, and W. C. McQuarrie 441
Interference and Corpuscular Light.—Louis de Broglie 441
Science and Psychical Research.—A. A. Campbell Swinton, F.R.S. 442
The Structure of the Continents.—Dr. Harold Jeffreys, F.R.S. 443
Curved Path of Wireless Waves.—A. Mallock, F.R.S. 443
Schroedinger's Quantum Theory and the Stark Effect. Dr. Paul S. Epstein 444
Atomic Volumes of Carbon and Hydrogen.—W. F. Short 445
A Glaciated Ochreous Flint from Cromer.—J. Reid Moir 445
Psychological Aspects of our Penal System. By Dr. James Drever 446
The Use of High Pressures for Steam Turbine Installations. By Stanley S. Cook 450
Malaria and the Mosquito. By J. W. W. S. . . 452
Obituary:
Prof. J. G. Adami, C.B.E., F.R.S. By Prof. Ernest Glynn; Prof. J. S. Macdonald, F.R.S. 453
Dr. J. L. E. Dreyer 454
Mr. J. H. Mummery, C.B.E. By M. F. H. . 454
News and Views 455
Our Astronomical Column 459
Research Items 460
Industrial Psychology. By Ll. W. J. . . . 462
Early Egypt and the Caucasus 463
Animal Breeding and Genetics. By E. W. M. . 464
University and Educational Intelligence . . . 464
Contemporary Birthdays 465
Societies and Academies 466
Official Publications Received 467
Diary of Societies and Congresses 468
Recent Scientific and Technical Books . . Supp. v.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

East African Research.

THE "Report of the East African Guaranteed Loan Committee appointed by the Secretary of State for the Colonies" (Cmd. 2701, Aug. 1926, 47 pp., price 9*d*.) directs attention to the urgent need for either a new organisation for the promotion of research in British Crown Colonies and Dependencies or for a more systematic use of existing agencies. The East African Commission, consisting of Messrs. Ormsby-Gore, Church, and Linfield, recommended a guaranteed loan of 10,000,000*l*. to aid the development of the British East African colonies and dependencies. This loan has been sanctioned, and applications for grants from it have been received from the East African Governments amounting to more than 16,000,000*l*., without including interest during construction. These applications have been referred to a Loan Committee consisting of Sir George Schuster, Mr. R. H. Jackson, and Brigadier-General F. D. Hammond.

The report of this Committee has now been issued, prefaced by a warning from the Secretary for the Colonies that he will take no action until he has submitted the proposals to the Governments concerned and has considered their comments. These opinions have already been foreshadowed, and are strongly adverse to some of the recommendations of Sir George Schuster's Committee: thus the railway across south-western Tanganyika Territory from Dodoma to Fife, which was especially recommended by Mr. Ormsby-Gore's Commission, has been set aside as not urgent. The plan for the railway and road development of Nyasaland is regarded as premature without further economic survey; the local authorities, however, maintain that the scheme has been approved by the local experts and that the survey proposed would merely occasion useless expense and delay. The whole scheme of the loan, so far as Kenya Colony is concerned, has been denounced by Major E. S. Grogan, a leading settler, as adding to what he considers the already excessive indebtedness of the Colony.

The disappointing feature of the new report is the inadequate provision for scientific research, the insistence on which was one of the especially valuable features in the East African Commission's Report. Sir George Schuster's Committee welcomes the recognition in its terms of reference "that efficiency of action in every field will be increased if guided by scientific knowledge"; and adds, "We wish particularly to emphasise our belief in the practical value of such work, if properly conducted." The Committee therefore recommends that "as works for the material development of a country are undertaken, a due provision should at the same time be made for the scientific study of all those factors on which good administration and material development depend."

After these assurances it is disappointing to find that the Committee, out of the total of 10,000,000*l.*, recommends the allocation of 8,949,536*l.* for railways, ports, roads, and waterways, and allocates only 39,000*l.* for research: namely, 4000*l.* for the Amani Institute, 5000*l.* for the Geological Survey in Tanganyika, and 30,000*l.* for a Northern Rhodesia Research Station at Mazabuka. Applications were submitted for larger sums, including 100,000*l.* by the Government of Kenya Colony for research in native welfare, 50,000*l.* by the same colony for a Veterinary Institute at Kabete, near Nairobi, 5000*l.* for the continuance of the Veterinary Laboratory at Mpapwa, and by the Uganda Government for a grant, amount unspecified, for a Sleeping Sickness Station at Entebbe. These research schemes are either so nebulous or so likely to overlap with other work that the Loan Committee is unable to recommend them without fuller information.

The Committee suggests that 1,000,000*l.* out of the loan should be allotted to roads, waterways, and research; and as out of that amount 547,872*l.* is not yet allocated, the balance appears to offer adequate funds if suitable definite research work is proposed. How much is likely to be used for research is doubtful. Of the 452,000*l.* of which the allocation has already been recommended by the Committee, only 8·6 per cent. is for research; and as the Committee has not included in its recommendations anything for road construction in Kenya, Uganda, or Nyasaland, and has invited alternative proposals for the large grant applied for under this head by Kenya Colony, the expenditure on research under this loan may be quite inadequate.

In regard to the Amani Institute for agricultural research, Sir George Schuster's committee proposes a policy which the Secretary of State states definitely in the preface that "he does not accept." Apparently he intends to appoint a Director and trust him to develop a plan for the work, organisation, and relation of the Institute to the technical departments in the East African territories. The Committee doubts the wisdom of this policy, which is certainly speculative, as its success depends entirely on the selection of a suitable man for an ill-defined post. The Committee recommends that a small commission of the best scientific experts available should determine the scope of the work to be undertaken there. If it should then be found impossible to provide the Institute with the necessary funds, the Committee considers that "it would be better to face the facts and close the institute altogether rather than to attempt to run it with an inadequate and second-class staff."

Either the closing of the Amani Institute or its second-rate maintenance would be a national disgrace as well as a calamity to East Africa. The Institute was established when the locality was in German East Africa; it was planned on magnificent lines, was well equipped, and had in progress work of primary importance. Sir Frederick Lugard's appreciation of the former merits of Amani doubtless inspired his excellent suggestion during the recent discussion at the British Association on African race problems, that it would be an appropriate gesture in the development of Tanganyika Territory to reappoint some of the former staff. Sir George Schuster's Committee doubts whether a first-rate scientific expert would be willing to accept the directorship of Amani until the future of the Institute be assured. Men considering the appointment might fear the fate of the former Geological Survey of Tanganyika Territory, where the Director would not agree to the Governor setting aside the method of work which had been agreed to when he accepted the appointment. It would appear difficult to select the right man for the post until the scope of the work to be undertaken at Amani has been defined. An appointment on the lines at present contemplated might follow the too common precedent of selecting as director a man of administrative experience and engaging scientific experts to work under him.

That scientific research should develop on economic and sound lines, the Committee recommends the establishment of a sub-committee under the Committee of Civil Research to consider the foundation of "an Imperial organisation of scientific research, with the object of securing the best possible co-ordination of effort throughout the Empire and of deriving full value from all existing organisations." Any scheme for the extension and better co-ordination of research throughout the British Empire is to be welcomed; but the sub-committee proposed would not serve the urgent needs of British East Africa and would not render unnecessary a special organisation for these territories. The duty proposed for the new sub-committee would, moreover, so far as concerns the scientific development of the economic resources of the Empire overseas, overlap with the Imperial Institute, which was established for that purpose. If that Institute is unable to fulfil its functions, it should be made able: it has a large building and a considerable endowment, and there seems no reason to expect a sub-committee of the Civil Research Committee to be more successful. The insistence by Sir George Schuster's committee that the different British East African territories should co-operate, and that each should specialise in the work for which it has the best opportunities, is unquestionably sound; and it is not the fault of that committee that it has only been able to recommend for research the meagre pittance of less than 0·4 per cent. of the loan. The proposals received were too indefinite. A sub-committee of the Civil Research Committee appears to be the most easily constituted authority to secure a prompt decision as to the research needs of East Africa; and if the sub-committee were successful with those territories, its efforts to secure co-operation and prevent duplication of work might secure for it the wider function with which the Loan Committee would overburden it at the start.

The Theory of the Gene.

The Theory of the Gene. By Prof. Thomas Hunt Morgan. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. xvi + 343. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1926.) 18*s.* net.

IN this volume is published the series of lectures on the Silliman Foundation recently given by Prof. Morgan. We are not told when the lectures were delivered, but as the book appeared only during the present year, we may take it as representing the latest pronouncement of the American school of geneticists on these matters. In the first chapter is given a formal statement of the theory of the gene, and in view of the fact that some misconception of what it implies is not infrequently to be found among biologists who have not specially studied genetics, it may be as well to reproduce it here.

> "The theory states that the characters of the individual are referable to paired elements (genes) in the germinal material that are held together in a definite number of linkage groups; it states that the members of each pair of genes separate when the germ-cells mature in accordance with Mendel's first law, and in consequence each germ-cell comes to contain one set only; it states that the members belonging to different linkage groups assort independently in accordance with Mendel's second law; it states that an orderly interchange—crossing-over—also takes place, at times, between the elements in corresponding linkage groups; and it states that the frequency of crossing-over furnishes evidence of the linear order of the elements in each linkage group and of the relative position of the elements with respect to each other."

It will be noticed that nothing is stated about the chromosomes; though if the linear order of the elements in each linkage group be accepted, and it is clearly the simplest explanation of the facts as they stand, then the interpretation in terms of chromosomes follows almost as a matter of course. Still, the omission is significant, conveying as it does the recognition of the fact that even if the chromosomal interpretation were ultimately to be rejected, the phenomena of segregation and of linkage, the foundations of the theory of the gene, would remain unaltered. At present, however, there are few signs of weakness in the chromosomal interpretation, and in his chapter on "Chromosomes and Genes" Morgan brings forward fresh evidence from Drosophila in demonstration of its strength.

As might be expected, the fruit fly is much to the fore in this volume, though less so than in Morgan's earlier books on "The Mechanism of Mendelian Heredity" and "The Physical Basis of Heredity." Nevertheless, in the chapters on the "Origins of Mutant Characters," on "Chromosomes and Genes," and on "Genes in Related Species," it figures prominently, owing to the unrivalled material which it offers for discussion. The brief chapter giving a comparative account of the operation and arrangement of the genes in several closely allied species of Drosophila is one of the most interesting in the book, and might well have been expanded. Geneticists will look forward with keen interest to the progress of this work, offering as it does one of the most fruitful lines of attack on the problem of species.

Another chapter of much interest is that in which the author discusses the well-known "Presence and Absence" hypothesis. This generalised view of the relation between dominant and recessive characters has never found favour with the American school, and Morgan devotes many pages and much ingenuity in arguing against it. Some of his cases will certainly not bear the strain he puts upon them. For example, the argument that the 'albino' guinea pig cannot be due to absence of the pigment producing gene, because it often has a few coloured hairs on the feet and toes, at once falls to the ground when it is realised that such animals are not true albinos at all, but very slightly pigmented forms analogous to the Himalayan rabbit. So too the objection that the recessive black rabbit actually has more pigment than the dominant wild grey type at once loses its force when it is understood that the question at issue is not of the grade of pigmentation but of a definite inhibitor for pigment. That this is the proper way of looking at it is clear from Onslow's striking research on the chemical nature of this very case. Again, Morgan argues that since there is a dominant white in poultry, there must, on the Presence and Absence hypothesis, exist an inhibitor for this white factor in the wild jungle fowl. The argument supposes that all domestic breeds are descended from *Gallus bankiva*, but in the light of recent work this is almost certainly not true. As a matter of fact, Morgan admits that it is very difficult to present any clear-cut evidence against the Presence and Absence hypothesis in contradistinction to the existence of positive recessive genes. In the end he falls back upon the familiar argument from multiple allelomorphs, and here we need not follow him; for if the reader will turn to Bateson's paper on "Segregation," which was recently published in the *Journal of Genetics*, he will realise that this group of phenomena, so often adduced against the Presence and Absence hypothesis, may quite well be regarded as one of its chief supports.

Still, the implications involved in the Presence and Absence hypothesis are of such fundamental importance to the science of genetics, and the difficulty of obtaining decisive evidence between the rival hypotheses is so great, that we may be pardoned for commenting upon a case which seems to provide the best evidence of the kind yet obtained. This is the interesting case of the 'bar-eye' in Drosophila to which Morgan has devoted several pages of his book (pp. 86-91). Experiment has shown that when females homozygous for the dominant bar gene (B) are crossed with the recessive normal male, they produce occasional normal sons. Sturtevant demonstrated that this is due to the fact that in the homozygous barred female an irregular process of crossing-over occasionally occurs which results in one of the X chromosomes carrying both of the bar genes while its mate is left without one. The occasional normal male alluded to above is produced when the gamete carrying the X chromosome that has lost its B is fertilised by the Y chromosome gamete of the male. Now since the X chromosome lacking B has been brought to this state through crossing-over with one that also contains B, it cannot contain that positive recessive gene for normal eye postulated by the American school. In other words, it can contain *nothing* from the bar locus. Yet in association with a Y chromosome which also contains *nothing* it gives rise to the normal eye. Hence the appearance of the normal eye must be due to the *absence* of B, and not to a positive recessive gene corresponding to bar. This is surely as good a demonstration of the validity of the Presence and Absence hypothesis as we can hope to obtain.

Nearly one-third of the book is devoted to an account of forms in which the chromosomes depart from the normal diploid arrangement, whether through the loss of a set as in haploids, or through duplication as in triploids, tetraploids, and polyploids, or else through loss or addition of individual chromosomes as in heteroploids. The author has made use of the interesting material that has recently accumulated in wheats and other plants, and especially in Datura through the remarkable researches of Blakeslee and Belling, and has produced an account which will be at once useful and stimulating to the student. There is rather a lack of synthetical grip in the account, but perhaps this is hardly to be expected when dealing with a branch of study where most of the facts are the outcome of the past few years only, and into which they are so rapidly pouring.

Another third of the book is devoted to the subject of sex considered in its relation to the chromosomes. The outstanding problem here is still the relation between the two groups into which diœcious animals fall, namely, that in which it is the male sex that is heterogametic (the XX-XY type) and that in which it is the female sex that is so constituted (the WZ-ZZ type). Seeing that both types may occur in the same class of animals, as for example in vertebrates, and also in insects, it is difficult to suppose that they will not eventually be harmonised under some common scheme. Morgan inclines to the view that the chromosomes involved in the two types are not homologous, but that the two types have arisen independently through some change in balance. It is not very clear how such a change might be supposed to have come about, and we could have welcomed more discussion on this most important point.

In this portion of the book devoted to sex the reader will find some account of intersexes and of sex-reversal, upon which so much interesting work has been done in recent years. The facts are often accompanied by shrewd bits of criticism which will be of great value to the student, but here again one has the feeling that the author tends to lose grip as he proceeds. The impression conveyed is that of a collection of facts, of the highest interest and fairly set forth, but insufficiently digested, inadequately related to one another. The book as a whole lacks that unity found in Prof. Morgan's other books dealing with heredity—the unity that comes from a thorough assimilation of the facts. We cannot help the suspicion that the author's hand was forced by his appointment as Silliman lecturer, and that if he had had his own way he would have preferred to wait a little longer before writing it. In making such a criticism we do not wish to imply any condemnation of the book. Every geneticist should read it and be grateful to Prof. Morgan. But, judged by the high standard that we have become accustomed to expect from him, we are naturally rather disappointed when he tends to fall below it.

In conclusion, we would direct attention to some errors in the hope that they may be set right when a further edition is called for. On p. 113 a drawing is described as "a periclinal chimaera, S. lycopersicum." It is true that it represents *S. lycopersicum*, but *S.*

lycopersicum is *not* a periclinal chimæra. On p. 175, last line but one, "Fig. 12" should surely read "Fig. 33." On p. 247 the figure of the embryo calves has been so drawn as to omit the direct vascular connexion which was the main point of Lillie's original picture. In the note on p. 265, Crew is quoted as having fertilised the eggs of a hermaphrodite frog with its own sperm. Reference to the original will show that this hermaphrodite only functioned as a male in fertilising the eggs of a normal female. The 'common' cabbage butterfly is a Pieris, not a Colias as given on p. 293. In Figs. 11 and 12 the rules should be arranged as in Fig. 13. In neither case does the male shown on the second line belong to the F_1 generation, nor does the third line represent an F_2 generation as indicated.

One further point may be mentioned in connexion with the bibliography at the end of the book. This runs to some 26 pages and contains numbers of titles to which no reference is made in the text. Yet in the text some 40 papers are quoted for which no reference is given in the bibliography. It is extremely aggravating to the student to find a reference to a paper that he does not know, and to turn to the bibliography to find that it has been omitted; nor is there any consolation in finding the titles of a hundred other papers with which he is already familiar.

R. C. PUNNETT.

Optics—Pure and Applied.

(1) *The Principles of Physical Optics: an Historical and Philosophical Treatment.* By Ernst Mach. Translated by Dr. John S. Anderson and Dr. A. F. A. Young. Pp. xi + 324 + 10 plates. (London: Methuen and Co., Ltd., 1926.) 21*s.* net.

(2) *Handbuch der biologischen Arbeitsmethoden.* Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 187. Abt. 2: *Physikalische Methoden,* Teil 2, Heft 1. *Das Interferometer, seine Anwendung zur Untersuchung von Gasen und Flüssigkeiten,* von Paul Hirsch; *Ultramikroskopie,* von Marie Anna Schirmann; *Refraktometrie,* von Heinrich Kessler. Pp. 737-906. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 7·50 gold marks.

(1) A CERTAIN philosopher once said, "Learn the past, so that you may know the future"; but history appeals very differently to different minds; one sees in it a subject satisfying in itself, while to another the past is dead save in so far as it yields lessons for present and coming days. Prof. Ernst Mach's "Principles of Physical Optics" is bound to make a wide appeal to the many who cannot find much time to go back to the original authors of optical theory and practice, though it must be noted that the matters treated do not extend to the more contentious topics of the present day, such as the nature of light, the problem of the ether, the quantum theory, and so on; they are confined to those older parts of the subject which are adequately treated on the basis of the undulatory theory of light.

It is a common experience that first-hand reference to original books and papers is invaluable. The early investigator was treading a new path, and the subject was developing in his mind in a spontaneous and natural manner. His very mistakes are instructive. The modern text-book, on the other hand, is apt to be written by a much less ingenuous author, who returns to the elementary parts of the theory with a subconscious contempt for, and lack of appreciation of, the difficulties which beset the path of the beginner. Then, again, there are the writers who fail dismally through never having thoroughly mastered the elementary principles of their subjects. On the other hand, an adequate acquaintance with even the works of the main optical writers, Newton, Huygens, Young, Fresnel, and the rest, is a matter for years. Hence the appearance of the book under review will be welcomed, because from its perusal it is possible to obtain a clear idea of the historical development of the subject and of the contributions of the various early thinkers.

It is not a book for the beginner. For such, nothing can take the place of a careful systematic treatment adapted to develop the philosophical sense which is demanded of the reader of the present volume. From its very nature, an historical treatment must deal with matters with which a beginner need not concern himself, such as Newton's "theory of fits." Then, again, the standard of knowledge demanded of the reader of Chapter ii. (on the rectilinear propagation of light) is certainly higher than that of a novice; and the same applies to the several later parts of the book. Nevertheless, it is a valuable book for a teacher or for a student who wishes to get a little beneath the surface of the subject.

The translators have performed their task well, although there are a few places in which the meaning is obscure. The text is full of interest, and the admirable range of portraits gives a human touch to all.

It seems to the writer that one or two references to recent work might well have been added by the translators. For example, the following passage occurs in the description of the Michelson interferometer: "If it is desired to study an interposed substance which is non-homogenous, and upon which the eye must thus accommodate, parallel light cannot be used for this purpose, and the substance may not be traversed *twice* by the rays." Such a statement, although perhaps applicable to the case in question, should not have been passed without a reference to Twyman's modification of the instrument, in which the interposed substances *are* traversed twice by the 'parallel' rays. There is still an unfortunate gap between the optics of the laboratory and the workshop, and there are several places where this is instanced in the present work.

Prof. Mach occasionally manifests an amusing touch of dogmatism. His introductory letter speaks of "the only possible form of immortality." Has he, then, explored the possibilities of life so thoroughly? Dogmatism emerges, too, in the discussion of colour vision. The conclusive nature of the introspective analysis of a series of sensations is taken for granted, and Thomas Young is accused of introducing confusion into the subject! It is to be hoped that this statement may challenge some to go back to Young's own discussion. In another case where a psychological question is involved, namely, the question of light quantities, the book is vague and unsatisfactory. The coming of physical photometry is foreshadowed in terms which give no hint of the many and serious difficulties which have been encountered since 1913, when the German edition of the book was published. Indeed, the statements on p. 20 would lead the unsuspecting to conclude that a physical measurement of the gross energy of "the *illuminating* rays" (whatever that may mean) is an adequate means of finding the "quantity of light emitted from a light source in unit time." We conclude with regret that the 'philosophy' of the book is lamentably lacking where it might be most helpful. This is yet another instance of a clear call for the insertion of a translator's note directing attention to more recent developments. It is not forgotten that the book deals with physical optics, but every text-book ought to indicate the vital points of connexion between its own subject and allied branches of knowledge.

A feature of the book which deserves especial praise is its treatment of polarisation and double refraction. For several years past, the present writer has encouraged optics students to begin the study of these subjects with the simplest apparatus and natural crystals, such as were available to the early workers. In this way they obtain a thorough acquaintance with the main features of the subject; after a day or two of making retardation plates of mica, and using natural crystals of quartz, they are ready to appreciate the quartz wedge; the natural rhomb of spar affords an introduction to the Nicol prism and its modifications. Thus by easy stages the properties of uniaxial crystals become familiar; and how many students are *really* ready to pass beyond this stage in the limited time of college courses? The book adopts a similar method of approach, and, in addition, describes many beautiful experiments which will be new to the majority of readers.

This book, then, may be commended to all teachers who have occasion, in the midst of the multiplicity of subjects comprised in present-day 'physics,' to give some little attention to 'light.'

(2) This volume is a part only of one of the series of 'Handbooks' with which German scientific literature is so extensively equipped. The present section has articles dealing with (*a*) interference refractometers for gases and liquids, by Paul Hirsch; (*b*) ultra-microscopy, by Marie Anna Schirmann; (*c*) refractometry, by Heinrich Kessler. The object of the whole handbook is to explain to biologists the various physical, chemical, psychological, and other experimental methods employed in biological practice; the discussion of the physical instruments is very elementary and non-mathematical; almost unnecessarily so, in fact. Nevertheless, the practical details are well described, such as the determination of the constituents of serum by the use of the interferometer for liquids. The portable gas-interferometer, which has found a use in detecting fire-damp in coal mines, is described.

The section on ultra-microscopy begins with an exposition of the Abbe theory of microscopic resolution, where the author apparently gets mixed with her two equations, then passes on to a good description of the different methods of 'dark-ground' work, and the methods of Siedentopf and Zsigmondy. The fault of these handbooks is that they are apt to give an undue confidence in their completeness. No mention is made of recent British dark-ground condensers of the focussing type. Nothing becomes out-of-date quite so rapidly as the highly technical handbook.

The section on refractometry appears to be reasonably complete so far as German apparatus and methods go, and there is an abundance of practical detail likely to be of use to the chemist or biologist. The differential method of Hallwachs is described by way of conclusion.

L. C. MARTIN.

Direct Realism.

A Theory of Direct Realism: and the Relation of Realism to Idealism. By Dr. J. E. Turner. (Library of Philosophy.) Pp. 324. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1925.) 12*s*. 6*d*. net.

THIS book is the outcome of a bold and engaging enterprise. It sets out to do two things; first (and chiefly) to cut a clean way through the tangled growth of modern epistemology by justifying the plain man's view that the perceiving mind is in immediate contact with the external world, "as this actually exists," or that ordinary sense-perception, so far as it goes, "is, in principle, veridical"; secondly, to show that Hegelian idealism is entirely compatible with this supposedly antagonistic realist view.

The second aim is well fulfilled. The last four chapters of the book give a good and well-documented version of what idealism meant for Hegel, and on lines that are not now unfamiliar, pretty completely demolish the charge of subjectivism that for long lay at Hegel's door. But the first part of the book is less satisfactory. One can imagine the sigh of relief that would go up if Dr. Turner or any one else thoroughly established the position which he wants to hold. For 'phenomenalism,' as Dr. Turner sees, is a nuisance to scientific workers and to philosophers alike: and we should all be glad to be persuaded out of it. The trouble is that whenever one starts to reflect upon the process of perception, the extreme complexity of that process drives one obstinately to the conclusion that only by ignoring many plain facts and making some gallant but unverifiable assumptions, is it possible to hold that (to use the simplest terms) 'the-thing-as-it-is-perceived' is 'the-thing-as-it-really-is.' Yet that is what Dr. Turner aims at showing—in his own words, "the existential identity between sensed contents and physical entities" (p. 23).

Dr. Turner's main point is that most of the difficulties have arisen because modern analysis has started its work too far up. It begins with and remains within mature adult experience where the distinction between 'appearance' and 'reality' is already entrenched. If, however, we start at a more primitive and simple level of apprehension, we find it free from that embarrassment, since all sensed contents are there taken as '*inherently* existent.' Standing on this ground, therefore, and carrying forward from it, under the guidance of this realised unity, the analysis of perceptual processes, Dr. Turner concludes that it is possible to regard "the entire series of physical and physiological processes as determining, not the actual existence nor real character of the object of perception, but simply *perception itself* as being also a process, but of a higher order than these preliminary basal processes" (p. 160).

The result is disappointing. For even if one grants the validity of the argument by which this thesis is supported, it is hard to see why it should be held to dispose of all the difficulties which have led to phenomenalism, or to justify the desired conclusion that perception is in principle veridical. Yet it is proper to say that in some of the detail of his argument Dr. Turner breaks new ground in an interesting and hopeful way. His discussion of imagery, for example, is acute and good; and if his review of the "causational aspects of perception" will scarcely bear all the weight which he lays upon it, it is nevertheless fresh and valuable.

It must be added that the first section of the book is sadly ill-arranged. Dr. Turner has gone to enormous trouble to make himself acquainted with the views of all important recent writers on realist epistemology. Unhappily, the very fullness of his knowledge prevents his allowing his own story to tell itself. It has to be gathered largely from his criticism of others—often enough on points of no great material importance. It is a pity that Dr. Turner did not take down his scaffolding. He has written a good book, which might easily have been much better.

Our Bookshelf

(1) *Modern Views on Digestion and Gastric Disease.* By Prof. Hugh MacLean. (Modern Medical Monographs.) Pp. x + 170 + 20 plates. (London: Constable and Co., Ltd., 1925.) 12*s.* net.

(2) *Modern Methods of Feeding in Infancy and Childhood.* By Donald Paterson and J. Forest Smith. (Modern Medical Monographs.) Pp. ix + 106. (London: Constable and Co., Ltd., 1926.) 7*s.* 6*d.* net.

THE value of the "Modern Medical Monographs" edited by Prof. Hugh MacLean has already been indicated in these columns. We now welcome the appearance of two additions to the series.

(1) "Modern Views on Digestion and Gastric Disease" is the contribution of the editor of these monographs. Its object is to provide a general account of the physiology of digestion and to indicate the main principles in the treatment of gastric disorders. The early chapters summarise the process of digestion, and include references to the more recent methods of gastric investigation, such as the fractional test-meal. The author emphasises the importance of recognising as a normal feature of digestion the existence of regurgitation from duodenum to stomach, which until recently was looked upon as an abnormal occurrence. The greater part of the book is devoted to the consideration of the main gastric diseases and their diagnosis. Perhaps the most controversial section is that dealing with the etiology of gastric carcinoma. Prof. MacLean records considerable evidence to refute the teaching of many pathologists and surgeons that this condition is often preceded by ulcer. The observations on the great differences in duration of symptoms of gastric ulcer and gastric cancer suggest very strongly that malignancy arising in an ulcer is rare. The section on treatment indicates the importance of basing therapy on physiological knowledge. The book is well illustrated by radiograms, and will be of great assistance to student and physician in the study and treatment of gastric disease.

(2) "Modern Methods of Feeding in Infancy and Childhood." An understanding of this subject is as necessary to the general practitioner as a sound knowledge of digestive disturbance in adult life. Dr. Paterson and Dr. Forest Smith urge the importance of insisting on breast-feeding wherever possible. The difficulties which may arise in connexion with this are

discussed and various methods of artificial feeding are indicated. A number of diet tables are given, covering the period of childhood up to the age of five. If the physician will remember the authors' reiterated maxim that feeding must be varied to suit the individual, he will find this book a very useful guide in an important branch of his practice.

Surveying. By Dr. W. Norman Thomas. Second edition. Pp. viii+548. (London: E. Arnold and Co., 1926.) 25*s.* net.

THIS second edition differs but little from its predecessor. A few more corrections, a revised section on air survey (or "aerial survey" as the author calls it), and an appendix on pivotal errors in theodolites constitute the changes. The book is written for students of civil engineering. Naturally, therefore, it is a text-book on engineering rather than on topographical surveying, and it lacks the practical hints, and models of computation, which should be included for the latter purpose. The civil engineer will, however, find in it a clear explanation of all the methods he is likely to employ. Unlike many authors of works on surveying, Mr. Norman Thomas is at pains to examine the precision of each method he describes. He does so with conspicuous success, and illustrates his mathematics by examples drawn, in the main, from surveys in Great Britain and in the Empire.

There are one or two odd points in the author's sequence. He refers to maps in the chapter on chain surveying, and none of those referred to save those published by the Ordnance Survey were made with the chain. Again, to most of us surveyors, triangulation is the usual preliminary and the most useful friend. It comes late in the book, and when it comes this chapter does not stress sufficiently the importance, in any type of survey, of the theodolite. British theodolite design is diminishing the lead which some continental manufacturers have been allowed to acquire. It is a pity, then, that in his note on "Recent Developments in the Construction of Surveying Instruments" (included in the appendix on pivotal "Errors in Theodolites") some mention of new theodolites has not been made. Nowadays, when labour and transport are so heavy an item, it is more than ever important to get the best of instruments and to economise in time and weight. These, however, are small points, and every surveyor will be well advised to get and study this volume.

An Introduction to Practical Biology: a Course of Work based chiefly upon the Plant and arranged for Use without Special Apparatus in either the Class-room or the Home. By Norman Walker. Pp. viii+224. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 5*s.* net.

ONE of the hindrances to the more frequent introduction of science subjects into the schemes of study under the tutorial class movement has been the difficulty of arranging for the practical work necessary to supplement the theoretical side, if the subject is to be at all successfully taught. Dr. Walker, who has had a long experience of the tutorial class movement in the north of England and has a wide knowledge of the needs and difficulties of adult students of this kind, has outlined a series of practical exercises illustrating some of the elementary principles of biology which can be carried out in the class-room or the home, without any special or elaborate apparatus and at a comparatively trifling cost. The work is based chiefly on plants, but certain exercises involving the use of animals are included. The student is guided, in clear and simple language, through a series of experiments and observations on the structure, physiology, and chemistry of plants and animals, sexuality and fertilisation, inheritance and variation, while the implication of such knowledge on the problems of human society is not overlooked.

The book is admirably conceived and meets a distinct need. It is becoming increasingly necessary that some knowledge of biological principles should form part of the educational equipment of all men and women. Dr. Walker's book shows how this can be acquired in a simple and inexpensive manner, and points the way to a wide dissemination of such knowledge through the medium of tutorial classes for adult students.

A Monograph of the British Lichens: a Descriptive Catalogue of the Species in the Department of Botany, British Museum. Part 2. Second edition revised. By Annie Lorrain Smith. Pp. ix+447+63 plates. (London: British Museum (Natural History), 1926.) 20*s.*

A SECOND edition of Part 2 of the well-known "Monograph of the British Lichens," published by the British Museum, has just appeared. Part 1 of the first edition was prepared by Crombie and published in 1894. Part 2, elaborated by Miss A. Lorrain Smith, was published in 1911. Miss Lorrain Smith then proceeded to the difficult but useful task of revising part 1 (1918): she has now laid lichenologists under a further debt of gratitude by revising and bringing up-to-date her own volume, part 2. She states in an introductory note that there are no fundamental changes in the new edition, though the addition of many species, some rearrangement of genera and species, and other alterations will be noted. Only those who have worked at the small saxicolous lichens can fully appreciate the time, care, and patience which are required in describing and naming this group of organisms. British lichenologists are singularly fortunate in having a flora thoroughly up-to-date, and by an authority such as the author, provided in the excellent series of monographs published by the British Museum.

Hydrology and Ground Water: a Practical Text-Book for the Use of Civil Engineers, Surveyors, Students, and all those who deal with the Control of Water. By J. M. Lacey. Pp. viii+159. (London: Crosby Lockwood and Son, 1926.) 12*s.* 6*d.* net.

WITHIN about a hundred and fifty pages the author has attempted to condense a treatment of the various phenomena associated with rainfall and ground water. Naturally the treatment is summary in places. The earlier chapters on rainfall, especially the sections on cycles of rainfall, are least satisfactory, and would require to be expanded if the volume were to be of general value. But it is planned chiefly to meet the needs of the water engineer, and for this purpose it is certainly well arranged, clear, and useful. The chapters on wells and water storage are of particular value.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

On the Oxygen Spectral Line λ=5577·35 Å.U.

A number of investigators, including Merton, Barratt, Johnson, Cameron and others, have shown that the spectrum of an element in the gaseous state can be profoundly modified if an electric discharge be passed through it when one or other of the rare gases helium, neon, argon is mixed in excess with it.

For example, Merton and Pilley showed that by this method it is possible to enhance greatly the arc spectrum of atomic nitrogen and even to isolate it completely from the spark spectrum of this element.

Again, it was shown a year ago by McLennan and Shrum that a line of weak intensity existed at λ 5577·35 Å.U. in the spectrum of oxygen, and that this line could be considerably strengthened when helium or neon were added in excess to oxygen excited by the passage of an electric discharge through it.

As McLennan and Shrum put forward the view that this line in the spectrum of oxygen is identical with the famous "green line" λ 5577 Å.U. observed in the spectrum of the light from the night sky, and in the spectrum of the aurora, we were led to engage during the past year in a rather exhaustive study of the main characteristics of the line. The results of this investigation will be given in detail elsewhere, but in the meantime we think it well to state here a few results that are of special interest now.

(1) The spectral line λ 5577 Å.U. has been shown to be obtainable with pure oxygen and with intensity the strongest when the gas is at a pressure of two millimetres of mercury and the exciting electrical discharge is passed through a tube about one metre long and three centimetres in diameter.

(2) When currents varying in strength up to 160 milliamperes were used, the intensity of the line steadily increased with the strength of the exciting electrical current.

(3) A new series of measurements has shown that the wavelength of this spectral line is very close to λ 5577·35 Å.U.

(4) This spectral line, λ 5577·35 Å U. has never been observed in our experiments in the spectrum of any electrical discharge in the absence of oxygen.

(5) When an electrical discharge was passed through oxygen at a pressure of 2 mm. of mercury mixed with helium, the line was obtained with strongest intensity when the partial pressure of the helium was about 20 mm. of mercury.

(6) A series of carefully executed experiments has shown that the power possessed by the rare gases of enhancing the oxygen line λ 5577·35 Å U., assuming the strength of the line in oxygen alone to be 1, is as follows: helium 1·7, neon 4·6, argon 84·2.

(7) When argon in excess was mixed with oxygen the line λ 5577·35 Å U. was obtained with an intensity greater than that of any known line in the spectrum of atomic oxygen having a wavelength shorter than λ 6000 Å.U.

(8) Observations with a powerful echelon spectrograph showed that the oxygen line λ 5577·35 Å.U. is simple and without any fine structure

(9) In studying the Zeeman effect with the line λ 5577·35 Å.U it was found that magnetic fields of weak to moderate intensity produced a symmetrical broadening of the line, the magnitude and the character of this broadening being of the order and of the nature respectively of that usually shown by spectral lines having an atomic origin.

(10) It would appear that this spectral line λ 5577·35 Å.U. originates in an electron transition between atomic levels for oxygen provided by one or other of two new singlet-triplet schemes that were based on Hund's theory and were recently put forward (*Proc. Roy. Soc.*, July 1926) by McLennan, Grayson Smith and McLay.

J. C. McLennan
J. H McLeod (Student of National Research Council of Canada).
W. C. McQuarrie.

The Physical Laboratory,
University of Toronto,
September 1.

Interference and Corpuscular Light.

In the new wave theory of matter (Einstein, L. de Broglie, Schrödinger), the material point is conceived as a singularity in a wave. More precisely, in the absence of any field of force, the wave phenomenon called 'material point' is represented by a sinusoidal solution of the equation:

$$\Delta u - \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2} = \frac{4\pi^2}{h^2}m_0{}^2c^2u, \quad . \quad . \quad . \quad (1)$$

where m_0 is a constant characteristic of the wave (proper mass of the material point). The function u has a uniformly moving singularity which *is* the material point. If the point at rest has a spherical symmetry, then the solution of (1) will be (the line of motion being chosen as z axis)

$$u = \frac{A}{\sqrt{x^2 + y^2 + \frac{(z - vt)^2}{1 - v^2/c^2}}}\sin 2\pi\nu\left[t - \frac{vz}{c^2}\right].$$

Further, the energy of the moving point is identical with the product $h\nu$.

In the special case of the light quant, we must suppose m_0 to be equal to an extremely small quantity if not to zero. Then the wave equation (1) reduces to the classical form:

$$\Delta u = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}. \quad . \quad . \quad . \quad (1')$$

For each problem of interference or diffraction, classical optics tries to find a solution of the form:

$$u = a(x, y, z)e^{2\pi i\nu[t - \phi(x, y, z)]}, \quad . \quad . \quad (2)$$

satisfying the adapted limiting conditions. But, for the new mechanics, the motion of the light quants is given by a solution of (1′) of the form:

$$u = f(x, y, z, t)e^{2\pi i\nu[t - \phi(x, y, z)]}, \quad . \quad . \quad (3)$$

where the amplitude f has many moving singularities. The function ϕ is to be the same in (2) and (3), and the singularities, *i.e.* the light quants, must describe the curves normal to the surfaces ϕ = Constant.[1] In substituting (2) and (3) in (1′), we get the two following relations connecting the classical amplitude a and the 'granulated' amplitude f, respectively, with the phase-function ϕ:

$$\frac{2}{a}\frac{\partial a}{\partial n} = \frac{1}{a^2}\frac{\partial(a^2)}{\partial n} = -\frac{\Delta\phi}{\partial\phi/\partial n}, \quad . \quad . \quad (4)$$

$$\frac{\partial\phi}{\partial n}\cdot\frac{\partial f}{\partial n} + \frac{1}{2}f\Delta\phi = -\frac{1}{c^2}\frac{\partial f}{\partial t}, \quad . \quad . \quad (5)$$

dn being an element of trajectory.

---

[1] Of course it remains to prove the existence of such a solution of equation 1′ in each case.

Now, by analogy with the solution for the free spherical material point, we can suppose that the quantity $f/(df/dn)$ is zero at the points occupied by the light quants at a given instant. Then the velocity of a quant in passing by a point M will be, for example, 5:

$$v_M = \left(- \frac{\partial f/\partial t}{\partial f/\partial n} \right)_M = c^2 \frac{\partial \phi}{\partial n}. \quad . \quad . \quad . \quad (6)$$

The motion of the quants is permanent and $-c^2\phi$ plays the part of a velocity potential.

But, during the motion, the number of quants remains constant and along a very thin tube of trajectories, we must have:

$$\rho\sigma v = \text{constant}, \quad . \quad . \quad . \quad (7)$$

where ρ is the mean density of light quants in the wave and σ the section of the tube.

Hence, we conclude that:

$$\frac{1}{\rho}\frac{\partial \rho}{\partial n} + \frac{1}{v}\frac{\partial v}{\partial n} + \frac{1}{\sigma}\frac{\partial \sigma}{\partial n} = 0. \quad . \quad . \quad . \quad (8)$$

But infinitesimal geometry teaches us that the last term of the first member is equal to twice the mean curvature of the phase surface. Thus, equation (8) gives easily:

$$\frac{1}{\rho}\frac{\partial \rho}{\partial n} = - \frac{\Delta \phi}{\partial \phi/\partial n}, \quad . \quad . \quad . \quad (9)$$

and by comparing (9) and (4) we see that:

$$\rho = c \,.\, a^2. \quad . \quad . \quad . \quad . \quad . \quad (10)$$

The density of light quants is to be taken proportional to the classical intensity. In the dark fringes of the classical theory, the density of quants will be zero, but in a bright fringe a great number of quants will pass. Now, the motion being permanent, this explanation of the experimental facts will still be available if the light is very weak (Taylor's experiment); we have only to define the density of quants by a time average instead of a space average.

LOUIS DE BROGLIE.

Paris, August 27.

Science and Psychical Research.

I HAVE read the editorial note appended to the letters on this subject published in NATURE of September 11, and desiring to keep within the limits that you wish to be observed in this discussion, I have tried strictly to confine myself in the following remarks to replying to allegations against myself made by Sir Arthur Conan Doyle in that issue, as also to the specific points raised by Dr. Tillyard in his rejoinder to my letter on this subject published in NATURE of August 28.

Sir Arthur Conan Doyle states that my account of the incidents connected with the Combermere photograph, published in the issue of August 28 "is both inaccurate and misleading." It will, I think, be sufficient to direct attention to one only of Sir Arthur Conan Doyle's statements, to show whether he is, or I am, the more accurate person. After telling how I challenged him to publish, in the *Morning Post*, the ghost photograph alongside a photograph of the peer taken in life, Sir Arthur Conan Doyle goes on to say (italics are mine) —"I at once sent up my photograph *without any suggestion whatever that it would not reproduce*. That statement is a pure invention on the part of Mr. Campbell Swinton."

In reply to this, may I quote the opening sentence of Sir Arthur Conan Doyle's letter to the Editor of the *Morning Post*, published in that paper on April 23? It is as follows:

"I beg to enclose the Combermere photograph. I am advised that it will not reproduce, but you will be the best judge of that."

These two entirely contradictory statements, both from the pen of Sir Arthur Conan Doyle, show how little reliance can be placed upon the accuracy of what he writes, and I therefore do not propose to make any further reference to the remarks contained in his letter to NATURE except to say that they consist of a tissue of misrepresentation, together with a number of statements which are no more accurate than the one quoted above.

With regard to Dr. Tillyard's rejoinder, I should like, first of all, to say how much I appreciate the spirit in which he has accepted what may have seemed to him my somewhat provocative criticisms. I must, however, further criticise what he now says.

Dr. Tillyard complains that I do not distinguish between spiritualism and psychical research; but, so far as I can see, the only distinction between the two is that the second includes the first, while I may add that, though the heading under which it appeared was "Science and Psychical Research," Dr Tillyard's article purported to be a review of a "History of Spiritualism."

Nowhere have I ever suggested that the medium is one of the experimenters, as Dr. Tillyard surmises. On the other hand, I cannot agree with him that the medium is a mere instrument, such as a microscope or spectroscope, for, quite apart from the question of free will, which is probably an illusion, due to the same portion of the brain being concerned in determining both our wishes and our actions, human beings have consciousness and motives, which are things possessed by no man-made instrument or mechanism.

Dr. Tillyard states, "If a medium is found to be fraudulent, then the genuine psychical researcher will not proceed with him, but will endeavour to find a more trustworthy one" But this, anyway, was not the method adopted by Crookes, who, I suppose Dr. Tillyard will agree, was one of the greatest of psychical researchers. If we are to believe the authorised life of Sir William Crookes, written by Dr Fournier d'Albe, "Crookes does not seem to have taken up the medium (Miss Cook) seriously until after she had been exposed by a Mr. Volckman, who seized 'Katie King' (supposed to be a spirit) and found himself holding the medium (Miss Cook) dressed up."

Furthermore, Miss Cook, who had by then married and become Mrs. Corner, was again exposed by seizure, when masquerading as a spirit, by Sir George Sitwell, the well-known baronet. A detailed account of this exposure will be found under the heading "Capture of a Spirit" in the *Times* of Jan. 12, 1880, while in the *Times* for Jan. 15 following, there is a letter from the secretary of the British Association of Spiritualists (on whose premises the seance was held), on behalf of the council of that body, stating that Sir George Sitwell's account of what occurred was substantially correct. Sir George Sitwell quite recently told me that this complete exposure, which had wide publicity, made so great a sensation that it nearly wrecked the whole spiritualistic movement of that time; so Crookes must have known all about it. Yet, a few years later, as recorded in Sir Arthur Conan Doyle's history, we find Crookes giving an unqualified testimonial as to the bona fide mediumship of this twice-convicted impostor.

All scientific men hold Crookes in the highest veneration both as a physicist and as a chemist, but what can they think of his judgment in respect to spiritualistic matters, having regard to what is disclosed above?

Dr. Tillyard mentions the names of Crookes and of four other scientific men who studied spiritualistic phenomena, and then asks me whether I can name a single one of these who did not become convinced of their genuineness. Surely this is a case of begging the question, as these are the particular five who did become convinced; but what about the others? What about Faraday, Tyndall, Sir David Brewster, and Dr. Carpenter, among those who are dead, and Prof. R. W. Wood of the U.S.A., Sir E. Ray Lankester, and Sir Bryan Donkin among those who are living? All these and many others have, I believe, made sufficiently serious investigations into the subject, though naturally, having come to the conclusion that there was nothing genuine in the phenomena warranting further research, they did not publish so much as other no more eminent, though perhaps more credulous investigators.

It may also be mentioned that, in 1908, a committee, including such eminent photographic experts as R. Child Bayley, F. J. Mortimer, and E. Sanger-Shepherd, though assisted by such a well-known spiritualist as Mr. A. P. Sinnett and others, failed to secure proof that spirit photography is possible.

Dr. Tillyard suggests that I should visit the National Laboratory for Psychical Research, but I must confess that I am not attracted by its name, which with its suggestion of parallelism with the National Physical Laboratory, seems to me to be *suggestio falsi*. I am informed that it is a purely private concern, with nothing national about it whatever. Apart from this, however, in my opinion thermographic phenomena in connexion with mediums are more a matter for a physiologist than for a physicist. That emotional disturbances affect the temperature of the body is, I think, fairly well known, and there does not seem to me to be any reason for dragging in such supernormal and incredible phenomena as the production of ectoplasm and such like in order to explain what are only commonplace matters. But then, all psychical researchers seem to delight in the maxim *omne ignotum pro magnifico*.

A. A. CAMPBELL SWINTON.

40 Chester Square, London, S.W.1,
September 10.

The Structure of the Continents.

As all the continental discussions of the observations of near earthquakes have been carried out by graphical methods, and as I could not satisfy myself as to the precision obtainable by these methods, I have recently carried out a rediscussion of the principal series of data by the method of least squares. These refer to the Kulpa valley earthquake of 1909, the Wurtemberg one of 1911, the Tauern earthquake of 1923, and the Oppau explosion. The results indicate very definitely that there is an upper layer that transmits compressional waves with a velocity of 5·6 km./sec. (though a velocity of 5·4 km./sec. would fit the Oppau explosion slightly better) and a lower one where the velocity is 7·8 km./sec. In addition, the Tauern earthquake gave rise to a wave with a velocity of 6·2 km./sec., which must have travelled in an intermediate layer. The probable error of all these velocities does not exceed 0·1 km./sec. The result for the upper layer corresponds to that found for granite by E. D. Williamson and L. H. Adams. The recent work of L. H. Adams and R. E. Gibson gives a velocity of 6·4 km./sec. in basaltic glass, and of 8·4 km./sec. in dunite, at ordinary temperatures and at pressures corresponding to depths of some tens of kilometres. If we allow for the higher temperatures within the crust, the basaltic layer below the granite may be in a glassy state, as Daly has suggested, and the lower layer may well be dunite. The evidence indicates that there is no further sudden change to a depth of about 1200 km.

The times of arrival of all the waves were linear functions of the epicentral distance; the consistency of the observations was great enough to give good determinations of the gradients of these functions, and hence of the velocities, but it was not enough to establish any departure from linearity. Hence there was no material for a determination of the depths of the foci or of the variation of velocity with depth in the various layers. By combining the results for near quakes with those for distant ones, however, it was possible to estimate the rate of increase of velocity with depth in the lower layer.

The observations permit a rough determination of the depths of the granitic and basaltic layers. The former may be about 12 km., the latter about 20 km., but both are subject to an accidental error of about 4 km. In addition there is a possibility of systematic error. Uncertainty as to the depth of focus may allow the thickness of the granitic layer to be doubled. On the other hand, the movement on the seismogram due to the indirect waves starts more gradually than that due to the direct one, and this may cause a slight delay in their measured time of arrival, especially as most of the observations seem to have been made on instruments recording on smoked paper. On this ground the depths determined may require some reduction.

I think, therefore, that determinations of the depths of the layers by means of near earthquakes are not more reliable than those based on the earth's thermal state, isostatic balance between continents and oceans, and the group-velocities of surface waves. All of these are affected by uncertainty concerning the thickness of the basaltic layer, but the uncertainties of the method based on the compressional waves from near earthquakes appear more serious. The results, taken as a whole, are as consistent as can be expected; a thickness of 10 to 15 km. for each layer would be within the range of uncertainty of every method.

HAROLD JEFFREYS

St. John's College,
Cambridge.

Curved Path of Wireless Waves.

IN a recent number of the *Proceedings of the Royal Society* (Series A, vol. 111, N.S. 757) there appears under the title of "Discussion on the Electrical State of the Upper Air," a paper giving the views of several of the authorities who have contributed to the examination of this subject.

The discussion really turns on the question as to why wireless waves follow the curvature of the earth instead of spreading into space.

Heaviside supposed that this was due to a hypothetical conducting layer of the atmosphere existing at a great altitude above the earth's surface, which would act as a reflecting barrier and would compel the wave to remain within the envelope formed by it. Only one contributor to the discussion referred to refraction and diffraction as possible causes.

If it were assumed that the speed of long waves is the same as that of ordinary light, and depends in the same way on the density of the air, then refraction would account for, roughly, one-tenth of the observed deflection. I believe, however, that there are no direct measures of the velocity of long waves, and there is no sufficient knowledge of the nature of the 'ether' or of its relation to ponderable matter to allow of any certain, or even probable, theoretical deductions on this point.

As regards the velocity of visible light in air, the shorter the wave-length the less the velocity, but if it is true that X-rays are only shorter but otherwise similar waves, then since it is found that their refractive index for all substances through which they can pass is practically unity, there must be, at and after a certain shortness of wave-length is reached, a condition in which a decrease of wave-length is accompanied by an increase in velocity.

At the other end of the spectrum (where wireless wave-lengths are reckoned in miles) it seems not impossible that there may be a drop in velocity as the wave-length increases, although at present a physical explanation may be wanting.

A case of diminished velocity with increased period would occur in air if the waves were of such great length that the heat due to compression had time to diffuse. For such waves the velocity would tend to approach that given by Newton.

If it were found that for 'wireless' waves the velocity increased about one part in four thousand (the velocity of light is scarcely known to this degree of accuracy) per mile of height above the ground, the reason for such waves following the curvature of the earth would require no further explanation, and until experiment proves that there is no such change, it would be reasonable to impute the observed curvature of path to this kind of cause.

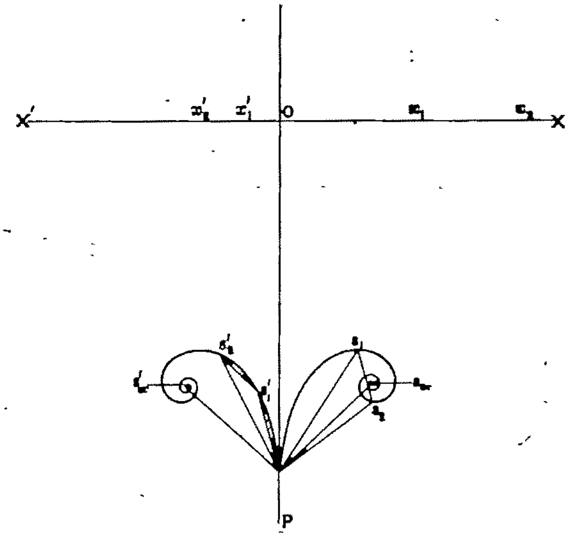


FIG. 1.

Assuming for the moment that the velocity of the long waves is in part dependent on the atmospheric conditions and increases with the elevation, it is certain that it will vary at different parts of the earth's surface; and this being so, the variation in the intensity and direction of trains of long waves would be only a leisurely analogue of the 'twinkling' of the stars.

Diffraction would have a slight effect in favour of increasing the audibility of signals when the observing station was within the 'shadow' of an obstruction, but this would only be noticeable for distances which were small fractions of the earth's radius. Diffraction would also cause variations of intensity at different levels above the boundary of the shadow, but it is unlikely that these 'bands' could be recognised without some instrumental aid in comparing intensities.

Nearly fifty years ago I gave[1] a graphical construction for determining diffraction effects, which as it was not published and is of very general application, I reproduce below.

Let it be required to know the intensity of the light at a given point in the normal to a wave surface.

For simplicity let the problem be one in two dimensions, and the wave surface be a line $X'OX$ (Fig. 1) emitting co-phasic waves confined to the plane of the paper. It is required to know the intensity at P due to all the partial waves emanating from $X'OX$.

Starting from P draw the curves S and S', such that the elements of arc at S and S' are proportional to the amplitude at P of the waves received from the elements dx and dx' at x and x', and also that the angle which the tangents at S and S' make with the normal OP, are the differences in phase in which the partial waves from x and x' reach P from the corresponding phase of the wave from O. Then the square of the chords PS and PS' are proportional to the intensity of the light which reaches P from either side of the normal between the limits x and x', and the total intensity at P is the square of the resultant of PS and PS' and the phase is given by the angle which the resultant makes with OP.

If x and x' are both infinite the intensity is given by $2PS_\infty^2$ and the phase is the same as that which reaches P from O.

If $x=\infty$ and $x'=0$ the intensity is PS_∞^2 and the phase differs from that of the wave from O by $\pi/4$. (This is the intensity at the edge of the geometrical shadow of O.)

If the source of illumination consists of disconnected portions of the line XOX', lying, say, between the limits x_1x_2, x_3x_4, etc., the resulting intensity at P due to each portion will be given by the squares of the chords $s_1s_2 . s_3s_4$, etc., and the square of the resultant of these chords will give the total intensity.

The formal proof of this construction is simple and need not occupy space here.

I have recently been told that a somewhat similar construction was given by Cornu, but this I have not seen.

A. MALLOCK.

9 Baring Crescent,
Exeter.

---

[1] This was in a Report to the Royal Society on the ruling of diffraction gratings, and on the variation of the intensities of the different orders of spectra as affected by the form of the cross section of the grooves.

Schroedinger's Quantum Theory and the Stark Effect.

THE theory of atomic oscillations recently advanced by Schroedinger is of extraordinary importance since it throws a new light on the problems of atomic structure and, at the same time, offers a convenient practical method for calculating the Heisenberg-Born intensity matrices. It seemed desirable to apply it to as many special cases as possible. A complete theory of the Stark effect in hydrogen was, therefore, developed.

The first order effect (displacement of lines proportional to the first power of the electric field) turned out to be identical with that obtained by the writer on the basis of Bohr's theory (*Ann. d. Phys.*, 50, 489, 1916). The second order effect (displacement proportional to the square of the field) differs slightly from the expression found in the old theory by the writer (*Ann. d. Phys.*, 51, 184, 1916) and independently by Mr. Mosharrafa (*Phil. Mag.*, 46, 753, 1923). The dependence of this term on the three quantic numbers n_1, n_2, n_3 is expressed in the new theory by

$$-(n_1+n_2+n_3)^4\{17(n_1+n_2+n_3)^2-3(n_1-n_2)^2 -9n_3^2+18n_3+10\},$$

while in the old theory the terms $18n_3+10$ were absent. Messrs. Takamine and Kokubu found a slight second order displacement of the central components of the H_γ line in a field of 130 kilovolts. Both formulæ give for this displacement practically the same value of 0·3 Å.U. in the right direction (while the absolute value of 0·3 Å.U. seems of the right order of magnitude, but somewhat smaller than the observed shift), so that the additional terms do not permit us to distinguish in favour of either theory.

Most interesting are the new intensity formulæ—comparatively simple closed expressions. It is known that in the old theory the correspondence principle was not sufficient to account for the intensities completely and that certain orbits ($n_3 = 0$) had to be eliminated by a special ruling prohibiting the electron from falling into the nucleus. Such a dualism is not necessary in the new theory; the state $n_3 = 0$ simply does not occur, and there is no need of any artificial restriction. So far, only the intensities of the p-components have been calculated. Comparing the calculated values with Stark's observations, the writer found the same situation which was stated by H. N. Russel in his work on intensities of multiplets (NATURE, 115, 835, 1925). The values estimated by observers agree, not with the calculated intensities, but with their square roots, *i.e.* with the absolute values of the amplitudes. Allowing for this, the agreement is fair, as appears from the following tables:

H_α line.			H_β line.		
Z.	Obs.	Calc. Ampl.	Z.	Obs.	Calc. Ampl.
2	1	0·8	0	1·4	0
3	1·1	1·1	2	1·2	1·8
4	1·2	1·3	6	4·8	4·8
			8	9·1	8·3
			10	11·5	9·9

H_δ line.			H_γ line.		
0	0	0	2	1·6	1·6
4	1	0·8	5	1·5	1·7
8	1·2	0·8	8	1	1
12	1·5	1·7	12	2·0	2·2
16	1·2	1·2	15	7·2	6·2
24	2·8	6·1	18	10·8	9·8
28	7·2	6·7			

We can say that the new theory based on Schroedinger's ideas accounts for the Stark effect at least as well as the old one. PAUL S. EPSTEIN.

California Institute of Technology,
Pasadena, California,
July 24.

Atomic Volumes of Carbon and Hydrogen.

PROF. INGOLD has introduced an important modification of Baeyer's strain theory, which brings the calculated ring strains into closer agreement with the thermal data of the cycloparaffins and with the general chemistry of the formation and decomposition of this series of saturated hydrocarbons (*Trans. Chem. Soc.*, 119, 305, 1921). He has pointed out that the carbon atoms in a cycloparaffin are secondary and, by assuming that the carbon atoms attached to the central one occupy more of the surrounding space than the two hydrogen atoms, has calculated the angle (115·3°) between the carbon to carbon valencies from the atomic volumes of carbon and hydrogen.

Objection may, however, be taken both to the method of calculation and to the values (Traube's) employed for the atomic volumes. In deducing the equation for the angle it is assumed that the two spheres representing the attached carbon atoms and the two spheres representing the hydrogen atoms are in mutual contact. This assumes either that the central carbon atom has a very much smaller volume than the carbon atoms united with it, or that the domains of the atoms are far from mutually exclusive. Neither of these assumptions appears to be in harmony with the main thesis that the value of the angle is determined by the volumes of the attached groups. It is possible, having determined the angle by this arrangement, to allow the small internal carbon sphere to assume its normal size without altering the angle, but, since the four attached spheres would then be moved through unequal distances, it is difficult to see how the arrangement then obtained depends directly on the volumes of the surrounding atoms.

Now the two spheres representing the attached carbon atoms and those representing two hydrogen atoms may be placed in contact with a sphere, representing the central carbon atom, in such a way that the inner tangents from the centre of the central sphere to each pair of adjacent spheres (in the plane through their centres) make equal angles. In such an arrangement allowance for the different atomic volumes of carbon and hydrogen is made directly, and, if the atomic volumes of carbon and hydrogen are taken as 4 : 1, it can be shown that the angle of the carbon to carbon valencies is 116° 34′ It would appear from recent investigations that the ratio 4 : 1 is a better measure of the atomic volumes which Prof. Ingold employed. W. F. SHORT.

University College,
Auckland, New Zealand,
June 21.

A Glaciated Ochreous Flint from Cromer.

DURING a recent visit to Cromer I found upon the foreshore site there, a flint of pyramidal form, and typical ochreous colouration. The more or less flat base of the pyramid is extensively glaciated (Fig 1), and the striæ were obviously imposed after the flint was patinated. The ochreous specimens from Cromer are, as a rule, remarkably free from striation, but it is evident that this particular flint was exposed to the effects of moving ice—possibly of the second glacial epoch of East Anglia. In any case the specimen is, without doubt, glaciated, and its discovery affords final proof of the great antiquity of the ochreous flints found upon the Cromer foreshore.

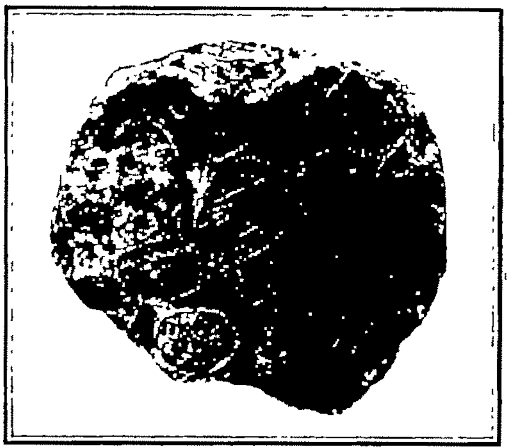


FIG. 1.—Glaciated surface of an ochreous flint found upon the foreshore site at Cromer. Half natural size.

J. REID MOIR.

One House, Ipswich.

Psychological Aspects of Our Penal System.[1]

By Dr. JAMES DREVER.

THE root idea in punishment as ordinarily understood is the infliction of some kind of disagreeableness, pain, or loss on an individual, because he has been guilty of some misdeed. There are thus two aspects—on one hand the infliction of hurt, on the other hand the relation of this to some wrongdoing or crime. Originally any end to be gained by such infliction was scarcely conscious, if it existed at all—any end, that is to say, beyond the satisfaction of the anger evoked by the misdeed itself. The psychological source is to be found in the anger caused by the wrong. From this primitive source to the modern conception the evolution of theories of punishment, conscious or unconscious, may be said to have passed through four stages or phases. These may be designated the vindictive, the retributive, the protective or deterrent, and the reformatory or curative.

To begin with, an individual who has suffered injury by the wrongdoing of another responds to the injury with the emotion and impulse of anger. This is satisfied by the infliction of some hurt on the wrongdoer. At the simplest and crudest stage of development—the stage where we have to deal with the mere instinctive impulse of the brute or the savage—the hurt inflicted on the wrongdoer may have no direct relation, either in kind or in degree, to the injury done, but only to the intensity of the anger evoked. Of course this is not really punishment in any strict sense. Nevertheless it is unquestionably the psychological origin, and it therefore marks the first stage in the evolution of what became punishment in the strict sense. This is the vindictive stage or phase. In so far as punishment at any time reveals the same emotion and impulse it represents this primitive vindictive stage.

Even in a very primitive social life, however, some crude notion of justice must very early act as a determining influence on the hurt that may be inflicted on another for some injury done. So far as some notion of justice is a conscious determinant of the hurt inflicted on the wrongdoer by the injured individual, this hurt takes on the character of retribution, and punishment as such comes into being. This phase or stage in the evolution of punishment is the retributive phase or stage.

Another factor must have made its influence felt in a rudimentary way at a comparatively early stage. The notion of punishment must have involved a looking forward as well as backward, in the shape at least of a dim feeling that similar actions to that which has incurred it must be prevented in the future. There can be little doubt, that is to say, that at a comparatively early stage primitive society must have felt vaguely that punishment had a protective function, since by means of punishment of a culprit the individual and society were protecting themselves against the repetition of an injurious act.

The general line of evolution of our modern penal systems is thus clear. First of all we have purely vindictive action on the part of the injured individual. Then there is some sort of legalising—if we may use that word—of retributive action on the part of the injured, so long as this retributive action does not go beyond the limits of 'justice,' this being regulated by social law. Finally, recognising that punishment has a protective function as far as social life is concerned, society itself takes over the infliction of punishment, and a penal system is inaugurated. This stage or phase is the protective or deterrent stage or phase.

EVOLUTION OF A PENAL SYSTEM.

To leave the matter thus, however, would be to obscure important aspects and phases of the actual course of events, and could not fail to produce a misleading impression of the facts. Stages in social evolution are never clear-cut. Thus the development of the retributive view of punishment by no means involved the discontinuance in practice of vindictive punishment. Still less did the realisation of protection as the primary social function of punishment alter the practice which had been founded on the older and more primitive conceptions. Practice lagged a long way behind theory in this, as in so many other cases.

The psychological explanation of the actual facts would appear to be that the crude emotion of anger remained the driving force behind punishment, though it was cloaked and obscured by other motives, and by various forms of rationalisation. After all, the reaction of anger is a natural reaction to an act which society agrees in reprobating. One leading authority on criminal law has indeed placed on record his conviction that it is "highly desirable that criminals should be hated, that the punishments inflicted upon them should be so contrived as to give expression to that hatred, and to justify it so far as the public provision of means for expressing and gratifying a healthy natural sentiment can justify and encourage it." I am afraid the learned author's thoughts have become somewhat mixed up in the latter portion of this statement. It sounds as if his rationalisation were not very satisfactory, even to himself.

However that may be, it is certain that the realisation by society in theory that the function of punishment from the point of view of society was primarily protective did not prevent an almost religious sanction continuing to be attached to the *lex talionis*. This remained, in fact, an assumption at the base of all penal systems which no one seriously challenged; and it is equally certain that the protective function of punishment was frequently made the excuse, as in the writer just quoted, for continuing the practice of vindictive punishment—'for deterrent purposes' was the usual rationalisation—even when it was quite evident that the psychological situation thus produced was often inimical to the ends sought. One need only instance the brutalising influence of capital punishment on society at large, and its inevitable tendency to increase the frequency of the crime of murder, during the period when it was the punishment also for less serious crimes, to show the kind of psychological situation which was created. Curiously enough the more humane—and indeed saner—attitude and practice of modern times in civilised countries were due far less to recognition of the fact that vindictive punishment for deterrent purposes was frequently an entire failure, than to the fact that the infliction of pain and suffering on human beings became objectionable to the general sense of society.

---

[1] From the presidential address to Section J (Psychology) of the British Association, delivered at Oxford on August 6.

The phase or stage of evolution at which we have now arrived is characterised, on one hand, by the discontinuance, or the radical limitation, of what was virtually the primitive vindictive punishment in disguise, and on the other hand by the recognition of social punishments as possibly possessing a reformatory or curative function. We may speak, therefore, of the present phase or stage as the reformatory phase or stage in the evolution of social punishment. The actual situation, however, is somewhat complex. Practically punishment still rests, in law and in popular thought, on the retributive basis—the *lex talionis*. Theoretically it is recognised that from the point of view of society punishment is protective, and this is its primary function, and also, I believe, that society is not directly concerned with the retributive aspect of punishment as such, but only indirectly because of the deterrent effect of retributive punishment. Moreover—and this is the mark of the phase of evolution at which we have arrived—it is realised that, so far as the individual is concerned, social punishment may be made reformatory, and that the reformatory function of punishment is worth keeping in view, if only because reformation of the individual means protection of society against the repetition of the injury so far as that individual is concerned, always provided that the attempt to reform the criminal does not involve the sacrifice of the primary aim.

PUNISHMENT OR REFORMATION?

The psychological problems of social punishment fall into two groups: on one hand those involved in the effects of punishment on the individual who is punished, and on the other hand those connected with the effects of punishment on the community itself. Of course there is a repercussion on society of the effects on the individual, so that the problems of punishment are ultimately in every case social problems. Nevertheless, we shall find it convenient to consider the two groups of problems separately in the meantime.

Consider first the problems arising in connexion with the effects of punishment on the individual who is punished. So long as the retributive aspect of punishment is placed in the foreground, the only psychological problems of serious import are those involved in the question of the responsibility of the offender. This question of responsibility is one over which medical and legal minds have long been at loggerheads. The source of this age-old controversy between lawyer and medical man lies primarily in the fact that the two use the word 'responsibility' in entirely different senses. For the lawyer 'responsibility' is purely a legal term, and the question of responsibility is to be determined on the basis of evidence germane to its legal meaning. For the medical man 'responsibility' is an ethical term, and the question of responsibility therefore raises much wider issues.

The psychological problems involved in the legal definition of responsibility are, more especially in so far as the question of control is raised, extremely difficult. I do not believe, however, that responsibility in this sense is a practical issue at all in connexion with any penal system. At least it does not arise in the form in which it is usually raised, or at the point at which it is usually raised, in a practical consideration of the problems of punishment as affecting the individual who has infringed social laws.

It is when we emphasise the protective and particularly the reformatory aspects of punishment that the vital psychological problems emerge. So far as we base our practice in social punishments upon these two functions, it is not too much to say that our whole practice must be guided primarily by the outcome of psychological inquiry. The two functions are not in conflict. We may aim at the protection of society by the reform of the delinquent. Treatment which is successful in eliminating a particular tendency to delinquency in an individual will *ipso facto* protect the community against the repetition of this delinquency by the same individual. Of course it will not necessarily protect society against the same form of delinquency in another individual. That is why we have to consider punishment, rather than reformation pure and simple, and that is why the silly and sickly sentimentality which regards the wrongdoer as a suffering victim rather than a criminal will always fail to appeal to any one, no matter how soft-hearted, who regards the whole situation frankly and sanely.

It is obvious also that the failure of reformatory measures must not be taken to imply the failure of society to protect itself. Other measures must be available, which are merely protective, and not at all, or only indirectly, reformatory. On the other hand, it is clear that reformation is, as a rule, the more economical way to secure protection for the community, provided there is reasonable hope of success, and so long as we restrict our attention to the individual delinquent. The reform of the delinquent is doubly a social gain. From being a minus quantity with respect to social efficiency he becomes a plus quantity. This point is especially important in the case of the juvenile delinquent.

Punishment exerts its influence through disagreeableness, or the fear of disagreeableness. The function normally performed by unpleasantness encountered in the activity of any living organism is to guide the activity so that unpleasantness may in future be avoided. The fear of unpleasantness again checks the immediacy of impulse, and so allows time for a new kind of behaviour to be substituted for the old kind which led to unpleasantness—the beginnings in the case of the human being, it is worth noting, of self-control. But it is only low down the scale of organic life that the phenomena are to be seen in their simplicity. As we pass up the scale the inner conditions which determine behaviour become more and more complex, and the actual results of any unpleasantness or fear become more and more difficult to foretell. With the human being the complexity of the inner situation has become enormous. The web of impulse and motive is so intricately and so subtly interwoven that the introduction of a new impulse and motive may come to have a result wholly unforeseen and entirely different from the result intended.

PRACTICAL DIFFICULTIES.

The most important source of practical difficulty is frequently our almost complete ignorance of the inner conditions which issue in any particular misdemeanour. This necessarily involves ignorance of the effect which our punishment is likely to produce. So far as the reformatory aspect of punishment is concerned, this is a very serious matter. We have to deal with an individual, and we must know the facts of that individual case. Any psychologist who has had experience of conflict cases among juvenile delinquents, can easily find illustrations from his experience. The usual form of misdemeanour that occurs is stealing, and frequently irrational and apparently motiveless stealing. Thus money, jewellery, and all kinds of things may be stolen and given away, or even thrown away. Until the inner conditions are understood and the causes of the trouble removed, no kind of treatment seems to be of any avail. Or sometimes, where punishment is apparently successful in eliminating the tendency to one particular kind of misdemeanour, there is a criminal outbreak in a totally different direction, the result of the punishment itself, which more than counterbalances any apparent success.

Cases of this kind tend to make one speak and think of treatment rather than punishment. It might be asked whether this is not the point of view from which all cases should be approached, not as a matter of ethics, but as a matter of practical expediency, punishment being merely a particular method of treatment. The proposition is arguable, but only so long as we confine attention to the individual delinquent, and that is only one side of the picture, as we shall see presently. Personally, I do not think the point of view will matter very much so long as we keep firmly in mind the essential fact that the action taken, whether we call it treatment or punishment, is primarily action taken by society for its own protection, the reform of the criminal being a means adopted to this end. There is undoubtedly a class of offender in whose case treatment, rather than punishment, is the appropriate notion and procedure. Other cases occur with fair frequency in which punishment as ordinarily understood is quite ineffective as regards the reform of the individual. The case of serious mental defect may be instanced.

The facts are such that we find the old problems of responsibility, so far as they were practical problems at all, cropping up in a new guise, and in new surroundings. It may be possible to determine beforehand, without waiting for the event, whether punishment will be effective for reform, and if so what kind of punishment, or whether the case is one demanding treatment, and not punishment at all, and if so what kind of treatment. The problems now, however, are neither legal nor ethical problems, but purely psychological problems.

The suggestion that in some cases punishment, as ordinarily understood, may be quite ineffective leads us on to the consideration of the measures society takes, and must take, for its own protection in certain instances. The most important method of protection that society utilises is the restraint of the offender in some appropriate institution—so far as the idea of punishment is concerned, some sort of prison. The restraint or imprisonment may be merely temporary, or it may be permanent. In the first case it is clear that the reformatory aspect of punishment ought still to be kept in view, so far as the psychological situation is taken into account. If it is not, it does not require much foresight to prophesy somewhat lamentable results. In particular, if the criminal is returned to social life, not only with his tendency to the original form of misdeed unaffected, but with other anti-social tendencies developed by his prison life, or by circumstances arising out of his prison life, our only possible verdict is that society is playing the fool. On the other hand, when the restraint is permanent, while reformatory measures must not be entirely excluded as intrinsically hopeless in every case, it is clear that the whole psychological situation and outlook are different. The prisoner will never be returned to civil life. For the protection of society he must be kept in restraint permanently. But he is a human being, and the moral sense of society will demand that he be treated as such, not merely negatively by the avoidance of inhuman conditions, but also positively by the provision of such amelioration of his lot as is possible without sacrificing essential principles.

Every one is agreed, I think, as regards these general matters. There will also be general agreement that the stigma of prison life means in itself the very serious modification of the psychological situation in the case of every individual who incurs it, so serious that no psychologist can regard short-term prison sentences with anything but dismay. It must be recognised that it is with respect to prison treatment especially that society, in protecting itself, or attempting to do so, runs the risk of making matters worse instead of better, and the gravest practical problems arise with regard to this type of punishment. Much has been done in recent years to remove acknowledged evils and defects of our prison system. Much may still be done. Nevertheless, I personally, and I imagine most psychologists, would look upon any further advance in the directions hitherto pursued with serious misgivings as to psychological results, until we have first attacked more fundamental problems, and reviewed our whole penal system in the light of the psychological knowledge of to-day.

NEED FOR PSYCHOLOGICAL DATA.

Let me try to indicate where, in my opinion, the crux of the whole matter lies. I think all will agree that the very first essential is that we should have the requisite knowledge and understanding of the psychological situation with which we are faced, and the psychological effects likely to be produced by the action taken. Society has to decide whether an individual delinquent is to be punished in this way or that way, whether he cannot be reformed but must be placed under restraint for life, or can be reformed during temporary restraint by appropriate treatment, or can be reformed without undergoing prison life, and in each case what can and ought to be aimed at. No general theories concerning the causation of crime, no systems of penal philosophy, not even the best intentions in the world, can take the place of a thorough knowledge and understanding of the individual case. This is precisely where our whole penal system is at present most defective. Moreover, the defect is one that can be remedied without serious difficulty in the present state of development of modern science, medical and psychological, but no opportunity is afforded.

The first and essential step towards the further reform of our penal system lies in affording this opportunity. This could be done by instituting a clinical examination, medical and psychological, of every delinquent before sentence is passed, and by taking advantage wherever possible of modern psychological knowledge. The psychological clinic is at present practically non-existent in Great Britain. It is high time this state of matters was remedied. School and law-court both demand its institution. That is the first step. When we have taken that step, we shall be able to take further steps in penal reform with the advantage of acting with adequate knowledge of what can be done, and what we are really doing in each particular case. Until that step is taken, every other change we introduce by way of reform has a hit or miss character, which cannot fail to be profoundly disturbing to any thoughtful student of social development.

It may be objected that we are in danger of losing sight of the fact that the topic under discussion is punishment, not simply the reformation of the criminal. The suggestion was made above that in certain cases at least it might be more appropriate to speak of treatment than of punishment, the suggestion involving the view that delinquency ought to be looked on as the outcome of something not unlike disease. However that may be, I do not think there is any warrant for excluding either the idea or the fact of punishment, provided we look to the future, and not simply to the past, in our conception of punishment. The action taken against an individual in the form of punishment must involve some disagreeableness or deprivation, and the reason for the punishment is some past act of the individual. But its purpose is the prevention of similar acts in the future. The fact that hitherto we have been discussing the individual aspect only has tended somewhat to obscure this deterrent function, and the consideration of this function will lead us over to the discussion of the social aspect.

The deterrent function of punishment has played no inconsiderable part in the discussion of penal measures at all times. The severity of past penal systems has been largely due—almost entirely so far as it has had a rational basis at all—to the attempt to deter others from similar offences to those for which punishment is inflicted on an offender. It is unquestionably the case that many a misdeed is prevented by the fact that the individual who is tempted knows that he will inevitably pay the penalty, and it is also a well-known fact that where, through the inefficiency of the police or other cause, punishment is easily evaded, crime shows a corresponding increase.

It cannot be lightly assumed, however, that the deterrent effect of punishment depends merely on fear of the disagreeableness or suffering which the punishment in itself involves. The penal system is an expression, however imperfect, of the sentiments of society with respect to certain acts—sentiments of hatred in varying degrees. It is not the result of a purely intellectual review of the social results and bearing of these acts. Apart, therefore, from the punishment by law decreed and legally inflicted, the criminal act is inhibited, so far as the normal socialised individual is concerned, by this sentiment in himself and in his fellows, how developed we cannot at present stop to consider, but resting ultimately on the primitive anger evoked by injury. "The sentence of the law," to quote again the legal authority already quoted, "is the moral sentiment of the public in relation to any offence what a seal is to hot wax. It converts into a permanent final judgment what might otherwise be a transient sentiment." Fear of the punishment as such, fear of the social disapprobation dependent on the evoking of the moral sentiment, of which the punishment is a concrete and tangible embodiment, recoil from the act because of the existence in the individual who is tempted of the moral sentiment in question in however feeble, attenuated, and fragmentary a form—all these are motives holding back an individual member of society from wrongdoing. The legal punishment exercises its deterrent influence because it, as it were, embodies and presents all of them in unmistakable and arresting fashion. The relative force of the different motives will vary with individuals. But until we can rely on the last of these motives being of itself sufficiently powerful to restrain every individual member of society from the breach of social laws—which would seem to involve a radical change both in the existing social structure and in human nature—the social necessity of some kind of penal system, in the strict sense, must remain.

In conclusion I would revert to the varying motives upon which the deterrent influence of punishment depends. Two points in particular demand notice. In the first place we cannot assume that penal law and moral sentiment will always be in harmony, and so reinforce one another. There may, in fact, be acute conflict between the two, so far as a considerable minority of the members of a community are concerned. In certain cases also they may be, so to speak, indifferent to one another. In either case the psychological situation is very radically modified, and the problems of punishment may in practice become very difficult.

In the second place the influence of the different motives may, as we have seen, vary with the individual. If that be so, two consequences would appear to follow. On one hand—and this refers more particularly to the adult criminal—our penal system must be such as to appeal with sufficient cogency to all the motives, so far as the criminally disposed individual is concerned. On the other hand—and now we have in mind chiefly the juvenile delinquent—it is of capital importance that we should recognise as early as possible in their criminal career those individuals who, either by nature or circumstances, or both, are tending towards abnormality in their reactions to social claims and social penalties. This brings us back to the crux of the whole situation. Means must be provided by which a knowledge of the individual case may be made available, before the decision is taken as to how any offender is to be treated. The temperamentally defective individual may be born, the habitual criminal is largely made. It ought at least to be possible to prevent the making of criminals. Again the glaring defect of our penal system stands revealed. No provision whatever is made for the diagnosis of incipient criminality. It is not merely a case of locking the door after the horse is stolen; it is a case of providing neither lock nor door.

The Use of High Pressures for Steam Turbine Installations.

By STANLEY S. COOK.

THREE different methods are available for the measurement of the performance of a steam engine, and serve that purpose from different points of view according to the particular feature of merit it is desired to emphasise. Thus, from the point of view of the manufacturer whose aim is to produce a turbine of the highest efficiency, that is, one which will convert into useful work the highest possible proportion of the pressure energy that is available in the steam, a figure expressing this proportion appears to meet the requirements of the case. This figure is almost (that is, except for the work of restoring the water of condensation to the boiler) identical with the 'efficiency ratio' as defined by Willans and Sankey in terms of the Rankine cycle, a ratio for many years accepted as the criterion of merit of a steam engine. The user of a turbine, on the other hand, is not so interested in what may be called the intrinsic efficiency of the engine, as in knowing how many pounds of steam per hour he has to generate in his boilers in order to produce a horsepower or kilowatt of output; consequently, a more significant expression of the engine's efficiency from his point of view is the consumption in pounds of steam per horse-power hour, under standard conditions of steam generation.

The latter method of statement of performance has also been commonly adopted, is if anything more familiar than the former and in a sense more practical. Used without qualification, however, it gives the manufacturer of the engine credit for any improvement he may make or find in the vacuum or in the steam conditions, although these are frequently taken into account by means of correction factors which reduce the consumption rate to a standard basis.

It must be recognised, however, that neither of these values supplies the user with the exact information he requires as to the cost of producing a unit of energy. It might easily be found, for example, that as the result of utilising higher pressures or lower vacua the efficiency ratio was reduced, but all the same a better overall result secured as measured in pounds of steam per horsepower, and even actually. At the same time, an improvement in consumption rate by improved steam conditions and improved vacua fails to take into account the increased cost of generating the steam under the new conditions.

A third and more comprehensive method is required to give an adequate measure of the performance of the steam engine as a heat engine. It must be remembered that a turbine is not correctly speaking a heat engine, but only a part of it. The expansion which is carried out in the turbine is only one of the processes in the complete cycle of the heat engine, which consists also of processes of heat rejection, re-compression and heat reception. The complete heat engine therefore includes the boiler in which heat is given to the steam, the condenser in which heat is extracted from it, and the condensate pump and feed pump which restore the condensed steam to boiler pressure.

The third method therefore relates to the heat engine as a whole, and aims at expressing its performance as a ratio of the net output, in equivalent heat units, to the heat energy latent in the fuel consumed. Such a ratio is known as the overall thermal efficiency. Its use is clearly necessary if satisfactory comparison is to be made between heat engines of different types, employing thermodynamic cycles of different character.

Inquiry must therefore be made into the conditions which make for the highest thermal efficiency. Now if it be presupposed that the highest possible efficiency of heat transmission in the boiler has been obtained, and the highest possible intrinsic efficiency of the turbine, there still remains another factor of supreme importance, namely, the efficiency of the thermodynamic steam cycle which alone determines the ratio between the heat supplied to the steam and the pressure energy that is available for the turbine. The turbine is able to use efficiently all the available energy that can be given to it, and it therefore remains to provide that the efficiency of the thermodynamic cycle shall be made as high as possible subject to practical conditions. At this point the problem becomes a thermodynamic one, and this ratio is a function of the conditions of heat reception and heat rejection.

The law which governs this question was enunciated by Carnot more than a century ago. It is that in order to obtain the maximum thermodynamic efficiency the temperature of heat reception must be made as high as possible and the temperature of heat rejection as low as possible. In the perfect Carnot cycle heat is received at a constant high temperature and abstracted at a constant low temperature. The heat received is proportional to the absolute temperature of reception, and the heat abstracted to the absolute temperature of rejection. The difference between these quantities of heat is the amount transformed into work, so that the thermodynamic efficiency of the perfect engine becomes $(T_1 - T_2)/T_1$ where T_1 and T_2 are the higher and lower absolute temperatures. It is easily seen that this ratio is increased by increasing T_1, or by decreasing T_2, or both.

The past success of the steam engine as a prime mover is due to two causes, the high value of the latent heat of steam and its ability to work on what is known as the Rankine Cycle. In the latter the compression stage of the Carnot cycle is replaced by the simple process of elevating the condensed water to boiler pressure. The consequent reduction of negative work gives this cycle a great practical superiority.

On the other hand, the employment of such a cycle involves a departure from the above-mentioned principle of heat reception at a constant maximum temperature. The heat is in fact supplied to the steam at a variety of temperatures. The feed water has to be raised from condenser temperature to the boiling point corresponding to the pressure of the boiler. Evaporation in the boiler takes place at that temperature, and the temperature of the steam is then raised continuously to the maximum temperature of superheat. The thermodynamic efficiency of each portion of the heat so supplied is conditioned by the ratio of the absolute temperature of supply to the absolute temperature at which all the heat is abstracted in the condenser.

Now the heat given to the steam during the process of evaporation, namely, the latent heat, is a large proportion of the total heat supplied. For example, with a boiler pressure of 250 lb. per square inch, a superheat of 200° F. and a condenser vacuum of 29 in. Hg. the latent heat is 836 B. Th. U. per lb. of steam out of a total supplied of 1276 B. Th. U. per lb. during the three processes just mentioned, or 65·5 per cent of that total. Omitting the heat required to heat the feed water, since, as will be seen presently, the disability of the low temperature of this process can be overcome, the total heat required for evaporation and superheat is 950 B. Th. U., of which the latent heat added during evaporation is 88 per cent. It is clearly, therefore, of importance from the point of view of obtaining the highest thermodynamic efficiency of the cycle that the heat supplied during the stage of evaporation shall be supplied at as high a temperature as possible. The temperature of this part of the heat reception can only be raised by increasing the boiler pressure.

At the same time, an increase of the maximum temperature of the superheated steam will lead to further improvement in efficiency, since this means additional heat reception at the highest temperature. In the case of superheat, there is the additional advantage that with a higher degree of initial superheat, the steam is in a dryer condition in the final stages of its expansion.

The circumstances are best visualised by means of an entropy temperature diagram. Fig. 1 is such a diagram representing the Rankine cycle for steam with a boiler pressure of 250 lb. gauge, a condenser temperature of 79° F., and superheat up to a maximum temperature of 700° F. Each stage of the cycle is represented by a curve on the diagram, and the property of the diagram is that, with absolute temperature as the vertical ordinate, the area vertically beneath any curve, or portion of a curve, which corresponds to a change of state is proportional to the heat taken in or given out during that change. The rising curve *AB* represents the heating of the feed water to boiler temperature, by whatever means it is carried out; the line *BC* represents the generation of steam and is horizontal because this takes place at constant temperature; the rising curve *CD* represents the superheating of the steam. No heat is taken in or given out during expansion in the turbine, so that the vertical line *DE* represents expansion of the steam down to the temperature of the condenser. In the condenser, condensation takes place at constant temperature, and is therefore represented by a horizontal line *EA*, which completes the cycle. The area enclosed by the cycle *ABCDEA* represents the excess of the heat taken in from the boiler along *ABCD*, over that rejected into the condenser along *EA*. This area therefore represents the energy which is available for conversion into work.

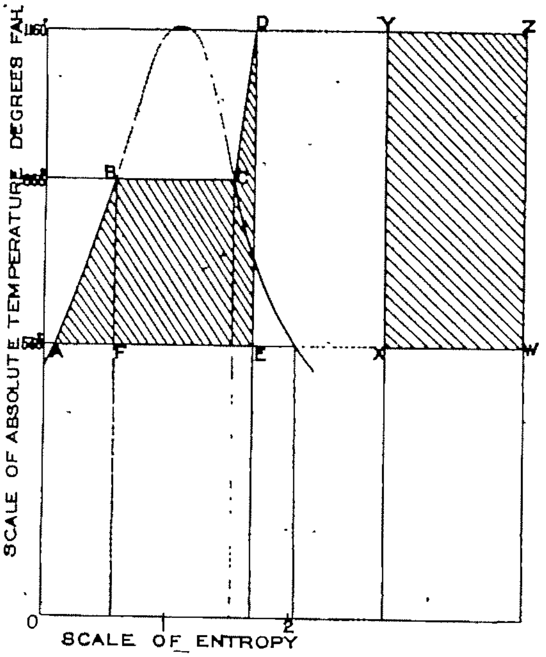


FIG. 1.—Entropy temperature diagram for the Rankine cycle for steam with boiler pressure 250 lb., condenser temperature 79° F. and superheat to 700° F.

The shortcomings of this cycle can be seen at a glance if we compare it with another cycle *XYZWX* in which all the heat received from the source is taken in at the highest temperature along *YZ*, and that rejected is rejected at the lowest temperature along *WX*. Here the work done is represented by the area of the rectangle *XYZW*, whilst the heat taken in is represented by the larger rectangle from *YZ* down to the base line. The proportion of the work done to the heat taken in is much higher than in the cycle *ABCDE*, and this is clearly seen to be due to the high temperature at which all the heat is taken in along *YZ*. The underlying areas of the first diagram shew us at once that, of the heat taken in along *AB*, that is, during the heating of the cold feed in the boiler, only a small percentage is converted into useful work. The heat taken in along *BC*, which is the latent heat of the steam, contributes a larger percentage, but still considerably less than the maximum. Even that received along *CD* during the process of superheating, yields less than the ideal maximum efficiency.

While the diagram thus exhibits the shortcomings of the Rankine cycle in comparison with an ideal Carnot cycle, it is of interest to remark that similar departures from the ideal are present in any type of engine in practical use. The internal-combustion engine, for example, contains an even greater departure from the ideal of constant temperature reception of heat, although its actual temperatures both of reception and rejection are higher throughout than in the steam engine.

Returning to the Rankine cycle for steam, it has been stated that the heat received during evaporation is a large proportion of the total heat received. That this is the case is readily seen from the diagram, this heat being represented by the area below *BC* down to the base line. By what is known as cascade feed heating, that is by heating the feed water by steam bled from the turbine at suitable successive stages, it is possible to a large extent to eliminate that part of the diagram which underlies *AB*, since by this process if carried out in its entirety the heat represented by the area from *AB* down to the base line can be saved, at the expense of a loss of work which can be shown to be equivalent to the area *ABF* for each lb. of steam. To raise the temperature of reception of the heat absorbed during evaporation, which in the case already considered is 88 per cent. of the total heat absorbed along *BCD*, would clearly result in considerable improvement of the efficiency of the thermodynamic cycle. Thus not only high temperatures, as in the case of the adoption of high superheat, but also high boiler pressures, lead to a substantial increase in over-all thermal efficiency.

The question of the improvement of the thermal efficiency of the steam engine by such means is one of prominent interest in the engineering world at the present time. Advances in this direction have already been made for land installations, and recently we have witnessed an application of the same principles to marine work, which had been awaited with keen interest, and was not without an historic setting. It is just a quarter of a century since the first commercial application of the steam turbine to marine work was made in the Clyde river steamer the *King Edward*, which, built in 1901, has continued in successful service season by season up to the present time. A new vessel, which has a high-pressure steam installation of geared turbines on the lines indicated above, has been built for the same owners and for the same service. This vessel, which has been named *King George V*, becomes in its turn the pioneer of the new system.

Malaria and the Mosquito.

THE enthusiast who is 'eradicating' malaria by any or all of the well known methods, should cease for a while from his labours and study the short report recently issued by the League of Nations and referred to below.[1] In Col. James's words, "He will at least realise what a great waste of effort is involved in measures directed against the breeding-places of mosquitoes as a whole and even in similar measures directed against one species. He will begin to appreciate how the secret of a successful control of malaria lies not in the general knowledge that the disease is spread by mosquitoes of a certain kind, but in the particular exact knowledge of the life history of the few individual mosquitoes which succeed in becoming transmitters of the disease."

This is a refreshingly new aspect of the problem. The enthusiast eradicates all mosquitoes. He does not stop to distinguish a Culicine (non-malaria) from an Anopheline (malaria) mosquito; he is out to destroy them all. Now he is advised to study not only the species of Anopheles which are concerned in transmission, for all are not, but also actually to concern himself about infected individuals! Why should he do this? It is because "Malaria is essentially a household disease and particularly a disease of certain kinds of houses . . . . Malaria should be dealt with in the houses of the people rather than in the environment." We have called this a new aspect of the problem, but the author points out that some twenty-five years ago Stephens and Christophers in their reports to the Royal Society directed attention to "fever houses." They state: "We may look upon such a house and its accessory hovels as one infected with malaria or as 'a fever house.' Such is the universal condition of European houses indeed in the remote stations situated in the African bush. It is in such houses that the malarial cachectic is living, exposed to frequent or even constant re-infection and in which every traveller staying the night is liable to infection. From such fever houses the majority of our cases of blackwater have come."

It has always been somewhat disconcerting that while, for example, in a native African village more than 75 per cent. of the children may be infected with malaria, yet the infection rate of sporozoites (infective stage of the malaria parasite) among the anophelines may be low, less than 5 per cent. Once infected, however, a single mosquito becomes exceedingly dangerous; how much so is shown by the fact that a mosquito which has lived (in captivity) 1-3 months and has bitten nearly half a hundred people in that time may still have numerous sporozoites in its salivary glands and is consequently still potent for mischief. But, on the other hand, if not bitten oneself, one may draw comfort from the fact that a mosquito is gradually purging itself of infection by biting other people, so that while 85 per cent. of mosquitoes showed a salivary glands infection on the 50th day, on the 70th day this was reduced to 20 per cent. (the glands, moreover, containing but few sporozoites), the mosquitoes having bitten about a dozen people in the interval. This at first sight appears inconsistent with the previous statement, but the difference lies in the fact that in the first case the mosquitoes' stock of sporozoites in the glands was being replenished by the oocyst stage present in the stomach, as shown by dissection, while they were absent in the second case.

Col. James's observations lead him to formulate some very important conclusions, namely, that "in Nature the only mosquitoes which succeed in transmitting malaria are those rare individuals who happen to pass their lives in conditions which resemble very closely those which we have found to be essential for the successful transmission of the disease in experimental work" and of these "not many will ultimately become infective." Let the sanitarian then pause and study the individual infective mosquito in the fever house. Here is the real centre of gravity.

Among interesting data with regard to the life of the malaria parasite in the mosquito are those concerning the persistence of oocysts and sporozoites, the young and the mature stages of the malaria parasite in the stomach and salivary glands respectively of captive hibernating mosquitoes, a persistence which is held to explain primary attacks of simple tertian malaria in Nature in the early spring in northern latitudes.

The report concludes with a study of the infected cases from the clinical and microscopical sides. They suggest that we shall have to revise somewhat our idea of the Golgi cycle in relation to the temperature chart, but in blood work we must never forget that the peripheral blood is almost certainly not the same thing as that of the spleen or marrows. Very prudently, we consider, the author refuses to sail on the troubled sea of immunity where shipwrecks are inevitable. The report is written in an agreeably clear fashion with an absence of assumption of authority quite charming.

J. W. W. S.

---

[1] League of Nations · Health Organisation—Malaria Commission. Report on the First Results of Laboratory Work on Malaria in England By Lieut.-Colonel S. P. James and P. G. Shute. (C.H./Malaria/57 (1)) Pp. 50. Geneva · League of Nations; London: Constable and Co., Ltd., 1926.)

Obituary.

PROF. J. G. ADAMI, C.B.E., F.R.S.

GEORGE ADAMI was a great pathologist, though not a 'laboratory man' in later years. A scholar and Darwin prizeman of Christ's College, Cambridge, he took a first class in the Natural Science Tripos, then studied in Paris with Pasteur and Roux, in Breslau with Heidenhain, and in Cambridge with Roy and Michael Foster. Afterwards he became John Lucas Walker student, and at the early age of thirty, professor of pathology and bacteriology at McGill University, Montreal. Through his inspiration, Sir Humphry Rolleston has written: "a continuous stream of papers" issued "from his laboratory dealing with all branches of pathology and its application to other sciences." He was awarded the F.R.S. in 1905 and the Fothergillian gold medal of the Medical Society of London in 1914. He was an ex-president of the Association of American Physicians, a fellow of both Jesus and Christ's Colleges, and held many honorary degrees. During the War, Adami became assistant director of Medical Services in the Canadian Army, for which he received the C.B.E. A member of the War Office Committee on the Medical History of the War, he published in 1918 vol. 1 of the "War Story of the Canadian Medical Corps." He was chairman of the Committee on Bacteriological Procedures, Medical Research Committee, and was largely responsible for the standardisation of Wassermann technique in the laboratories of Great Britain.

Adami's greatest contribution to science was the "Principles of Pathology." The first volume on general pathology, published in 1908, marked an epoch. It was, as stated in the preface, "not a mere record and description of phenomena, but an attempt to analyse those phenomena in an ordinary manner." It contained his exposition of inflammation and his original and helpful classification of neoplasms upon an embryological basis. Four years later he published with his friend Dr. John McCrae, of McGill University, his popular text-book of pathology. Other contributions to science included "The Physiology and Pathology of the Mammalian Heart" with Roy (*Phil. Trans.*), Pictou cattle disease, and a survey of the 1918 influenza epidemic in the British Army. In his Croonian lectures on adaptation and disease, delivered at the Royal College of Physicians in 1917, Adami argued against the doctrine that acquired characters are not transmitted. He was greatly interested in the problem of malignancy, and in the *Medical Journal and Record*, New York, August 18, 1926, controverted the view "that one particular order of microbe is concerned in the production of all malignant tumours;" he believed that the colloidal lead treatment was an "advance."

Adami accepted in 1919 the arduous post of vice-chancellor of the University of Liverpool. By his broad and practical outlook on life, his buoyant energy, his genial friendship, and his high ideals, he ennobled the University and the City of Liverpool and brought the two into closer and more intimate relationship. He faced his gradually failing health with unflinching courage, carrying out his duties to within a few weeks of his death.

ERNEST GLYNN.

THE news of Vice-Chancellor Adami's death came as a great shock to his personal friends, and no man had more: for so great was his passion for pleasant intercourse, and his enjoyment of human fellowship, that he sought and made firm friendships where other men would have only multiplied acquaintances. To meet him was a pleasure which he always actively developed, striking sparks from stones, and even finding entertainment in dullards. Doubtless it was partly this side of his character which found satisfaction in the very onerous post of vice-chancellor in the midst of this busily employed provincial city: a post which he filled with distinction, and with a grace which few could imitate. Not very different was that other interest which could leave no medical problem untouched, and carried him, enthusiastically always, through the wide-spread fields of knowledge in the subject of which he was a master, ever curious to meet new developments and always with the firm hand which grasped what others were satisfied with merely touching.

Gifted with this spirit of adventurous and penetrating curiosity, a man of incessant industry, and with a natural facility of expression and delight in exposition, his scientific papers and lectures have since his earliest days excited marked admiration: and to many it was a matter for regret that this more widely-known side of his activities was submerged in the daily routine of an administrative post. However, in Liverpool, an occasional lecture to a local society frequently disclosed the talents which his administrative duties otherwise concealed: and even to those to whom his main subject was a closed book, he was a shining example of the light which the University represented in the lives of the younger generation to which he patiently struggled to make it more and more accessible.

Resident long in Canada, familiar with methods of co-operation better known there than in our more conservative home-surroundings, Adami was sincerely an advocate of modes of procedure, methods and manners of organisation, which are not quite our own: and this advocacy was not without some discovery that habits and tastes were not readily remodelled. Such surprises must come to every man of action who ventures into new fields, and there the weaker spirit fails. Adami's spirit never flinched. Through every temporary conflict his buoyancy survived, and the geniality of his character helped him ably to overcome any lingering remnant of hostility.

Nor is this perhaps without some application to the endeavours in medical progress with which Adami has been most closely associated in the last few years of his life. Cancer, as he phrased it, is a *killer*, therefore it must be fought, and that by *team-work*. Absolute sincerity, tremendous enthusiasm, great breadth of knowledge and keenness of insight, and yet opposition, as natural as the clouds, which he somehow failed to understand.

Splendid gifts, sturdily continued efforts, great endeavours, all carried in a nature that was poised and balanced as by an internal gyrostat of goodwill and honourable intention; none of these qualities have been without success in the realms of science, medicine, and affairs. In Liverpool his efforts to strip the University of its shell and bare it to the life of the City have left a permanent effect of greatest value, by which he will be remembered here for many years to come. *Vale!* J. S. MACDONALD.

DR. J. L. E. DREYER.

ON September 14, Dr. John Louis Emil Dreyer died at the age of seventy-four years from an illness which he had resisted for the greater part of a year with an astonishing vitality. By his death astronomers are deprived of the presence of one of the most distinguished historians of their science. There are others who have treated the history of astronomy more comprehensively, but within the wide range of his labours there is certainly none who has excelled Dr. Dreyer in the combination of learning, sagacity, scholarly precision, and clear and well proportioned exposition.

Dr. Dreyer was descended from a family which had long been distinguished, largely as soldiers, in the public service of Denmark. The son of Lieutenant-General F. Dreyer, he was born at Copenhagen in 1852 and was educated at the University of Copenhagen. In 1874 he came to Ireland as astronomer at Lord Rosse's Observatory at Birr Castle. Lord Rosse's famous telescope had been found to be specially adapted to the observation of nebulæ, and Dreyer in consequence embarked on the study of nebulæ, with which, next to his studies in the history of astronomy, his name is most closely associated. In 1878 his work on nebulæ was interrupted by his appointment as assistant astronomer at the Royal Observatory at Dunsink, but it was revived on his appointment in 1882 to be director of the Armagh Observatory. While at Birr he prepared for publication the whole series of observations made with Lord Rosse's telescope from 1848 to 1878, published by Lord Rosse in the *Transactions of the Royal Dublin Society*, 1880, and he also published a supplement to Herschel's catalogue of nebulæ with numerous corrections. At Armagh, in addition to minor studies on nebulæ, he produced in 1888 the "New General Catalogue of Nebulæ and Clusters of Stars," included in the forty-ninth volume of the *Memoirs of the Royal Astronomical Society*, which, with his two supplementary catalogues published in the same series in 1895 (vol. 51) and 1908 (vol. 59), form the standard catalogues to which reference is always made.

While at Dunsink, Dreyer joined Copeland in founding an international astronomical journal called *Urania*, the first number of which appeared in January 1881. In July of that year its name was changed to *Copernicus*. The last number appeared in June 1884. The editors contributed their full share of reports and articles, and the journal is full of matter which, after more than forty years, remains both interesting and instructive. Dreyer's most important contribution was his "New Determination of the Constant of Precession," vol. 2, pp. 135-155, which, though never adopted in practical work, was used by Newcomb in his classical determinations.

At Armagh Dreyer produced in 1886 the "Second Armagh Catalogue of 3300 Stars," but his subsequent publications have been restricted to nebulæ and astronomical history. In 1890 he produced "Tycho Brahe, a Picture of Scientific Life and Work in the Sixteenth Century." Danish patriotism has given rise to much research on Tycho Brahe, but Dreyer found no scholarly biography, which should at once establish the facts in the light of the evidence available and at the same time place Tycho in his true position in relation to the progress of astronomy and to the life and thought of his time. Dreyer's volume, which is as illuminating as it is scholarly, supplies this want. In 1913 he began the publication of a complete edition of Tycho's works, of which ten volumes have appeared and the remaining four are stated to be complete in manuscript. This edition must probably be regarded as in the main a work of piety. The preparation of the text must have been a laborious task. The notes, in Latin, are brief, but exhibit the editor's usual scholarship. He has among other things taken the pains to discover what editions of the classics Tycho used.

In 1906 appeared Dreyer's "History of Planetary Systems from Thales to Kepler." The history of planetary systems for those ages is practically the history of astronomical theory. Here as usual we find that mastery of authorities and that sober judgment in weighing doubtful evidence that we should expect from a scholar alone, combined with that skilful interpretation and sympathetic exposition that only an astronomer could give. Dreyer returned to parts of this subject in two papers contributed to *Monthly Notices of the Royal Astronomical Society* in 1917 and 1918, in which he effectively disposed of the long prevailing idea that Ptolemy's star catalogue did not rest on his own observations, but on those of Hipparchus or Menelaus reduced to his own time. In 1920 he succeeded, largely as a result of research on manuscripts at Oxford, in restoring the original form of the Alfontine Tables (*Mon. Not. R.A.S.*, vol. 80, pp. 243-62). He took the leading part in the editing of Sir William Herschel's "Scientific Papers," published in 1912, and a very large share in the volume which the Royal Astronomical Society has recently produced on the first hundred years of its history.

Distinctions came as a matter of course. In 1916 Dreyer received the gold medal of the Royal Astronomical Society, of which he was president from 1923 until 1925. He received the honorary degree of D.Sc. from the University of Belfast, and of M.A. from the University of Oxford, in which city he had settled on his retirement from Armagh in 1916.

In private life Dreyer was unobtrusive, but accessible. He spoke quietly, and with the same deliberation and authority with which he expressed himself in public. His learning was always available to those who wished to benefit by it, and he will be greatly missed. His wife, a daughter of John Tuthill, of Kilmore, Co. Limerick, whom her friends hold in affectionate remembrance, died in 1923. He leaves three sons, all distinguished in the fighting services of the British Crown, and one daughter, who is married to Mr. Warham Shaw-Hamilton, late of Dartan, Co. Armagh.

MR. J. H. MUMMERY, C.B.E.

THE death of John Howard Mummery on August 30, whilst on a holiday visit to Cornwall, deprives the world of an eminent microscopist. Born on January 19, 1847, he was educated privately, previous to entering the medical school of University College Hospital. After qualifying as a member of the Royal College of Surgeons, and taking his L.D.S. diploma, he joined his father, a well-known dental surgeon and research worker, in practice in Cavendish Place, London, W.

During his studentship, whilst working under Sharpey, Mummery showed great aptitude for microscopic technique; this bent he developed to a remarkable degree. Specialising in dental histology, admittedly one of the most difficult branches of the art, he achieved a world-wide reputation. His most important papers were contributed to the *Philosophical Transactions of the Royal Society*, and include "Some points in the Structure and Development of Dentine," Ser. B, vol. 182, 1892; "On the Distribution of the Nerves of the Dental Pulp," Ser. B, vol. 202, 1912; "On the Process of Calcification in Enamel and Dentine," Ser. B, vol. 205, 1914; "On the Nature of the Tubes in Marsupial Enamel and its Bearing on Enamel Development," Ser. B, vol. 205, 1914; "On the Structure and Development of the Tubular Enamel of the Sparidæ and Labridæ," Ser. B, vol. 208, 1914; "The Epithelial Sheath of Hertwig in Man, etc.," Ser. B, vol. 209, 1919; "On the Nerve-end Cells of the Dental Pulp," Ser. B, vol. 209, 1920. Of these, the most remarkable is that dealing with the final distribution of the nerves of the dental pulp. Here was a problem the solution of which had been attempted by many workers; by dogged patience Mummery succeeded in demonstrating the passage of fine neuro-fibrils into the dentinal tubes. His work, too, on enamel tends to prove that this tissue is not wholly inorganic in structure but possesses an organic content, and is capable of exhibiting a vital reaction to injury and disease.

It is impossible here to allude to all of Mummery's numerous papers, dealing not only with the histology of normal tissues, but also many others of a pathological nature. These are to be found in the *Transactions of the Odontological Society of Great Britain*, *Proceedings of the Royal Society of Medicine*, and various British and foreign medical and dental journals; his last, "The Pathology of Chronic Perforating Hyperplasia of the Pulp," appeared in the *British Dental Journal* within a month of his death.

In 1919 Mummery published his text-book "The Microscopic Anatomy of the Teeth," which at once became popular with students. A second edition in 1924 was enlarged to include the general anatomy of the teeth, both human and comparative, and will no doubt remain a standard text-book for years to come.

Mummery was a first-class draughtsman, and his publications are enriched and their value enhanced by his own delightful drawings, in addition to the photomicrographs of his brilliant sections. He was also a water-colour painter of considerable merit.

It is given to but few to remain in active work, with intellectual powers undiminished, for four score years. To his intimate friends Mummery never appeared old. After visiting him in his study one came away stimulated by the suggestions emanating from his fertile brain, and steeped in admiration of his broad and catholic outlook.

Many honours came to Mummery; he was a past president of the old Odontological Society of Great Britain, and the first president of the Section of Odontology of the Royal Society of Medicine, which Society afterwards elected him an honorary fellow. The Royal College of Surgeons of England elected him a fellow and awarded him the Sir John Tomes Prize in 1897. He was a past president of the British Dental Association, and chairman of its representative board. International honours were also his; the University of Pennsylvania gave him its D.Sc. degree; he was president of the sixth International Dental Congress, and was awarded the Miller Prize by the International Dental Federation in 1922 for his original research in dental histology. During the War he acted as superintendent and registrar of the Maxillo-Facial Hospital, for injuries of the face and jaws, at Kennington, and for his services there received the C.B.E.

Mummery will ever rank among the worthies of his profession, as a distinguished follower of Thomas Bell, James Salter, John and Charles Tomes. M. F. H.

WE regret to announce the following deaths:

Prof. F. W. Gamble, F.R.S., Mason professor of zoology and comparative anatomy in the University of Birmingham, on September 14, at fifty-seven years of age.

Dr. A. W. Rowe, Lyell medallist of the Geological Society in 1911, who was distinguished for his researches on the zones of the White Chalk of Kent and Sussex, on September 17.

News and Views.

ON September 17, the *Morning Post* published a Reuter message from Berlin to the effect that Profs. Paneth and Peters of that city had, after years of experimenting, succeeded in transforming hydrogen into helium "with the aid of particles of metal." This announcement, if correct, is of great importance and will evoke even more interest than the claim by Miethe and Stammreich to have transmuted mercury into gold. The two claims differ, however, in the important respect that whereas the experiments of Miethe and Stammreich, and of Smits, indicated disintegration of heavy atoms into lighter ones, those now announced involve the synthesis of an element from a lighter one, thus more nearly approaching the alchemist's dream of changing the relatively light base metals into the heavier gold and silver.

To judge by the published literature, recent efforts at the transmutation of elements seem to have been concentrated on disintegrating heavy atoms—a course doubtless suggested by radio-active disintegration and by Rutherford's transmutation experiments with α-particles—but modern views on atomic structure also adumbrate the possibility of synthetic transformations. According to these views the hydrogen atom consists of one positively charged unit of electricity (a proton) with a single electron revolving round it; and the helium atom contains a nucleus of four protons and two electrons with two external electrons; so that the problem, on paper, consists in condensing, as it were, four hydrogen atoms into one helium atom, or of bringing into close association four independent protons and two electrons. No particulars are yet to hand concerning the methods adopted by Profs. Paneth and Peters, for the statement "with the aid of particles of metal" is meaningless as it stands. The experimental difficulties must be very great, not only in obtaining the energy necessary for such a change, but also in applying it under the appropriate conditions. Moreover, helium is an atmospheric gas, and traces of it are extremely difficult to eliminate by the methods of evacuation and adsorption at present in use; so that belief or disbelief in the Reuter message must be reserved pending further and more definite evidence.

THE German Scientific and Medical Association (Gesellschaft Deutscher Naturforscher und Ärzte) has now issued a handbook of the eighty-ninth assembly at Düsseldorf on September 19-26. From May to October of this year there is in Düsseldorf an exhibition for Hygiene, Social Welfare, and Physical Exercises: 'Gesolei' (GEsundheitspflege, SOziale Fürsorge, und LEIbesübungen). A series of separate societies hold their meetings at the close of the association assembly, which has therefore something of the character of a federation. Excursions include Bonn, Eifel, Neanderthal, and Holland, but chiefly the Rhine-Westphalian industrial area, for example, the Leverkusen dye-works. Düsseldorf is not now in the occupied area, but it has been occupied and is still near the occupied area. As in Innsbruck in 1924, the emotional undertone of the meeting may emphasise that political boundaries cannot divide the solidarity of civilisation (Kulturgemeinschaft).

THE Press bureau at Düsseldorf is in charge of Dr. R. Plohn, and two kinds of abstracts will be prepared—a general report for the daily Press and detailed abstracts for the technical Press. Those using the Press bureau are asked to acknowledge its assistance by sending two copies of any published report. The long list of papers to be presented is arranged in 34 sections. Sections 1 to 15 are the scientific sections. Section 15, presided over by Dr. Rein, is concerned with scientific education; and to the discussion on educational reform medical members are particularly invited. The remaining sections, 16 to 34, are medical, but 16 deals also with the general history of science. The chief addresses will appear in *Die Naturwissenschaften* and also as *Verhandlungen*, to be obtained by members and *Teilnehmer* for 4·50 gold marks either in Düsseldorf or by sending to the Geschäftstelle der Gesellschaft, Leipzig, Gustav-Adolf Strasse 12, to the public through booksellers for 6 gold marks.

A VIVID and intriguing discussion of possible developments in the cotton industry, by Dr. W. Lawrence Balls, will be found in the pages of the *Nineteenth Century* for August. Dr. Balls points out that cotton as a crop suffers from the fact that it inevitably competes for space which is suitable for a food crop, a competition in which the scales are weighted against it in the long run by the continual growth of population; on the other hand, some forms of its new competitor, artificial silk, are made from wood pulp and can be nourished by the spaces in the world that are not available for arable cultivation. Reference is made to the difficulty met with by the grower in the new areas trying to develop cotton production, when he tries to learn what demands the industry makes as to quality in his crop. The industry is so complicated, and divided into so many water-tight compartments, that from different types of spinner and weaver different and often contradictory demands are emphasised, often on very inadequate because too specialised experience. From that point forward, Dr. Balls indicates the inestimable value of the formation of the British Cotton Industry Research Association and the Empire Cotton Growing Corporation; these two organisations have made it possible "for the man from overseas to learn more in a day than he could formerly glean in a month, while the mill manager has become independent of Press stunts." The growing extension and improvement in technique in the production of artificial silk have undoubtedly brought about a new stage in the development of the cotton industry. Much interest therefore attaches to Dr. Balls' forecast, which he admits is heterodox, that whilst cotton will retain its place as a 'structural' material it will lose it as a mere 'covering' material; a change that implies a considerable shrinkage in volume of the cotton industry coupled with specialisation in quality, both of raw product and manufactured article.

PROF. JOHN M. COULTER gives an account of the new Boyce Thompson Institute for Plant Research at Yonkers, New York, in the *Scientific Monthly* for August. This account, with its accompanying photographs, shows how private endowment in the United States has supplied an instrument for fundamental research upon plants which has no counterpart in Great Britain. The only endowed institute which is directing research into fundamental problems of plant culture in Britain is the John Innes Horticultural Research Institution, which, under the late Dr. Bateson, obtained world-wide recognition as a centre of investigation into genetics, and under its new director, Sir Daniel Hall, may be expected to widen its field of attack. The new Boyce Thompson Institute provides a laboratory and greenhouse equipment for the study of the plant under controlled conditions which far exceeds that at the disposal of any British research station whether supported by public funds or private endowment. Col. W. Boyce Thompson was impressed, in making his liberal endowment of the institute that bears his name, with the dependence of the whole population upon plants and their products. In a crowded isle like Britain this is even more impressed upon the consideration of both Government and liberally minded citizens, and though the resources provided by the State may not permit of such extensive researches upon physiological problems of plant development and growth, the annual reports for

1925 of such stations as Long Ashton, near Bristol, and East Malling in Kent, which have recently been issued, show what extensive and thoroughly scientific work into problems of fruit and vegetable culture is in progress.

EAST Malling Research Station has now been established for some fourteen years, whilst Long Ashton commenced work about the beginning of the century. Both these stations have to confine themselves to fruit and vegetable problems, but for many years the Edinburgh Botanic Gardens have been noted for their experimental study of problems of propagation with both garden and greenhouse plants. Valuable aid in the study of commercial greenhouse plants is also given now by the Cheshunt Station in the Lea Valley, which has been associated both with Rothamsted and with the Department of Plant Physiology of the Imperial College of Science and Technology. A brief account of the work of this station from the pen of Prof. Mangham, appears in *Modern Science* for August 1926.

THE *Chemist and Druggist* for July 10 contains a beautifully illustrated account of the chief botanical gardens of Europe, and also a separate account, with equally charming illustrations, of the wonderful gardens established by the late Sir Thomas Hanbury at La Mortola. British botanists will be interested in both these articles, and many of them will have benefited by the generous policy pursued at La Mortola in the distribution of seed to British botanical departments. Another article of considerable interest in the same issue is the account by Prof. Jan Muszyński, of Vilna, of the medicinal herb fair held annually at that town on June 24. No fewer than 122 different kinds of herbs are collected and offered for sale by the peasant drug harvesters at the annual fair, and as the author, who is professor of materia medica at the University, points out, recent work on vitamins, hormones, etc., rather stresses the fact that the herb may mean considerably more in therapeutics than the pure drug extracted from it.

THERE are so many phenomena in connexion with the reception of long-distance radio signals that it is very difficult to give satisfactory explanations of the variations in the intensities of the signals. Mr. L W. Austin in the *Journal of the Washington Academy* (vol. 16, p 398) gives a résumé of measurements made by the Bureau of Standards on these signals and on atmospheric disturbances during 1925. One of the methods used was to compare the intensity of the received signal with that of an artificial signal of adjustable intensity produced by a local radio frequency generator. The principle of the method is identical with some of those used in Europe. No certain relationship has been discovered between sunspots and abnormal signals. To do this a complete study over at least one complete sunspot cycle would be necessary. Directional measurements on the atmospheric disturbances were made at frequencies of 21 4 and 15 kilocycles at the U.S. Naval receiving stations at Colon and Balboa, the two ends of the Panama Canal. During the dry season, that is, from January 15 to April 1, the disturbances at both stations come almost entirely from the direction of the high Andes in Northern Colombia. When the dry season is over, local storms begin and disturbances coming from the low mountains of the isthmus are prominent. In midsummer the direction of the incoming disturbances at Colon is roughly south-east, while at Balboa the direction of the disturbances is north or north-west. The observations prove that both stations give equally good reception to signals coming from the north during the dry season, but during the rest of the season the Colon station should give much better reception. Observations in Washington show that in winter the prevailing afternoon disturbances seem to come from the direction of eastern South America or possibly from Africa. In summer the direction is south-westerly, apparently from Mexico or the south-western United States. This agrees with the hypothesis that disturbances generally originate over land and are most intense in the afternoon and evening in the regions where the sun passes very nearly overhead.

MR. J. T. CUSWORTH, Upperthorpe, Sheffield, sends us a copy of notes made by him during the severe winter of 1885–6 on the vitality of a frog which was frozen in the centre of a block of solid ice. At the end of eight weeks the block of ice was carefully broken, and the frog, which was frozen stiff, was placed near a fire. In less than half an hour it was leaping about. Mr. E. G Boulenger, director of the Aquarium at the Zoological Gardens, Regent's Park, has been good enough to send us the following comments upon this communication: "It is well-known that batrachians and fishes may revive after having been frozen stiff for several months. So far as I am aware, however, exactly how long life may be thus suspended is not established In the rivers of Siberia, which may be frozen solid, fishes are often imprisoned for months on end and during such period assume a rigid condition, their vital functions being temporarily suspended. This fact suggested experiments in the freezing of live fish for transportation, and some were conducted in Switzerland and America several years ago. As a result of these, it was found that fish could be frozen stiff for from two to three months, showing no signs of ill-health, when thawed, as a result of their prolonged imprisonment. The fish which in certain parts of America are now sometimes transported on a commercial scale embedded in ice, are first placed in a closed tub of water into which oxygen under pressure is introduced. After being kept just above freezing-point for three days they are frozen solid. The blocks of ice containing the fish are then removed from the tubs and are surrounded with heat insulating packing. Under such conditions they can be kept in cold storage until wanted. The cost of transporting live fish in water is prohibitive, about ten gallons being required for each pound of fish. The freezing method therefore saves expense."

PROF. J. W McBAIN, Leverhulme professor of physical chemistry, who for twenty years has been on the staff of University College and the University of Bristol, has now accepted an appointment at Stanford University, California, U.S.A., where he will take up his duties after Christmas of this year. Miss M. E. Laing and Miss M. H. Norris have also been appointed to the staff of Stanford University.

THE Mineralogical Society, which was instituted on February 3, 1876, has just celebrated its jubilee in London. The programme included visits of delegates from foreign mineralogical and geological societies and invited guests to the British Museum (Natural History), South Kensington, and to other museums and institutions in London; a conversazione in the Geological Society's Rooms at Burlington House on September 21; and a dinner at the Connaught Rooms on the following evening. The celebration in London was preceded by an excursion (September 12-18) to Devon and Cornwall under the direction of Mr. Arthur Russell, and is to be followed by an excursion (September 23-30) to the north of England under the direction of Prof. A. Hutchinson.

THE news columns of the daily papers during the past few days have contained long accounts of the disastrous hurricane which visited Florida on the night of September 17. According to the New York correspondent of the *Times*, the coastal region from Palm Beach to Miami was the area most affected, and it is estimated that 800-1500 lives were lost. The material damage is put at 30,000,000*l*. In Miami, wooden houses were ripped apart, concrete houses broken from their foundations, 'skyscrapers' were badly twisted, small shipping were lifted into the Royal Park, and the new docks were destroyed. The wind is stated to have reached a velocity of 130 miles per hour, and the first visitation lasted nine hours. Farther north there were also damage and casualties. The West Indies is one of the five regions of the globe where these violent tropical cyclones occur. When such storms arise in or near the West Indies, they generally pursue a curved path towards the north-west or into the Gulf of Mexico and then north-eastward along the Atlantic coast. They lose their violence as they pass into the temperate zone. The Galveston hurricane was apparently of even greater violence than that which has just occurred It occurred in the same region on September 8, 1900, and on this occasion 6000 lives were lost and 6,000,000*l*. worth of damage was done. The wind velocity was estimated as 120 miles per hour, and much destruction was caused by high tides and a storm wave. These storms occur in the West Indies most frequently between August and October It seems a little remarkable that buildings of the character of 'skyscrapers' should ever have been erected in a region which is known to be liable to these violent tropical cyclones.

AN attractive series of lectures or popular 'talks,' calculated to interest the most diverse tastes, has been arranged for the coming winter on behalf of King Edward's Hospital Fund for London. The lecturers and subjects announced are as follows: Mr. H L. Baird on seeing by wireless (October 7); Air Vice-Marshal Sir Sefton Brancker on flying to-day and to-morrow (October 14); Mr. W. E. Garner on liquid air (November 12); Sir Richard Paget on the artificial production of the human voice (November 19); Mrs Rosita Forbes on her trans-Saharan journey (November 25); Dr. Ezer Griffiths on the romance of refrigeration (November 26). The lecture hour in each case is 5 P.M. The fact that these distinguished people are giving their services, and that the charges for the lectures are moderate, should insure that King Edward's Hospital Fund derives considerable financial benefit from the lectures, details of which can be obtained from the secretary of the Fund, 7 Walbrook, London, E.C.4.

IT has been pointed out that the table in the article on "Patent Office Statistics" in NATURE for September 18, p. 428, contains errors arising from the fact that 'inclusive' salaries and those carrying bonus are shown intermingled in the estimates. The writer of the article has accordingly prepared the following corrected table:

Department	Total personnel	Number of personnel with salaries rising to a maximum of		Total of higher posts	Percentage of higher posts.
		1000*l* to 1800*l*	2000*l*. and over.		
Treasury	331	17	9	26	7·8
Foreign Office	839	24	3	27	3·2
Ministry of Transport	524	9	2	11	2·1
Board of Trade	567	7	5	12	1·8
Ministry of Agriculture	1197	14	3	17	1·4
Patent Office with Trade Marks and Design Branches	685	4	0	4	0·38

A SHORT manual on First Order Triangulation, by Rev. C. V. Hodgson, forms *Special Publication* No 120 of the United States Coast and Geodetic Survey. Its purpose is to summarise the methods employed in executing first-order triangulation and base measurement. The Survey now uses the term 'first order' in place of the term 'precise' or its earlier equivalent 'primary.' First order triangulation must have an average triangle closure of about 1″ or less, and a maximum closure not exceeding 3″. The closure in length upon a measured base must not exceed an error of 1/25000. The pamphlet contains chapters on instruments, organisation of parties, routine, sources of error, field computations, and base-line measurement. It is essentially practical, and pays little attention to theoretical considerations.

A CATALOGUE (Dept. No. 3, August) of second-hand books on natural history has reached us from Messrs. W. and G Foyle, Ltd., 121 Charing Cross Road, W.C.2. It should be seen by readers on the look-out for natural history books, the range being large and the prices low.

DR. C. W. STILES, secretary of the International Commission on Zoological Nomenclature, informs us that a new (English) edition of the International Rules, together with the summaries of 'Opinions' 1 to 90, has been printed in the *Proceedings of the Biological Society of Washington*, D.C., vol. 39, pp. 75-104, July 1926. Copies can be obtained from Dr. Thomas E. Snyder, the Secretary of the Society (address: Bureau of Entomology, U.S. Dept. of Agriculture, Washington, D.C.), price 1 dollar.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chemist for research work on the evaporation rates and the ignition temperatures of vapours, of certain inflammable spirits used in industry as solvents, under the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1. (September 29). A head of the mining department of the Central School of Science and Technology, Stoke-on-Trent—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (September 30). An assistant for technical records work in connexion with the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (October 4). A senior lecturer in electro-technics at the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (October 15). An engineer to take charge of the section of Wood Preservation of the Forest Products Research Laboratory at Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (December 1). A director of agriculture in the Territory of New Guinea—The Official Secretary for Australia, Australia House, Strand, W.C.2 (December 15). An assistant lecturer in agriculture at the South-Eastern Agricultural College, Wye, Kent—The Secretary. Junior professional assistants in the Meteorological Office—The Secretary, Air Ministry, Adastral House, Kingsway, W.C.2. A senior woman library assistant at the School of Oriental Studies—The Librarian, School of Oriental Studies, Finsbury Circus, E.C.2. A laboratory assistant for the Veterinary Research division of the Agricultural Department of the Government of Kenya—Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (quoting M/14661). A mistress for physics at the Cowley Girls' School, St Helens—The Secretary to the Governors of the school, 17 Cotham Street, St. Helens.

Our Astronomical Column.

RECENT NAKED-EYE SUNSPOTS.—The last naked-eye group of sunspots noted in these columns was No. 9, seen on the sun's central meridian on July 30. Another large group bordering on naked-eye visibility was in transit across the disc between August 10 and 22, but as some observers failed to see it, a number has not been assigned to it in our tabular list of these large spots. Since September 13, however, an important group has been an easy naked-eye object. This new group is composed of two very large spots, both of which could be seen separately through morning fog on September 18. On that day their apparent separation was 3¼′, corresponding to 14¼° of solar longitude between their respective centres.

When the spots first appeared round the sun's east limb on September 13, they were evidently of recent origin and growing rapidly, for within 48 hours their total area had doubled. On September 18 the area of the group was 3000 million square miles or 1/400th of the sun's hemisphere. The group ranks accordingly in size with the spot of last December as the second largest group seen as yet this cycle. The region of the sun in which the group occurs is very near that of No. 8, the central meridian passage of which was June 29. During the interval between the disappearance of group No. 8 and the formation of No. 10, the photosphere of that region was marked fairly strongly with faculæ. Particulars of position and area of the August and September spots are given below:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
—	Aug. 10-22	Aug. 16·2	18° S.	1/1400
10	Sept. 13-25	Sept. 19·5	24° N.	1/400

COMETS.—Two periodic comets, Giacobini-Zinner and Neujmin, are due at perihelion in a few months. The former is interesting from the near approach that its orbit makes to that of the earth. Mr. Cripps has calculated the perturbation and finds December 7 as the date of perihelion. The following ephemeris for 0^h U.T. is from the B.A.A. Handbook:

	R.A.	N. Decl.	log r.	log Δ.
Sept. 30	16^h $50·3^m$	7° 15′	0·136	0·144
Oct. 8	17 8·2	5 5	0·115	0·133
,, 16	17 28·5	2 48	0·093	0·120
,, 24	17 51·7	0 25	0·070	0·105

The comet is fairly well placed in the evening sky, being on the meridian about 4 P.M.

THE SPECTRUM OF ϕ PERSEI.—The results of a detailed photometric study of certain features of the spectrum of the star ϕ Persei (Sp. type B0pe), by Dr. W. J. S. Lockyer, Director of the Norman Lockyer Observatory, are recorded in *Monthly Notices, R.A.S.*, vol. 86, p. 474 (1926). Bright hydrogen lines appear in this spectrum, superposed on broad absorption lines. Each of these bright lines appears double, owing to the superposition of a fine absorption line which undergoes a periodic oscillation, presumably due to a Doppler effect. The two bright components accordingly undergo a periodic change of relative intensity, and the paper records the measurement of this change by the wedge photometer at frequent intervals throughout a complete cycle (Sept. 9, 1925–Jan. 13, 1926). Interesting conclusions are drawn from the measurements, some of which are contrary to what was expected from the observations of other workers. A similar study of the narrow absorption lines of hydrogen confirms an indication of a preliminary investigation that a variation of short period with quite a considerable amplitude is superposed on the primary variation. Pulses of activity are suggested, which seem to increase up to the epoch of maximum negative velocity and decrease down to that of maximum positive velocity. Bright lines of helium and other substances also occur in the spectrum, and the paper includes some comments on their behaviour. The character and intensity of the helium lines suggest a period of variation equal to half that of the primary variation, but the components of the bright ionised metallic lines, although their relative intensities occasionally alter, do not all behave alike, nor do they present any apparent cyclical change.

Research Items.

'Sôma.'—A note by Prof. G. Jouveau Dubreuil, in the *Indian Antiquary* for September, deals with the identity of the sacred Sôma plant. Dr. Vincent Smith pointed out that while the plant used in the sacrifices of the Parsis of Yezd and Kirmân, as well as of the Deccan and Bombay, is identified with one or other of the species of Asclepias, the real Sôma plant may have been different. Mr. Havell has suggested that it is Eleusine, the common millet still found in the Himalayas. An inquiry has been made as to the plant used by the Sômayagis, who practise the Sôma sacrifice, among the Nambudris, a very high caste of Brahmans in the district of Malabar who, having been sheltered from invasion and change, have thus preserved the Vedic tradition. A reply was received from the great temple of Taliparamba where are the best examples of the *agnidriyas*—the temples of the Vedic fire—that the Sômavalli plant was a rare plant found in the mountains and was obtained from a raja who lived at Kollangôd (ten miles south of Pâlghât). After some difficulty a specimen of the plant was obtained. It proved to be a climbing plant having a stem which was green, bare, round, and woody, and containing a milky liquor. It is absolutely without foliage, and has been identified as belonging to the genus Asclepias.

Antiquities from Kedah.—Mr. Ivor H. N. Evans, in the *Journal of the Federated Malay States Museums*, vol. 12, pt. 3, describes the results of a visit to the Langkawi Islands, the neighbourhood of Sungai Patani, Baling, and Weng, to obtain additional examples of antiquities from these localities, and in the last-named place to collect specimens of the manufactures of the Negritos, whose presence had been reported there. Excavation work was undertaken on the Sungai Batu estate towards the foot of the Kedah Peak, where an ancient statue, some brickwork, and four worked stones had been obtained in 1921 and 1923. Of these last, two were conduit stones, and another had apparently at some time borne a bas-relief of an elephant-headed god (Ganesha). The excavations revealed the remains of a shrine consisting of wallings of laterite and bricks and, apparently, the sill of a doorway, as well as boulders embedded in a cement of laterite. A number of sculptured stones were found including a highly conventionalised ancient Hindu *Yoni* (female sex organ) apparently of quartzite, a sharpening stone with two depressions for holding the water used in whetting, and two stones with spiral markings, probably the terminals of a balustrade. The conclusion suggested is that the early inhabitants of Sungai Batu were Hindus and worshippers of Siva or related deities. Probably they were non-Malayan traders or miners or, if Malays, they had learnt the art of stone carving from Indian sources. Occupation goes back to a time when stone implements were in use, as is shown by a beautifully made chalcedony celt, and lasted until an ancient Mohammedan settlement. Here also strong Hindu influence is to be observed in four graves of obviously important personages.

Intestinal Secretion of Insects.—In *Memoirs of the College of Science, Kyoto University*, Series B., Vol. 2, No. 2, 1926, Mr. Osamu Shinoda contributes an important paper on this subject. It has long been known that in insects the mid-intestine performs the dual function of digestion and absorption. There exist various theories and hypotheses as to whether these two functions are performed by two distinct kinds of cells or whether they represent different physiological phases of the same kind of cells. Mr. Shinoda's studies were mainly carried out on larvæ of the Saturniid moth *Dictyoploca japonica*. He finds that the epithelial layer is composed of goblet cells and ciliated cylindrical cells which are, in his opinion, homomorphous at different phases of their activity. The cylindrical cells are those in the phases of secretion and absorption, while the goblet cells are nothing more than a resting phase of the cylindrical cells. In the secretory phase the nuclei of the cylindrical cells are large and loosely filled with irregularly shaped basophile granules: the nuclei, it may be added, are situated slightly higher than the middle points of the cells. The cytoplasm just beneath the ciliated border is filled with secretory granules. In the stage of absorption the nuclei lie near the distal ends of the cells; they are small and densely filled with chromatic granules. When the phase of absorption is over the accumulation of secretory granules begins while the nuclei increase in volume and migrate downwards in the cells.

Insects and the Transmission of Rinderpest.—Very few attempts appear to have been made to transmit rinderpest by the agency of arthropods. Certain bacteriological data obtained by the Director of the Veterinary Research Institute at Muktesar, India, seemed to indicate that the causative organism of rinderpest was possibly not very unlike the Leptospira of yellow fever, which is transmitted from host to host by the mosquito *Ædes argenteus*. This analogy appeared to be worth following up with reference to the possible insect-transmission of rinderpest, and a lengthy paper on this subject has recently appeared in *Memoirs of the Dept. of Agriculture in India*, Vol. 9, No. 5, May 1926. The author, Mr. S. K. Sen, carried out a series of transmission experiments which resolve themselves into three categories. In one series the mosquito *Ædes albopicta* was used as the transmitting agent. The results of the experiments on hill bulls were negative, but some of the rabbits employed showed thermal reactions when infected mosquitoes fed upon them. In another series the possibility of the mechanical transmission of rinderpest through the agency of *Musca domestica* was tested. In a fair proportion of the experiments positive results were obtained when bodies of flies fed upon infective material were inoculated into susceptible bulls. The results, however, were negative when the trials were carried out with reference to transmission under conditions more likely to occur in a state of Nature. The third series was carried out with *Pediculus humanus*. The infectivity of saline suspensions of crushed infested lice was tested upon three bulls, and one of these developed rinderpest. The effects of the transference of infested lice on to a healthy bull, however, were negative.

The Climate of North-East Land.—In a paper in the *Geographical Journal* for September on the weather of North-East Land, Spitsbergen, during one month in the summer of 1924, Mr. K. S. Sandford has collected some evidence of value in relation to the problem of glacial anticyclones. In this relatively small but almost entirely ice-covered area he found no fixed anticyclone but a definite tendency towards the establishment of anticyclonic conditions with radial gravitational winds. This intermittent glacial anticyclone is blotted out by interference from outside the area but quickly re-establishes itself. Winds are markedly outflowing and lead to an augmentation of the bordering ice at the expense of the higher parts of the interior. On the other hand, interference from outside is great and leads to melting of ice in the bordering zone and to a less extent in the interior. During the maintenance of anticyclonic conditions there is some indication of a pulsation, from calm to blizzard. Mr. Sandford believes that in New Friesland, on the mainland of Spitsbergen, there is a similar but modified system. Other parts of Spitsbergen have an insufficient ice-covering for its development. Up to the present there are no winter observations available from North-East Land.

THE NEW MAP OF FRANCE.—The standard map of France is the Carte d'État Major on a scale of 1 to 80,000, from which other scales are derived. So long ago as 1881, on the completion of this map, it was proposed to produce a new coloured map on a scale of 1 to 50,000. In the *Revue Scientifique* (Nos. 12 and 13, 1926) Col. G. Perrier traces the history of these proposals. It was not until 1899 that a specimen sheet of the new map was prepared and then the project was again suspended, eventually to be resumed, but restricted to certain regions in the north-east, east, and south-east for purely military purposes. In 1914 the number of published sheets was only 42. Some provisional sheets for Alsace-Lorraine were produced during the War, and a few for the Saar basin have been since published. But the scheme, which embraces about 1000 sheets, is now definitely suspended owing to expense Apart from the provisional issues, only 53 sheets are available of this new survey.

THE AGE OF THE EARTH.—In the *Transactions of the New Zealand Institute* (March 6, 1926) the Hon. Sir Frederick Chapman discusses the origin of living organisms and their evolution with the view of reaching a reasonable idea of the period during which the earth has been inhabited. He thinks it is now possible to draw the conclusion that the first organisms were very minute; perhaps far smaller than the typhus bacillus or the invisible microbe of foot-and-mouth disease. Traces of micro-organisms have been found by Walcott in the pre-Cambrian rocks of North America, and from that beginning organisms have become larger and larger up to the massive creatures of the Mesozoic and the 150-ton whales of to-day. The broad question is raised: how many generations are required, and how long would it take, for evolutionary processes, to develop such enormous animals from ancestors of which a thousand million would make up less than a pin's head in bulk? No definite estimate is suggested, for the author recognises that no law of uniformity—either arithmetical or geometrical—can possibly be assumed. Nevertheless, it is made clear that his own sympathies are in favour of the longer estimates of geological time. He rightly protests against the idea that the evolution of the horse within the Cainozoic era could have been accomplished in the four million years that were formerly allowed to that era by certain geologists, then intimidated by the authority of Lord Kelvin. However, this is now of no more than historical interest. It is scarcely likely that Sir Frederick Chapman's problem will ever be directly soluble, even by the integration of its parts. Biologists will probably do better to take their time-scale from the study of geological and radioactive processes, and to make such deductions as to the rate of evolution as may be useful for their purposes. The only direct contribution from palæontology is the broad conclusion that hundreds of millions of years would be preferable to tens of millions.

THE NATURE OF ISOSTASY.—An important paper on isostasy from the pen of Dr. Harold Jeffreys appears in *Gerland's Beitrage zur Geophysik* (Bd. 15, 1926, p. 167). He shows that the work on which the theory of isostasy has been founded is adequate to prove that surface inequalities are compensated at depths of the order of tens of kilometres, but that it fails to provide satisfactory criteria for discriminating between the Pratt and Airy types of compensation or between local and regional compensation. Theoretically there is an infinite number of density distributions which would fit the gravity data, but excluding those that are physically unplausible there is a general likeness between those that are left. The Airy compensation is found to be much the more probable from the point of view of the physical and geological processes involved; and regional compensation spread out to a distance comparable with the depth of compensation as usually inferred is more probable than local compensation. Unfortunately, the depth of the compensating matter and its lateral extent are complementary in the sense that they cannot be disentangled by gravity observations alone. However, regional compensation must be effected at a smaller depth than an equivalent local compensation, and from this consideration it is inferred that the thickness of the granitic layer of the continents must be about half the least value (41 km.) found for the depth of compensation on the local hypothesis. As seismic and thermal evidence suggests a thickness of 15 or 20 km. there is already independent evidence in favour of Jeffrey's conclusions.

TRIETHYLAMINE AND DIETHYLAMINE.—A communication received from the Mellon Institute of Industrial Research, Pittsburg, Pa., states that a new process for manufacturing triethylamine and diethylamine has been developed there by Dr. D. K. Tressler and his assistants. The cost of production of the amines is said to have been considerably reduced, and it is anticipated that they will find extensive industrial applications, many of these being suggested. No details of the method are disclosed.

THE HISTORY OF CHEMISTRY IN AMERICA.—We have received a copy of a paper by E. F. Smith, reprinted from the *Journal of Chemical Education*, Vol. 3, No. 6, June 1926, containing fragments relating to the history of chemistry in America. The six sections refer to such varied subjects as Dr. L. Spalding's "New Nomenclature of Chemistry," 1799; Priestley's visit to America, 1794, alchemists in the New England Colonies, *c.* 1700; mineral analysis, 1824; Amos Eaton's "Chemical Instructor," a very practical text-book, *c.* 1800; and articles from the *Pennsylvania Magazine*, or the *American Monthly*, first published in 1775 by Robert Aitken.

IGNITION OF GASES.—Paper No. 24 (Part 1, by N. S. Walls and R. V. Wheeler; Part 2, by W. Rintoul and A. G. White), published by the Safety in Mines Research Board, describes some of the work being carried out on the ignition of gases. When mixtures of methane and air are exposed to flame, combustion does not take place instantaneously, but an exposure of a definite period is required. The period depends on the character of the flame, being shorter for larger flames. With fully aerated flames, mixtures containing between 9·5 and 10 per cent. of methane are the most readily ignited, but if the flame is not completely aerated and abstracts oxygen from the mixture to which it is exposed, the most readily fired mixtures are those containing an excess of oxygen. When fully oxidised explosives are employed to ignite the mixtures, the optimum methane content is 9·25 per cent., suggesting that the flame of the explosive is not the only factor involved.

Industrial Psychology.

IN the programme of Section J (Psychology) at the Oxford meeting of the British Association, industrial psychology was the subject of several papers and demonstrations of which the following is a brief review :

(1) Mr. R. J. Bartlett, King's College, read a paper on the judgment of value of individual advertisements. The paper arose from an inquiry undertaken by the National Institute of Industrial Psychology three years ago. The first essential of a good advertisement is attracting power and the second holding power. The grading of individual advertisements according to 'attracting-holding' power was taken as the principal task. But in a world as inconstant as that of Paris fashion a 'scale' for measuring this power can have only a temporary value. The scatter of some 180 advertisements when arranged in a scale of 7 grades was found to be normal. Most advertisements fell in the central three grades and very few indeed in grades 1 or 7. For the advertiser the lesson is the old one : 'There's plenty of room at the top.' Another feature is that when the 16 Bovril posters were judged by 15 members of the advertising profession, great variability of judgment from subject to subject was exhibited, yet the resulting order of merit correlated with the winning ballot order as high as 0·8±0·1, showing that there is a common factor in the judgments which is shared by the large population that contributed to the ballot figures.

It was concluded that with a small number of advertisements, up to say 20, the method of paired comparisons, though tedious, is trustworthy. Above that number a fractionation method using 7 groups was recommended. Some practised subjects are even capable of employing this method using 15 groups. Simplicity and unity of design coupled with artistic treatment of shape and balance make for the good advertisement, while overcrowding, distraction from competing foci, and failure to secure the illusion of perspective are among the principal causes of failure. In conclusion, two kinds of variability were discussed, namely, the common variability from some nodal value, and that founded on the limited appeal of certain advertisements ; for example, pipe smokers agreeing very closely in their disagreements with cigarette smokers. The latter kind is important and deserves further study. This, however, was set aside in forming the present scales, the aim being to assess the value of an advertisement on the assumption that the reader is a prospective purchaser.

(2) Mr. Arthur Stephenson, of the National Institute of Industrial Psychology, read a paper on some observations on accidents in industry. Although one must not belittle the success of mechanical safeguards, yet 90 per cent. of present-day accidents are to be accounted for as failures on the part of the human subject. The U.S. Federal Board for Vocational Education gives many examples of efficient safety work in various industries, but only one-third of the reductions in the personnel sustaining accidents has been effected by mechanical safeguards : two-thirds have been accomplished through organisation and education. Mr. Davis, Secretary of Labour, states that the fatal industrial accidents in the U.S.A. probably exceed 23,000 per annum and non-fatal accidents 2½ millions, and he is advised by experts that 85 per cent. of these are preventable. In Great Britain there are about 1200 fatal accidents per annum in factories and workshops, and another 1200 in coal mines and quarries. Non-fatal accidents of sufficient severity to cause disablement for a week or more number 120,000 a year in factories, and 200,000 a year in coal mines.

The National Institute of Industrial Psychology, so far back as 1922, recommended preliminary surface instruction of youths entering the mine and applied a scheme of training. Mr. Stephenson described an experiment where learners were trained in an industrial process along certain lines. Some of the learners were raw novices while others had had previous experience. Periodical tests of efficiency were made and those who proved incapable of profiting by instructions were discharged. After the scheme had been in operation for 10 months the accident frequency was analysed. The frequency rate for novices dismissed was 1½ times as great as for novices retained, while for experienced learners dismissed it was 3½ times as great as for experienced learners retained. The data obtained made it probable that ability to acquire the neuro-muscular co-ordination required by the particular process, is at least as important a factor as age or experience. Whilst agreeing that a considerable advance may be made by educational and propaganda methods, it is considered probable that the scientific selection of the workers would probably tend to diminish the frequency rate of accidents.

(3) Mr. A. Angles read a paper on restriction of output. In no case within the experience of the National Institute of Industrial Psychology has restriction of output been attributable to the particular trades union as such It is usually brought about by a strong feeling of class loyalty which, in known cases, has even overcome individual self-interest. Two of the reasons given by workers for this policy are sufficiently frequent to be outstanding :

(*a*) Fear of rate-cutting. Examples are on record where employers have reduced rates in order to keep the workers down to a certain minimum.

(*b*) Fear of unemployment, or increased short-time. The work is spread out so that time-rate workers shall have the benefit of longer hours and more pay. Other reasons are : The fear of discharge of less competent workers, general dissatisfaction with present conditions, influence of the foreman, satisfaction with present earnings. General conditions and systems of wages vary enormously according to the efficiency of the management, but where the 'mental atmosphere' of the factory is good, restriction of output will very rarely be found.

(4) Miss W. Spielman gave a lecture on recent progress in vocational selection. The older methods of vocational selection were compared with modern methods employing mental and physical tests. This lecture served as an introduction to the demonstration given at the conversazione, by Miss Spielman and her assistants, of psychological tests in use at the National Institute of Industrial Psychology. There were tests for vocational guidance (*e.g.* of intelligence, mechanical ability, and manual dexterity) ; and tests for vocational selection (*e.g.* for engaging weavers, packers, clerks, sales assistants, etc.). In addition, the material collected from various countries by the Research Committee on Vocational Guidance was on view and the various reports of this Committee were distributed to those interested.

(5) Mr. Eric Farmer, investigator to the Industrial Fatigue Research Board, arranged an exhibition, and gave a demonstration at the conversazione, of apparatus designed for the Board by Dr. Schuster, namely, a pursuit-meter, steadiness-meter, a fatigue-inducing apparatus, a dotting apparatus, an original type of chronoscope for serial reactions, and a figure-setting apparatus which serves excellently as a non-verbal test of intelligence. All were original in design and ingenious in workmanship and well calculated to render effective service in the hands of the industrial psychologist.

LL. W. J.

Early Egypt and the Caucasus.

During the recent meeting of the British Association at Oxford, the question of the origin and date of the Badarian culture of Egypt was again raised by Sir Flinders Petrie, and provided the material for an animated discussion which, with two closely related papers on the geology and archæology of the Fayum by Miss Gardner and Miss Caton-Thompson respectively, occupied the whole of an afternoon session in Section H (Anthropology).

Sir Flinders Petrie in opening gave a brief summary of the paper which he read before the Section last year at the Southampton meeting. It may perhaps be a convenience to recapitulate here the facts. While working at Badari, a site thirty miles south of Asyut, four seasons ago, members of the British School of Archæology in Egypt discovered a settlement which had in its lowest stratum pottery of a very fine type, entirely hand made, and the thinnest and hardest of any age, with a polish never surpassed With it were associated ivory statuettes and flints finely worked in technique and form and resembling the Solutrean, and identical with the finely worked flints already known, though from surface finds only, to occur in the Fayum and across the desert up to Palestine. A later investigation by Miss Caton-Thompson produced similar implements from the settlement sites of the Fayum

Sir Flinders Petrie suggested an Asiatic origin for this culture, its centre possibly being the Caucasus. As regards its dating, basing his conclusions in the levels of the Nile as a time scale, he suggested something like 12,000 to 15,000 B.C. as the period at which the sites had still been uncovered. The chronological evidence was thus, on this reckoning, not contradictory of an attribution of the culture to the Solutrean, following the indication of form and technique in the flint work. Obvious difficulties stand in the way of accepting the Badarian culture as an Egyptian offshoot of a Solutrean culture, not the least of course being the presence of pottery. To this the reply is that while one branch of the original Solutrean culture on its migration into Europe along a glacial fringe lost certain elements in that culture, such as the pottery, the other branch, proceeding southward in easier conditions of travel, was able to retain them.

Further, among other criticisms, it has been pointed out that flint working of this delicate type occurs at what is known and admitted to be a later date: it is not to be accepted as being beyond question Solutrean on the ground of its form and technique. In Scandinavia, implements known to be neolithic present a resemblance to the Solutrean form and technique Sir Flinders Petrie is prepared to accept the facts, but not necessarily as militating against his conclusions. Just as the European Solutrean lost in its way across the Continent, so the south-western branch lost something and degenerated after it had reached Egypt; there was a descent from the finest to the coarsest pottery and from the finest to the coarsest flint work. The recurrence of the finer technique is to be regarded as evidence of a long-continuing Asiatic civilisation which sent off branches from time to time at long intervals.

Apart from the recapitulation and expansion of the argument in favour of the Solutrean date of the Badarian culture, Sir Flinders Petrie brought forward at Oxford two pieces of evidence bearing upon the question of its northern origin, one of which is certainly of first-rate importance if it should be ratified by subsequent examination. Among the finds made by Miss Caton-Thompson in her excavations on the settlement sites of the Fayum during the past season, straw granaries were found buried in the ground which were made of the straw of wheat. This wheat has been pronounced to be neither the old wheat of Babylon and Egypt nor the wheat of Roman times, but a northern wheat. This wheat was certainly unknown in later times, and if the claim that it is of a northern origin can be substantiated, it is a conclusive piece of evidence for, at least, an intrusive element from the north.

The second class of evidence which, in Sir Flinders Petrie's opinion, pointed to a Caucasian origin, was derived from the coincidence between names mentioned in the "Book of the Dead" and certain place-names in the Caucasus. Recently Mr. Fessenden of U.S A. has advanced the view that in the Caucasus area we are to find the cradle of civilisation, basing his theory upon a multitude of coincidences between Caucasian place-names and names mentioned in legend and tradition. Among others he identified names mentioned in the "Book of the Dead." Sir Flinders Petrie has carried the investigation further Extracting place-names in the "Book of the Dead" in their local relation to one another, he finds that they equate with place-names in the Caucasus, and, what is more, their local relation corresponds to the correct geographical relation of the equivalent place-names in that area. Further, the mention of a lake of fire in a fertile valley surrounded by barren hills could only correspond in actual fact to the conditions of a naphtha lake in the Caucasus. The traditional origin of Osiris, the god of the corn, in this legendary region is corroborated by the northern origin of the corn now discovered.

It is perhaps scarcely necessary to say that Sir Flinders Petrie's theories found many stern critics, ranging from Prof. Sollas, who pointed out that the conditions of the Badarian culture could not be regarded as corresponding to the conditions of the Solutrean, certainly as regards dating, to Mr. Peake, who, while inclined to accept the northern origin of the culture of the pottery and the grain-growing worshippers of Osiris, not only raised the question as to the equation of Badari and the Fayum, but also in regard to the last argument pointed out the necessity for certainty in the transliteration of the names taken from the "Book of the Dead." Such experts in the technique of flint working as the Abbé Breuil, Dr. Bosch Gimpera, and Mr. M. C Burkitt concurred in thinking that the finely worked flint might be an independently developed Solutrean-like technique entirely African in origin.

It was, however, the papers by Miss Gardiner and Miss Caton-Thompson which most strongly emphasised the difficulties inherent in Sir Flinders Petrie's theories. As already mentioned, he had based his dating of the Badarian culture on the height of the water level. Miss Gardiner's investigations of the recent geology of the Fayum showed that the lake beds north of the Birket Qarun must be divided into at least two series—those of an earlier lake occurring up to 222 ft. above the Birket Qarun level, which were at one time connected with the Nile, as is shown by the fauna, and a later series which only reached the maximum of 205 ft. above the present level. Miss Caton-Thompson's examination of the settlements yielded flint implements of the characteristic type, pottery, and ample evidence of the agricultural, hunting, and fishing culture of the people. It is a characteristic culture of advanced neolithic type. Further, it was found that the sites fringe the shore of the second lake period, resting upon the sands and clays of the old high-level lake. There is no sign of subsequent submergence. Both topography and the distribution of the high-level gravels emphasise the long period which elapsed between middle palæolithic times and the arrival of the Fayum flint-workers.

It would appear that both the geological evidence and the evidence of culture—unless we are to revise entirely our conception of the culture attainable by a palæolithic people—preclude the attribution of a very high antiquity to this civilisation of the Fayum. In so far it has failed to support the early dating of the analogous culture found at Badari, where too it must be remembered that it has been stated that copper beads were found, not, it is true, in the settlement, but in a grave in the adjacent cemetery.

Animal Breeding and Genetics.[1]

THE report under notice contains the record of a series of most interesting researches, not by any means all of which deal with what may be termed genetical problems, for a considerable number consist in studies of abnormal development. Thus the Director, Dr. F. A. E. Crew, has studied the so-called 'bull-dog calf.' These calves are born dead, and their anatomy shows a close resemblance to the so-called achondroplasia in human dwarfs. Dr. Crew maintains that the tendency to produce such offspring is hereditary and 'mendelises' when crossed with the type. He attributes it to the retardation of the coming into action of the pituitary gland; this may be so, but the immediate mechanism is doubtless as it is in human dwarfs, amniotic pressure, *i.e.* a too closely clinging amnion.

Mr. Nichols investigated a cross between Leicester and Cheviot sheep, the result of which had been stated to produce a hybrid of stable character. When the F_2 generation was raised, however, it was found that whereas 64 out of 103 resembled their F_1 parents, 18 approached the Leicester type and 20 had mixed characteristics of both Cheviot and Leicester. This result does not, as Mr. Nichols imagines, prove Mendelian segregation in the proper sense of the word. It is a result always obtained when two natural races are crossed; every conceivable intermediate turns up, but the attempt to express the result in 'factors' leads to interminable confusion. The number examined (100) is far too small to warrant any statistical conclusions.

Mr. Blyth has been engaged in a microscopical survey of the various types of wool raised in the British Islands. Four types are distinguished, namely, mountain long wool, lustre (also long wool), mountain short wool, and short wool (Down breeds). There are two main types of hairs making up the fleeces, namely, (*a*) long coarse hairs with reticular scale markings, and (*b*) short, fine hairs with coronal markings. Type (*a*) is found only in the long wools, type (*b*) in varying proportions in all the breeds. Short coarse fibres called 'Kemp,' frequently shed, are found in all the breeds. This and type (*a*) are regarded as equivalent to the primitive hair of the wild progenitor, whilst type (*b*) represents the original wool.

Mr. Greenwood has been following the fate of grafts of gonads implanted in fowls. This is especially interesting in view of the claim of Zawadovsky to have changed a cock into a hen by two operations, (*a*) cutting out the testes, (*b*) implanting an ovary. Mr. Greenwood finds that the ingrafted ovary frequently assumes a testicular structure by the ingrowth of sex-tubules from its periphery, and that sometimes the removal of the ovary stimulates the development of the vestigial right gonad. This gonad in one case was testicular in structure, in another ovarian, but with ingrowth of sex-cords indicating that it was being transformed into a testis.

Mr. L. Tamura is engaged in investigating the sex dimorphism of the suprarenal gland, which, as a result of previous work, he asserts, is different in the two sexes, the gland of the female showing a wide zona reticularis, whilst this region is vestigial in the male gland. It was found that when the male was castrated the suprarenal underwent enlargement, which was entirely due to the appearance of a wide zona reticularis. A sterile Dingo bitch which was investigated showed an infantile vagina and uterus with degenerating ovaries whilst the teats were normally developed, but not only the suprarenal but also the thyroid and pituitary glands showed obvious and gross signs of degeneration.

In conclusion, we should like to congratulate Dr. Crew on the variety and interest of the researches which are being carried on under his supervision.

E. W. M.

---

[1] Animal Breeding Research Department, the University, Edinburgh. Report of the Director for the year April 12, 1924, to March 31, 1925 (being the Fifth Annual Report). Pp. 21. (Edinburgh.)

University and Educational Intelligence.

THE Brighton Technical College in its calendar for 1926–27 is able to offer substantial evidence of the efficiency of their instruction in engineering subjects, six of the students having gained directly from the College the B.Sc. (Engineering) degree of the University of London in 1926. The College has a flourishing school of pharmacy, and provides courses of building, architecture, commercial subjects, and domestic science, as well as in arts and pure science subjects.

THE Technical College, Bradford, gives particulars in its prospectus for 1926–27 of diploma courses in textile industries, arranged with special reference to the needs of the worsted industry, chemistry, dyeing, civil, mechanical and electrical engineering, physics, and, exceptionally, biology. In recognition of the importance to students in all branches of technology of a knowledge of the fundamental principles of economics, courses in the department of commerce and banking have been developed in relation to those in the various other departments of the College, and particularly to those in the department of textile industries. Conversely, a special course for merchants has been established to equip those students who are to be engaged in the distributive side of the industry with a sufficient knowledge of dyeing and textile subjects.

FROM the Czech Academy of Sciences and Arts, Prague, we have received an 'Almanach" for 1924. It is beautifully printed on 240 pages and is embellished with a large number of remarkably fine portraits accompanying biographical notices. It is printed throughout in the Czech language without any summary or abstracts in more widely known languages, and it was with some difficulty that we ascertained the purport of even the title-page. One of the recommendations made by the Directors of National University offices at their recent reunion at Paris was that the official publications of universities should, if printed in a language the use of which is not widely diffused throughout the world, have appended to them abstracts in one of the languages in more general use. The adoption of this recommendation is no doubt impossible in many cases without a certain sacrifice of *amour propre*, but it is one the practical utility of which is obvious, and the "Almanach" in question is a case in point.

THE London County Council Education Officer has issued a remarkably attractive programme for 1926–27 of lectures and classes for teachers. Ninety-three different courses are offered, each course comprising, in most cases, six or more lectures. They are designed with the admirable objects of bringing London teachers into touch with the latest developments in educational methods and giving them opportunities of hearing leading authorities on questions of national and civic importance. Under the general heading of science are ten courses and four special single lectures. These four are: on eugenics, by Prof. Karl Pearson; production of voice sounds, by Sir Richard Paget; talking by light, by Prof. Rankine, of the Imperial College of Science; and surveying by aerial photography, by Dr. H. H. Thomas, of Cambridge. Among the most valuable of the courses is one on the relationship between science (physics, chemistry, biology, bacteriology, economics) and domestic work, by members of the staff of the Household and Social Science Department, King's College for Women.

THE Royal Technical College, Glasgow, directs attention in its calendar for 1926–27 to the fact that its new building (completed 1910), comprising over seven acres of floor space, forms the largest structure in Great Britain devoted to education. It might also boast that of all institutions included in the University Grants Committee's returns it had in 1924–25 the largest number, 2645, of part-time students, the next largest being the 1926 of the London School of Economics. Among the specialist courses provided by the college which are recognised by the University of Glasgow for attendance by students preparing for the degree of B.Sc. in applied chemistry may be mentioned: fuels, dyes and their applications, oils and fats, sugar manufacture, technical bacteriology, metallurgical chemistry, coal tar and intermediate products. The college maintains one of the five principal schools of pharmacy in Great Britain. The Glasgow School of Architecture is under the superintendence of a committee representative of the College and the School of Art. Among the numerous courses in technology not forming parts of degree courses are important series, both day and evening, in textile manufacture.

THE functions of municipal universities are discussed in a paper by George F. Zook, President of the Municipal University of Akron, published in the May number of *School Life*. The paper is concerned chiefly with the question whether municipal universities should continue to regard the traditional four-year curricula as their main business or should develop, alongside of these, one-year, two-year and three-year completion courses of a technical or semi-professional character. It is admitted that the experience of the land-grant colleges in establishing and maintaining one- and two-year curricula in agriculture and mechanic arts has not been very encouraging, but conditions in the municipal universities are very different and they would be failing in their duty to the communities which support them if they did not cater for the requirements of the large number of young people who, after completing their high school course, want to spend less than four years in university studies in preparation for such careers as those of pharmacist, librarian, school teaching, nursing, and the hundred and one occupations lumped under the headings of 'business' and 'industry.' In this connexion it is pointed out that the whole field of evening instruction, both general and technical, is awaiting vigorous development.

Contemporary Birthdays.

September 24, 1874. Prof. Alexander Findlay.

September 26, 1854. Major Percy Alexander MacMahon, F.R.S.

September 28, 1873. Prof. Julian Lowell Coolidge.

October 2, 1875. Prof. Arthur William Conway, F.R.S.

October 2, 1876. Mr. Thomas Sheppard.

October 3, 1858. Prof. Percy Faraday Frankland, C.B.E., F.R.S.

Prof. FINDLAY, occupant of the chair of chemistry in the University of Aberdeen since 1919, was educated at that city's grammar school, proceeding afterwards to the University there, and to the University of Leipzig. Early he was a research student in University College, London, whilst from 1902 until 1911 he held a lectureship in chemistry in the University of Birmingham, leaving to take up a professorship in science at University College, Aberystwyth. He has published several books, among them being a stimulating volume entitled "Chemistry in the Service of Man."

Major MACMAHON (Royal Artillery, retired), late Deputy Warden of the Standards, Board of Trade, was born at Malta. He was educated at Cheltenham College, passing thence into the Royal Military Academy, Woolwich, where later (1882–88) he was instructor in mathematics. The Royal Society awarded him a Royal medal in 1900 on the ground of the number and range of his contributions to science in the department of pure mathematics. Further recognition by the Society came with the allotment of the Sylvester medal to Major MacMahon for studies in the partition of numbers. General secretary of the British Association from 1902 until 1914, he is a past president of the London Mathematical Society.

Prof. J. L. COOLIDGE, mathematician, was born at Brookline, Mass., U.S.A. A graduate of Harvard, he also studied at the Universities of Oxford and Bonn. He has been successively instructor in mathematics, assistant professor, and, from 1918, professor in that subject at Harvard. Prof. Coolidge is an Officer of the Legion of Honour. He is the author of "Elements of Non-Euclidean Geometry" (1909), and "Geometry of the Complex Domain" (1924). also [illegible]

Prof. CONWAY, registrar and professor of mathematical physics in University College, Dublin, was born at Wexford. He was educated at Dublin and Corpus Christi College, Oxford.

Mr. THOMAS SHEPPARD, the zealous director of the Hull Museum, was born at South Ferriby, Lincolnshire. He has long rendered sterling service as editor of various Yorkshire society publications relating to natural history, numismatics, geology and archæology. Mr. Sheppard is the author of "Yorkshire's Contribution to Science" (1915).

Prof. PERCY FRANKLAND is a Londoner. He was educated at University College School, the Royal School of Mines, and the University of Würzburg. From 1888 until 1894 he was occupant of the chair of chemistry in University College, Dundee, leaving there to take up a similar post in Mason College, Birmingham, continued also in its University. He was president of the Institute of Chemistry in 1906, and of the Chemical Society in 1911. Prof. Frankland was awarded the Davy medal of the Royal Society in 1919 for distinguished work in chemistry, especially on optical activity, and on fermentation.

Societies and Academies.

London.

The Institute of Metals (Liège meeting), September 2.—L. **Boscheron**: An account of the non-ferrous metals industry in the Liège district. An historical account is given of the development of the zinc industry of the Liège district, with particular reference to the discovery of the distillation process by Dony and the subsequent improvement and application of this process. The absence of water-power and the high cost of electrical energy in Belgium renders the new electrothermic and electrolytic methods of manufacture of zinc inapplicable in Belgium. The discovery of a method of continuous production would be welcomed.—A. G. C. **Gwyer** and H. W. L. **Phillips**: The constitution and structure of the commercial aluminium-silicon alloys, with an appendix by D. **Stockdale** and I. **Wilkinson** upon the properties of the modified aluminium-silicon alloys. The investigation deals with the constitution, structure, and mechanical properties of modified aluminium-silicon alloys, and a theory based upon colloidal lines is put forward to explain the nature of the modified structures. The alloys possess good founding qualities; are appreciably lighter than pure aluminium, and in both chill- and sand-cast states possess a high resistance to shock, excellent ductility, and a high degree of incorrodibility.—J. D. **Grogan**: Some mechanical properties of silicon-aluminium alloys. The sodium and 'salts' methods of modifying these alloys are described. The 'salts' method is preferred. Ternary alloys containing also magnesium or zinc are not superior to the binary alloys.—Buntaro **Otani**: Silumin and its structure. The chief development of aluminium-silicon alloys during the last three years has been in the direction of a marked increase in mechanical properties, due to the modifying action caused by the addition of metallic sodium or alkali fluoride to the molten alloy. The present paper puts forward a theory to explain the process of modification.—H. J. **Gough**, S. J. **Wright**, and D. **Hanson**: Some further experiments on the behaviour of single crystals of aluminium under reversed tortional stresses. The resulting distortion under this complex type of straining action is observed using slip-band measurements, and is related to the atomic orientation of the crystals by means of X-ray analysis. The complicated system of slip-bands observed is in agreement with the simple law that slip is confined at any point of the surface of the crystal to one of the octahedral planes and in the direction of the most highly stressed (shear stress) principal lines of atoms. The progressive hardening during a long endurance test has been studied.—P. **Chevenard**: Thermal anomalies of certain solid solutions. Certain feebly magnetic solid solutions show transformations which are similar to those of ferromagnetic substances in that they occur without change of phase (that is, change of space lattice), they are spread out over a large range of temperature, they are subject to relatively slight hysteresis, and result in anomalies in the different physical properties, dilatation, specific heat, resistivity, thermo-electric power, etc. They differ from the magnetic transformations in that the temperature of their occurrence does not vary with change of composition. Evidence is given of the existence of these so-called 'X' transformations in copper-aluminium, nickel-chromium, and copper-nickel solid solutions, and a detailed study is made of their effect on the dilatation of the first two groups of alloys and on the resistivity of the last.—W. T. **Cook** and W. R. D. **Jones**: Preliminary experiments on the copper-magnesium alloys. The chief feature is the production of sound chill-cast bars free from smooth-sided internal gas cavities by means of a double-melting process similar to that recently recommended by Archbutt for the production of castings in aluminium free from pinholes. Details are given of the method adopted of a type of bottom-pouring crucible used to eliminate inclusions of flux and slag.—Kotaro **Honda**: A comparison of static and dynamic tensile and notched-bar tests. Machines for testing materials have recently considerably increased in number; for example, referring to the methods of testing, there are the following tests: tension, bending, torsion, toughness, fatigue, abrasion, hardness, and single and repeated impact tests, etc. Since for each of these tests we have several types of machines, it is of importance to study the merits and demerits of these machines and to make a selection of those which are best for the purpose.

September 3.—C. J. **Smithells**, H. P. **Rooksby**, and W. R. **Pitkin**: The deformation of tungsten crystals. When metals are rolled or drawn the crystal fragments tend to take up a definite orientation with respect to the direction of working; the same effect is produced during the swaging of tungsten rods. The micro-structure and X-ray diffraction pattern at various stages of the swaging have been examined with the view of learning the mechanism by which this preferred orientation is attained.—A. **Pinkerton** and W. H. **Tait**: Season-cracking in arsenical tubes. While severely hollow sunk tubes made from arsenic-free, deoxidised copper are not liable to season-cracking, tubes made from arsenical copper, according to the British Engineering Standard specification, are liable to season-cracking when made under certain conditions. The temperature at which annealing renders such tubes immune from season-cracking has also been determined.—Cyril S. **Smith** and C. R. **Hayward**: The action of hydrogen on hot solid copper. When copper (wire) containing oxygen is heated in hydrogen, maximum brittleness is obtained at intermediate temperatures, and a marked recovery occurs when the action is carried out at temperatures approaching the melting-point. The rate of penetration of hydrogen into cast copper has been determined and certain peculiarities observed. When the oxygen in the copper exceeds 0·07 per cent the depth of penetration in a given time is greater at about 800° C. than at higher temperatures. When brittle gassed copper is annealed and forged in a non-oxidising atmosphere, the cracks responsible for the brittleness close, and metal of remarkable properties is obtained.—Francis W. **Rowe**: Bronze worm-gear blanks produced by centrifugal casting.—Kathleen E. **Bingham**: The constitution and age-hardening of some ternary and quaternary alloys of aluminium containing nickel. This investigation is part of a scheme of research on aluminium alloys which has been in progress in the Metallurgy Department of the National Physical Laboratory, under the direction of Dr. W. Rosenhain. The first part deals with the age-hardening of some of the ternary alloys of copper, nickel, and aluminium; and the second with the constitution and age-hardening of similar alloys, with the addition of small percentages of magnesium.—Captain F. R. **Barton**: Development of the use of nickel in coinage. In its pure form, and also as a constituent of binary alloys, nickel has been widely adopted during the last half-century as a coinage metal. Experience shows that pure nickel coins wear longer in circulation than those made of silver, and that they were equally proof against counterfeiture.—C. H. M. **Jenkins**: The constitution and the physical properties of the alloys of cadmium and zinc. The constitution and properties of the zinc-rich alloys seem to be considerably influenced by the two polymorphic changes which appear to exist in zinc. One of these changes caused an increase in the solid solubility of cadmium in zinc above the eutectic temperature; the resulting equilibrium diagram is therefore somewhat unusual, containing a region representing a completely solid alloy occurring above an area which is composed of both liquid and solid alloys. The cold-worked alloys very slowly soften at room temperature, but the effect of ageing does not cause any unfavourable alteration. The zinc-rich alloys should not, however, be annealed after this ageing. The properties of cast and rolled zinc are improved by the addition of cadmium. The eutectic alloy previously proposed for use as a medium hard solder possesses very suitable physical properties for this purpose.—G. B. **Phillips**: The primitive copper industry of America (Pt. 2). Many thousands of copper objects have been investigated; they show a somewhat sporadic industry, but considerable mechanical skill and artistic taste in their manufacture with stone and bone tools by the aborigines. Analysis indicates the source of the metal to be the native copper from the mines of northern Michigan and not copper brought from Europe.

PARIS.

Academy of Sciences, August 23.—**Bigourdan**: A means of verifying the uniformity of the earth's rotation.—A. **Bigot**: The Bathonian of Chailloué (Orne).—Jacques **Chokhatte**: Some applications of the polynomials of Tchebycheff with several variables.—N. **Stoyko**: The precision of time of the rhythmic signals of the Bureau International de l'Heure.—Louis de **Broglie**: The possibility of connecting the phenomena of interference and diffraction with the quantum theory of light.—J. **Cayrel**: Double detection with galena and chalcosine. The generality of the phenomenon.—Robert **Régnier** and Roger **Pussard**: The conditions under which the disease communicated to field mice by the Danysz virus is propagated.—E. P. **Fortin**: Histological investigations on certain elements of the retina.—P. **Wintrebert** and **Yung Ko-Ching**: The protoplasmic contraction of the early embryonic forms in *Gasterosteus aculeatus* and *Pygosteus pungitius*.—E. **Iwanow**: Time of persistence of the fertilising property of the spermatozoids of mammals in the epididymus separated from the organism.—L. **Nattan-Larrier**, G. **Ramon**, and E. **Grasset**: Antitetanus immunity in the newly-born.

CAPE TOWN.

Royal Society of South Africa, July 21.—J. Smeath **Thomas**: The action of sulphur chloride on mercaptan—the existence of diethyl-tetrasulphide. The author has previously shown that in the case of the alkali metals the maximum number of S atoms that can be introduced into the polysulphide molecule increases with increasing electro-positivity of the metal, that in the polysulphide series some members are of greater stability than others, and that only these more stable compounds are obtained by ordinary laboratory methods of preparation. In every case the disulphide is stable, but the composition of the higher stable compound varies; the more electropositive the metal the greater the number of S atoms in the molecule of the higher stable polysulphide. An extension of the work to organic polysulphides led to a similar conclusion. Here again the disulphides are always stable and the higher stable polysulphide, in the case of the alkyl compounds, seems to be the pentasulphide. Thus both sodium *tetrasulphide* and potassium pentasulphide on treatment with ethyl iodide yield diethyl pentasulphide mixed with a little disulphide.—W. A. **Jolly**: On the rhythmical functions of the spinal cord. The author discussed the oscillations which appear on the electromyograms in reflexes and the intraspinal delays, and pointed out the relation which subsists between the time intervals in the two phenomena.—J. **Moir**: Colour and chemical constitution, Part xxii.—A study of methyl derivatives of the phenolphthaleins Nearly all the methyl derivations of phenolphthalein (ordinary and orthopara) have been examined. The effect of all substitutions on colour is additive, each item acting independently.

SYDNEY.

Royal Society of New South Wales, August 4.—R. H. **Cambage**: Acacia seedlings. Part xii. The seedlings are described of the following ten species: *Acacia bivenosa*, *A. Burkittii*, *A. Cambagei*, *A. Cuthbertsoni*, *A. latipes*, *A. leptoclada*, *A. pruinosa*, *A. restiacea*, *A. rupicola*, *A. salicina*. In regard to the vitality of Acacia seeds in the soil, it is recorded in the paper that 200 seedlings of *Acacia mollissima* sprang up immediately after the ploughing of an area of four acres which had not been cultivated and on which Acacia trees had not grown for sixty years. In a second case, six acres of grass land had been enclosed and ploughed. No Acacia trees had grown on the area since it was cultivated sixty-eight years before, although some were growing a quarter of a mile away, but after the land had been ploughed, more than 1000 seedlings sprang up on one particular acre of the enclosed area, evidently at a spot where many trees of the same species formerly grew.—A. R. **Penfold**: The essential oil of *Zieria macrophylla* (Bonpland), and the presence of a new cyclic ketone. The leaves and terminal branchlets yield from 0·3 to 0·66 per cent. of a brownish coloured oil of peculiar odour. The following constituents have been identified: d-limonene (10-20 per cent.), a new cyclic ketone, $C_{15}H_{22}O$, about 50-60 per cent. (called zierone), together with sesquiterpene, sesquiterpene alcohol, amyl alcohol, a low boiling isovalerianic ester, etc.—F. R. **Morrison**: The fixed oil of the kidney fat of the emu. The oil, which was yellow in colour, had an odour resembling mutton fat, and was of a soft buttery consistency during the winter months. The oil consisted of the glycerides of oleic, linolenic, palmitic and stearic acids. The occurrence of linolenic acid is of interest, this acid being rarely found in animal oils.—A. **Grady** and H **Hogbin**: Mountain lagoon and the Kurrajong fault. Mountain lagoon is apparently formed by the damming up of a small stream by the rising Kurrajong fault. The lagoon is a topographic feature which will soon disappear, for creeks, on all sides, have cut back by headward erosion, almost to the lagoon itself.

Official Publications Received.

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 35, No. 1, 1926. Pp. xii+988. (London: Institute of Metals.) 31s. 6d. net.

State of Illinois. Department of Registration and Education: Division of the Natural History Survey Vol 16, Article 1: Third Report on a Forest Survey of Illinois. By Clarence J. Telford. Pp. iv+102+4 maps. (Urbana, Ill.)

Department of the Interior: U.S. Geological Survey. Bulletin 779: Guide to Ore in the Leadville District, Colorado. By G F. Laughlin. (Washington, D C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1925. (Washington, D.C.: Government Printing Office.)

Department of Marine Biology of the Carnegie Institution of Washington. Vol. 21: Samoan Foraminifera. By Joseph Augustine Cushman. (Washington, D.C.: Smithsonian Institution.)

The Hydrostatic System of Trees. By D. T. MacDougal. (Publication No. 373.) (Washington, D.C.: Smithsonian Institution.)

University of Bristol. Proceedings of the Spelæological Society for 1925. Vol. 2, No. 2. Pp. v+190-315. (Bristol.) 5s. net.

Philosophical Transactions of the Royal Society of London. Series B, Vol. 215. The Cretaceous Plant-Bearing Rocks of Western Greenland. By Dr. A. C. Seward. (B. 422.) Pp. 57-175. (London: Harrison and Sons, Ltd.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok 7, 1925. 5: Hydrografiska mätningar i Sverige. (Stockholm.)

Proceedings of the American Academy of Arts and Sciences. Vol. 61, No. 8, July: Studies in Ethiopian Braconidae, with a Catalogue of the African Species. By Charles T. Brues. Pp. 205-436+2 plates. (Boston, Mass.)

Transactions of the Royal Society of Canada. Third Series, 1925, Vol. 19, Section 3. Visualization and Energy Survey of a High Frequency Diffraction Beam. By R. W. Boyle, J. F. Lehmann and C. D. Reid. Pp. 167-196+plates 12-14. Third Series, 1926, Vol. 20, Section 3. Practical Experiments on the Detection of Icebergs and on Sounding by Means of an Ultra-Sonic Beam. By R. W. Boyle and C. D. Reid. Pp. 233-243+plates 1-2. Reflection Powers of various Materials for Ultra-Sonic Waves. By R. W. Boyle and G. B. Taylor. Pp. 245-257+1 plate. (Ottawa: Royal Society of Canada.)

Sixth Annual Report of the Scientific and Industrial Research Council of Alberta, 1925. Report No. 16. Pp. 66. (Edmonton: University of Alberta.)

The Royal Technical College, Glasgow. Calendar for the 131st Session, 1926–27. Pp. xxxi+409. (Glasgow.)

Annals of the Pickett-Thomson Research Laboratory. Edited by D. Thomson and R. Thomson. Vol. 2, No. 2, July. Pp. iv+29-203+50 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox.) 42s. net.

The Present Status of the Wild-Fowl of Europe, with special reference to those of the British Isles. By Percy R. Lowe. Pp. 20. (London: International Committee for the Protection of Wild Birds, Natural History Museum.)

Prospectus of the Royal College of Art, South Kensington, London, Session 1926-1927. Pp. iv+28. (London: H.M. Stationery Office.) 6d. net.

Madras Fisheries Department. Administration Report for the Year 1923-24. By Dr. B. Sundara Raj. (Report No. 1 of 1925, Madras Fisheries Bulletin, Vol. 19.) Pp. 58+5 plates. (Madras: Government Press.) 12 annas.

Memoirs of the Asiatic Society of Bengal. Vol. 8, No. 5: Algæ of the Loktak Lake. By Paul Bruhl and Kalipada Biswas. Pp. 257-316. (Calcutta: Asiatic Society of Bengal.) 7.5 rupees.

Survey of India. Map Publication and Office Work, 1924-25: from 1st October 1924 to 31st March 1925. Pp. vii+17+5 maps. (Calcutta: Survey of India.) 1 rupee; 1s. 9d.

Department of the Interior: Bureau of Education. Bulletin, 1926, No. 5: General University Extension. By G. H. Shelby. Pp. 22. (Washington, D.C.: Government Printing Office.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 538: Experimental Study of the Relation between Intermittent and Nonintermittent Sector-Wheel Photographic Exposures. By Raymond Davis. Pp. 95-139. (Washington, D.C.: Government Printing Office.)

Aeronautical Research Committee: Reports and Memoranda. No. 951 (Ae. 170): An Investigation of the Air-Flow Pattern in the Wake of an Aerofoil of Finite Span. By A. Fage and L. F. G. Simmons. (A. 3. a. Aerofoils—general, 149—T. 2041.) Pp. 28. 1s. net. No. 997 (Ae. 209): The Distribution of Pressure over a Biplane with Wings of Unequal Chord and Span. By H. B. Irving and A. S. Batson. (A. 3. l. Pressure Distribution, 13—T. 2164.) Pp. 15+10 plates. 1s net. No. 1024 (M. 40): Some further Experiments on Single Crystals of Aluminium employing Reversed Direct Stresses. By H. J. Gough, Dr. D. Hanson and S. J. Wright. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (B. 1. a. Metals, 48.—T. 2176.) Pp. 14. 9d. net. (London: H.M. Stationery Office.)

Stonyhurst College Observatory. Results of Geophysical and Solar Observations, 1925; with Report and Notes of the Director, Rev. E. D. O'Connor. Pp. xxxi+45. (Blackburn.)

Journal of the Federated Malay States Museums. Vol. 12, Part 3, July: xii: Results of an Expedition to Kedah. By Ivor H. N. Evans. Pp. 73-82+8 plates. (Kuala Lumpur and Taiping.)

Aeronautical Research Committee: Reports and Memoranda. No. 1006 (Ae. 214): Wind Channel Tests of Slot and Aileron Control on a Wing of R.A.F. 15 Section. Part i: When the Central Portion of the Wing is R.A.F. 15; Part ii: When the Central Portion of the Wing is Slotted and Fitted with a Flap. By F. B. Bradfield, A. S. Hartshorn and L. E. Caygill. (A. 2. a. Stability Calculations and Model Experiments, 101 and 104—T. 2161, T. 2181.) Pp. 30+19 plates. 1s. 6d. net. No. 1011 (M. 34): Some Mechanical Tests of Cast Bars of Alpax. By H. J. Tapsell. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (L.A. 48.) Pp. 9+2 plates. 9d. net. No. 1025 (M. 41): A Test on a Specimen consisting of three Crystals under Reversed Torsional Stresses. By H. J. Gough, S. J. Wright and Dr. D. Hanson. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (B. 1. a. Metals, 49—T. 2177.) Pp. 5+2 plates. 6d. net. No. 1036 (Ae. 222): The Analysis of Experimental Results in the Windmill Brake and Vortex Ring States of an Airscrew. By H. Glauert. (A. 3. d. Airscrews, 59—T. 2220.) Pp. 8+2 plates. 9d. net. (London: H.M. Stationery Office.)

New Zealand: Dominion Museum. Bulletin No. 7: The Maori Canoe; an Account of various Types of Vessels used by the Maori of New Zealand in Former Times, with some Description of those of the Isles of the Pacific, and a Brief Account of the Peopling of New Zealand. By Elsdon Best. Pp. iv+312. (Wellington, N.Z.: W. A. G. Skinner.) 15s.

Journal of the Municipal College of Technology, Manchester: a Record of Investigations undertaken by Members of the Manchester College of Technology. Vol. 12, 1926. Pp. 160. (Manchester.)

Technical College, Bradford. Diploma and Special Day Courses, Session 1926–27. Pp. 204+10 plates. (Bradford.)

Proceedings of the American Academy of Arts and Sciences. Vol. 61, No. 9, July: Studies in the Urea Series; Transformations of Nitroguanidine. By Tenney L. Davis and Armand J. J. Abrams. Pp. 437-457. 50 cents. Vol. 61, No. 10, July: On the Distribution of Intensity in Stellar Absorption Lines. By Cecilia H. Payne and Harlow Shapley. Pp. 459-486. 50 cents. Vol. 61, No. 11, August: Changes during the last Twenty Years in the World's Speed Records of Racing Animals. By A. E. Kennelly. Pp. 487-523. 50 cents. (Boston, Mass.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 69: Spectroscopic Study on the Discharge in Helium. By Toshio Takamine. Pp. 55-61. 40 sen. (Tokyo.)

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 3, No. 15: The Digestive Diverticula in the Lamellibranchs. By Dr. C. M. Yonge. Pp. 703-718+2 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1s. 9d.

Diary of Societies.

SATURDAY, September 25.

North of England Institute of Mining and Mechanical Engineers (Associates and Students Section) (at Newcastle-upon-Tyne), at 3.—Prof. G. Hickling: The Chemical Relations of the Principal Varieties of Coal.

MONDAY, September 27.

British Mycological Society (Annual Meeting) (at Hereford), at 8.45 p.m.

TUESDAY, September 28.

British Mycological Society (Annual Meeting) (at Hereford).—Dr. G. H. Pethybridge: Mycology and Plant Pathology (Presidential Address).

WEDNESDAY, September 29.

British Mycological Society (Annual Meeting) (at Hereford), at 8.30 p.m.—J. Ramsbottom: Fungi (Lecture).

THURSDAY, September 30.

Institution of Municipal and County Engineers (East Midland District) (at Gainsborough), at 11 a.m.

Institution of Locomotive Engineers (at Engineers' Club, Coventry Street, W.), at 7.15.—Sir Seymour B. Tritton: Presidential Address.

British Mycological Society (Annual Meeting) (at Hereford).

FRIDAY, October 1.

Faraday Society.—General Discussion: Physical Phenomena at Interfaces, with Special Reference to Molecular Orientation (at Chemical Society), at 2.30.—Dr. E. K. Rideal: Introductory Address.—Prof. H. Freundlich: Electrification at Interfaces.—R. K. Schofield: Electrification at Interfaces.—Dr. W. E. Garner: Adsorption on Solids.—Dr. G. Shearer: Orientation in Solids.—At 5.—N. K. Adam and G. Jessop: Insoluble Films on Liquid Surfaces.—Prof. E. Gorter: On the Spreading of Proteins.—Prof. W. Ramsden: Adsorption of Proteins.—Dr. S. Sugden: The Arrangement of Molecules on the Surface of Pure Liquids.

Junior Institution of Engineers, at 7.30.—L. Smith: Notes on Transformer Testing and Test Plant Requirements.

British Mycological Society (Annual Meeting) (at Hereford), at 8.30 p.m.—Dr. M. Wilson and J. S. L. Waldie: Some Fungi occurring on Leaves of Conifers.

SATURDAY, October 2.

Electrical Association for Women.—Visit to All-Electric Farm of Mr. Borlase Matthews, Greater Felcourt, East Grinstead.

CONGRESSES.

September 24 and 25.

Reading and District Teachers' Association (at Reading University).—Discussion on Education and Life.

September 24.—Prof. Winifred Cullis: The Teaching of Biology in Schools.

September 25.—Mrs. A. H. Radice: The Changing Child.—N. Richmond: The Physiological Basis of Change.

September 24 to 27.

Association of Special Libraries and Information Bureaux (at Balliol College, Oxford).

September 26 to 29.

International Congress of Individual Psychology (at Düsseldorf).

September 26 to October 2.

Congrès de Chimie Industrielle (at Brussels).

September 27 to 30.

All Russian Ophthalmological Congress (at Moscow).

September 30 to October 2.

German Society of Urology (at Vienna).

October 13 to 16.

German Society for the Study of Diseases of Digestion and Metabolism (at Berlin).

October 25 to 28.

Italian Congress of Surgery (at Padua).

SATURDAY, OCTOBER 2, 1926.

CONTENTS.

PAGE
Production and Use of Synthetic Nitrogenous Fertilisers 469
Peasant and Pundit in India. By F. J. R. . . . 472
Wilhelm Hofmeister 473
Radioactivity. By A. S. R. 475
Our Bookshelf 476
Letters to the Editor:
Calculation of the Ages of Radioactive Minerals.—Prof. Arthur Holmes and Dr. Robert W. Lawson 478
Protoplasmic Viscosity as determined by a Temperature Coefficient of Biological Reactions.—Dr. J. Bělehrádek 478
Science and Psychical Research. — Sir Bryan Donkin; E. J. Dingwall 480
The Egyptian Shadouf and the Rate of Human Work.—H. S. Rowell; P. J. H. Unna . . 481
Antagonistic Action of Electrolytes and Permeability of Membranes.—K. C. Sen 481
Lightning.—Dr. N. Ernest Dorsey; Dr. G. C. Simpson, C.B., F.R.S. 482
The Absorption Spectrum of Formic Acid Vapour in Relation to Molecular Associations.—Louis Harris 482
The Scope of Organic Chemistry. By Prof. J. F. Thorpe, C.B.E., F.R.S. 483
Francis Bacon and Scientific Method.—I. By Dr. C. D. Broad 487
Antarctic Weather. By C. S. W. 488
Obituary:
Prof. F. W. Gamble, F.R.S. 490
News and Views 491
Our Astronomical Column 495
Research Items 496
The Alloys of Aluminium and Silicon. By F. C. T. 498
The Twelfth International Physiological Congress in Stockholm 499
The Geological Search for Oil 500
University and Educational Intelligence . . . 501
Contemporary Birthdays 502
Societies and Academies 502
Official Publications Received 503
Diary of Societies and Public Lectures . . . 504

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Production and Use of Synthetic Nitrogenous Fertilisers.

AMONG the factors that are shaping the course of nations to-day, few are more important than the possession or control of raw materials. Nature, in her perverse way, has not only made men very unequal in character, energy, and ability, but she has also distributed so capriciously their means of sustenance and development that no civilised country is, or can expect to be, entirely self-supporting in the economic sense. There are many signs that the question of raw materials for food and industry will profoundly affect, if not dominate, international relationships. The United States is crying aloud for sources of supply of rubber, potash, mercury, manganese, long-staple cotton, and sisal; Germany, by her loss of territories in Europe and overseas, has become more dependent than ever upon foreign countries for a host of basic raw materials; Italy, Belgium, and Japan are asking the League of Nations to appoint a committee to consider the subject.

The question is, however, not entirely an economic one; its ramifications penetrate many spheres of human activity, including that of science and its applications, for chemistry, physics, physiology, botany, and entomology are all playing their parts in alleviating the consequences of Nature's haphazard distribution of the necessaries of life and progress. From chemistry and physics we may, perhaps, expect most, for are they not showing us every day how to satisfy our primary needs by fabricating the raw materials of food, of clothing, and of shelter from such simple materials as air, water, fuel, and vegetation?

Of all the basic needs of man, food is the most essential; and, as Sir Daniel Hall recently reminded us at Oxford, the old problem of its supply still awaits solution. Man ever tends to multiply beyond his means of subsistence; land suitable for agriculture is limited in extent; its fertility declines, and must not only be restored but also increased to meet our ever-growing needs. Civilisation, through the sanitary authority, has made us abandon the economic practice (followed by Germany during the War, and by China from time immemorial) of returning to the soil the unassimilated plant nutrients of our food; and as other organic manures are strictly limited in amount, the only solution is to manufacture fertilisers from natural products. Fortunately for us all, the continued application of fertilisers does not, as was formerly believed, sicken the soil, provided they are scientifically applied; and the raw materials of their manufacture are very abundant, though some of them are very unequally distributed over the earth. The occurrence of potash is very localised, but the deposits are enormous, Germany and the Upper Rhine being estimated to contain no less than 21,000 million tons of crude potash salts situated at workable depths. Phosphate deposits are more numerous, although the life of the most important of them has been estimated at from twenty-one to seventy years; there are, however, vast deposits that are poor in grade or badly situated. Apart from the Chilean nitrate-beds, which have a definitely limited life, and the wonder-workings of the nitrogen-fixing bacteria, the world is ill-supplied with natural nitrogenous fertilisers, but the chief raw material of these fertilisers—nitrogen—is extraordinarily abundant: no less than eight tons of it are present in the air over every square metre of the earth's crust; and few human achievements can compare in importance with the recent work of physical chemists in making this mine of potential fertility available for agricultural purposes.

To Germany belongs most of the credit for having elaborated the manufacture of synthetic nitrogenous fertilisers by means of the Haber process. That process, together with the modifications due to Claude, Casale, and Fauser, consists in uniting nitrogen from the air with hydrogen from water to form ammonia; and to-day it is by far the most important of nitrogen-fixation methods, the cyanamide process coming next and the arc process third. The estimated production of combined nitrogen in Germany during the fertiliser year 1925–26 (June-May) was 600,000 metric tons (equal to nearly 3 million tons of sulphate of ammonia), of which 90 per cent. was to be made by synthetic processes. Although the Haber and cyanamide processes were much used in Germany during the War, it was not until 1923–24 that Germany had sufficiently recovered from its effects to be able to export nitrogenous fertilisers; for the year 1925–26 her estimated exports were about 135,000 tons of fixed nitrogen, equivalent to about 675,000 tons of sulphate of ammonia. Following Germany's lead, the manufacture of synthetic ammonia has been taken up in many lands, and although, in general, achievements have not so far corresponded with effort and *réclame*, there is no doubt that within the next decade production will attain a figure undreamed of before the year 1914. It is satisfactory to note that, next to Germany, Great Britain is the most important producer of synthetic nitrogen compounds, an achievement that is due to the initiative and enterprise of Messrs. Brunner, Mond and Co., Ltd., through its associated company, Synthetic Ammonia and Nitrates, Ltd.

The future of the British nitrogen industry, its ability to retain the home market and to withstand foreign competition in the outlying parts of the Empire, are matters of national concern, not only in respect of the peace-time manufacture of fertilisers, but also in respect of the war-time production of nitric acid and high explosives. In Great Britain the chief source of supply of manufactured nitrogenous fertilisers has long been, and is still, the ammonia that is obtained from coal as a by-product in the manufacture of metallurgical coke and town's gas. This ammonia is converted into ammonium sulphate, which is still the most popular of manufactured nitrogenous fertilisers, and of which very large quantities are sold at home and abroad. Our total production of nitrogen as ammonium sulphate in the year 1925–26 was 429,517 tons, of which 238,611 tons was exported. Exports and prices, however, are falling as the result of severe German competition, and the outlook is not cheerful. At the recent International Conference on Nitrogen Propaganda in Biarritz, it was stated that the British Sulphate of Ammonia Federation, of which Synthetic Ammonia and Nitrates, Ltd., is a member, had made an arrangement with the German Nitrogen Syndicate by which new German nitrogen compounds that are suitable to English conditions would be made available to English farmers; but nothing in the nature of a *quid pro quo* was mentioned. Now the Germans are very active in producing new fertilisers, which play an important part in their propaganda.

Dr. J. Bueb told the conference at Biarritz that when Germans enter a foreign market they are very careful to 'push' only well-known fertilisers until they have obtained a firm foothold; then they introduce their novelties, usually mixed fertilisers, that are especially suitable to the local conditions. In 1919–20 it was recognised in Germany that ammoniacal nitrogen could never completely replace nitric nitrogen (as in Chile saltpetre); and the hygroscopic and explosive ammonium nitrate being regarded as unsuitable, efforts were concentrated on producing mixed fertilisers like ammonium sulphate-nitrate and ammonium-potassium nitrate. To compete with Chilean nitrate, a white calcium nitrate of the same nitrogen content, but without its bad effect on 'sticky' soils, has been successfully marketed. In 1924 the manufacture of urea was started on a large scale, and this highly concentrated fertiliser (46 per cent. nitrogen) is selling very well, being especially valuable for tobacco, hops, vine, garden plants, meadows and pastures. Pure di-ammoniumhydrogen phosphate ('Diammonphos'), and a mixture of it with ammonium sulphate ('Leunaphos'), are among the chief products of the well-known 'Badische' company; whilst a compound fertiliser containing nitrogen, phosphoric acid, and potash in the ratio 1 : 0·75 : 1 has been specially worked out for sale in China under the name of 'Leunaphosphate.' Variety of form, low price, and intensive propaganda are the outstanding features of the rapidly expanding German trade in fertilisers.

With regard to the security of the British home market, it appears highly probable that Synthetic Ammonia and Nitrates, Ltd., will come to an arrangement with the German Nitrogen Syndicate whereby spheres of influence will be defined and selling prices will be fixed and adjusted in ways advantageous to both. Failing the conclusion of such an arrangement, or in the event of its future collapse if made, competitive ability will depend upon quality, manner of marketing, production costs, selling policy and salesmanship. On the score of quality we need entertain no fear. British goods are not always best, as the Government post-mark asserts (though they may be always the best to buy), but in the case of chemical products made by a firm of the standing of Brunner, Mond and Co. there is no doubt that they can hold their own against all comers. In the matter of producing costs there is much less certainty. The cost of labour and fuel, together with paralysing taxation, constitute at present enormous handicaps to cheap production; and it is unlikely that any Government would succeed in restricting foreign competition under the provisions of the Safeguarding of Industries Act. On the other hand, it is understood that Synthetic Ammonia and Nitrates, Ltd., has effected a number of improvements and economies in the Haber process; it commands a personnel, financial and administrative as well as technical, that is second to none; and it has ample capital resources.

Competition at home is not to be feared, for synthetic nitrogen compounds will be produced at a cost which, in the event of unrestricted competition, would oust by-product ammonium compounds from the market. Both coke-ovens and gas-works will have to toe the line set by the nitrogen factory. The gas companies will continue to produce sulphate of ammonia, because they will not be allowed to turn their poisonous gas-liquor into streams and estuaries; and what they lose on the swings of ammonia they will make up on the roundabouts of gas and other residuals. Coke-oven works will suffer an important loss of revenue, so that the price of metallurgical coke may rise, and with it the prices of iron and steel. The home industry will therefore be able to present a solid front to the foreigners who would invade the home market; but if that market is to be preserved, producing costs must be kept low by all possible means; and if labour is refractory we must cheapen overhead costs by extending sales, the possibilities of which are very considerable. The recent appointment by Synthetic Ammonia and Nitrates, Ltd., of Sir Frederick Keeble to take charge of research into the application of synthetic nitrogenous compounds to agricultural purposes, and to be director of propaganda, is of especial significance, for it shows that the company is fully aware of the possibilities of the application of science and scientific method to the problems of industry, and of the value of trained experience in organising propaganda among potential consumers.

Among the more promising new outlets for nitrogenous fertilisers is their application to meadow and pasture land. In the past only arable land has been fertilised in this manner, but three years ago the German manufacturers initiated a series of large-scale tests on the use of nitrogen, with or without phosphates, for grass-land, and the results have shown that the treatment is economically profitable, provided that due regard is had to the nature of the soil and the vegetation, although the increased returns are lower than in the case of arable land. The capital cost of this extension to farming practice would undoubtedly put an additional burden on the small farmer, but the constantly diminishing price of combined nitrogen, and the increasing cost of artificial feeding-stuffs, are factors that should encourage him to undertake the risk. Another possibility lies in the breeding of new types of the most important species of cultivated plants that will assimilate much larger quantities of nitrogen than existing types, and so yield much bigger crops from the same acreage. Such an achievement is held to be quite feasible, although many years may elapse before it is consummated. Further progress would result from the devising of means to retain in the soil the nitrogen that is applied to it in the form of nitrogenous fertilisers and manures. Sir John Russell estimates that under good farming conditions only about one-half of the applied nitrogen is recovered in the first year's crop, and but very little of the residual nitrogen in later crops. Such an economy would at first sight appear to be disadvantageous to the manufacturer, but the farmer would be able to extend his purchases of fertiliser and bring under intensive cultivation land which could not previously stand the cost of artificial dressings.

Quite apart, however, from novel developments of the above kind, there is no doubt that the field of consumption of nitrogenous fertilisers is capable of almost unlimited extension. Russia, Argentina, Canada, Australia, and South Africa are practically virgin fields for the use of manufactured fertilisers, whilst of all the countries that already use them, only Germany, the United States, France, Great Britain, Holland, and Italy are important consumers. The order for consumption of fertilisers of all kinds is that given; for nitrogenous fertilisers only, it is Germany (easily first), the United States, France, Great Britain, Holland, Italy, and Egypt. A better view of the present position is, however, obtained by considering the consumption per unit area of cultivated land. From the statistics published by the International Institute of Agriculture at Rome for nitrogen consumption in the fertiliser year 1921–22, it is seen that Holland comes first, followed closely by Germany, and then at a long interval come Egypt, Belgium, Great Britain, Japan, France, and Sweden, whilst the United States and Canada rank very low indeed.

When we consider that intensity of cultivation differs very greatly in these countries, and that experts in Germany maintain that her soil would respond to twice the quantity of fertilisers which are now applied, we obtain some idea of the great possibilities in store. There is big business in fertilisers to-day; there will be bigger business to-morrow; and no progressive country will be able to afford to neglect provision of these basic raw materials of food production. With expansion of the world's demand for them, we may expect the chemical industry to occupy a more prominent place in the industrial world than it does to-day, and even the chemist may receive that meed of recognition for which he has been striving so long. In Germany to-day it is openly said that the I.G.—the enormous combine of chemical manufacturers—*is* the Government.

If Great Britain is to hold her own in the world's markets, better men must be attracted to the profession and industry of chemistry by offering more adequate rewards; and salesmanship and propaganda, which are playing an increasingly important part in mundane affairs, must not be neglected. We must abandon the attitude of 'take it or leave it,' and study actual demands, local conditions, and the psychology of our customers. The farmer is proverbially one of the 'toughest nuts to crack.' Conservative by nature, he is also frequently regarded as simple. In reality he is very astute, although his time-reactions are slow. He is also suspicious, as he has good reason to be, because of his past experience of quack wares and of good wares sold at extortionate prices. He is apt to regard the adjective 'chemical' with grave suspicion: did not his forbears denounce nitrate of soda as 'the scourge'? He is also more resistant than the average town-dweller to the lure of printed advertisements; but he is not impervious to the advances of the well-qualified agricultural lecturer, and still less to the evidence of the demonstration plot. What does appeal to him strongly is the success of a neighbour or a rival in obtaining yields and results which he has been unable to achieve; and, of course, he is very susceptible to the argument of *l. s. d.*; in other words, he should be approached through his primary instincts of positive self-feeling and acquisition. In this respect he is not markedly different from the rest of us; as Goethe said, "Mankind progresses, but man remains the same."

Peasant and Pundit in India.

Bihar Peasant Life: being a Discursive Catalogue of the Surroundings of the People of that Province. By Sir George A. Grierson. (Prepared (in 1885) under Orders of the Government of Bengal.) Second and revised edition. Pp. iv + 4 + 443 + xvii + clv + 40 plates. (Patna: Government Printing Office, 1926.) 10 rupees.

BIHAR, the homeland of Buddhism, came under the East India Company in 1765, and remained merged in Bengal until 1912, when it reappeared as senior partner in the new province of Bihar and Orissa. In area Bihar is larger than Hungary; its population (nearly 600 to the square mile) is greater than that of Canada, Australia, and the Union of South Africa combined. Of its people, only 8 per cent. live in towns, a fact not easy for the 80-per-cent.-urbanised Englishman to appreciate.

The Bihari peasant is reputed boorish, but a certain young civilian who landed in India in 1873 found him well worth study. There is only one way to get to know a peasant, and that is by talking to him. His language is not the language of poets and pundits, nor can it be learned from a dictionary, for many of its concepts have no equivalents in English and many of its words are as strange to literature as 'zoles' and 'spitters' (unless he come from Devon) to the average professor of classical Greek. So it was that one of the most masterly linguists of the age became the peasant's pupil; "every word in this book," writes the author, "has been collected from the mouths of the people." The task took seven years.

The plan of the book is modelled on a work by the late Dr. Crooke. It is a pity that the lead was not followed in every province of India; for a better key to the life and mind of the ryot could not be proffered to the new-fledged civilian.

Sir George Grierson describes his book as a "discursive catalogue." It is more than that; for, though intended only as a foundation for serious research, it throws in vivid relief the things that count in Indian peasant life. Its main interest centres, of course, in the land; the rich belt nearest the home, the leaner belt on the village outskirts, and the belt between; land new made and land washed away by the vagaries of rivers; soils sandy, clayey, loamy, saline, or stony; soils water-logged and soils which will not retain moisture; the ploughing and reploughing—"a hundred ploughings for cane, fifty for wheat," as they say in Gaya—the sowing, transplanting, irrigating, weeding, and watching; and then the harvest, and the division of the crops between landlord and tenant; the deductions and remissions, and the perquisites due to the village carpenter and blacksmith, the weaver and shoemaker, the sweeper, the accountant, the weighman, and the watchman; a tough business was this settlement of grain rents, by custom and without contract, and the variety of tenures is bewildering. Then there is the problem of labour; the serf who cannot leave his job, or marry, or do anything without his lord's consent; the debtor who binds himself to work until his debt is cleared; the one-year servant and the half-day servant; the man who, in lieu of wages, borrows a plough and oxen one day in three; the pair of cultivators who join and till each other's land in turn; and, in the background, advances of grain and cash, and loans and mortgages on terms unthinkable in generous England.

Other sides of peasant life there are, subsidiary always to the land; the live stock, the home life, the cottage industries. It would puzzle a lexicographer to discriminate in English between the 140 odd varieties of earthenware vessels named (the list is not exhaustive), let alone vessels of metal, wood, or leather, baskets, boxes, and nets, the 100 or so different kinds of jewelry, or the 250 or more different kinds of food.

Of domestic ceremonies, the rites of birth, marriage, and death, the treatment is necessarily cursory; such subjects can only be dealt with adequately by an intensive study of each separate community, for in no two castes are they exactly alike. The same applies to religion generally, for each cult requires separate handling, and more than a hundred cults are named.

The list of country craftsmen, so unlike anything European, shows how little the simple self-contained culture of the Indian peasant is dependent on Western industrialism. Of local products, the only one of industrial importance was (before German chemistry strangled it) indigo.

In mechanics, the Bihari shares with the rest of India the oil-mill and the water-lift, but his masterpiece of ingenuity is the two-wheeled 'large complete country cart,' in which the art of adjusting strains and stresses seems to run riot; the why and wherefore of its three pairs of intersecting spokes, which run from felloe to felloe, its twin axles, one for each wheel, and its 'spinal curvature,' deserve an expert monograph.

Needless to say, Sir George Grierson is scrupulous to observe the niceties of scientific writing, the neglect of which too often impairs the value of books on India. He is careful to define his geographical units, and to explain them with a map; each vernacular word is printed twice, once in the vernacular script, and again transliterated in italics; and, a point most necessary in a land of more than 200 languages, plants are given their botanical names, though the terms used are sometimes out-of-date and generic names seldom begin with capitals. To question Sir George's accuracy would be presumptuous, but (p. 401) Bakr-Id does not always fall in December or Barah-Wafat in March; these festivals, like the rest of the Moslem calendar, fall a little earlier year by year.

Events in India in recent years have somewhat obscured the ryot's interests, and the timely reissue of this valuable work is to the credit of the Bihar and Orissa Government. But in 'get up' this second edition is a sorry travesty of its former self. The first edition was neatly printed on excellent paper, smartly bound and lettered, and beautifully illustrated. In the new volume the paper is coarse, the binding clumsy, the printing dirty and irregular, the pictures blurred; while the errata list covers 29 printed pages and yet records but a fraction of the misprints which disfigure almost every page of the text, making it everywhere untrustworthy, and sometimes unintelligible. Such being the case, it is not a little surprising to read in the 'Foreword' that the proof-feading was entrusted to two distinguished officers who are thanked by the Government "for the care they have taken to produce an accurate reprint."

F. J. R.

Wilhelm Hofmeister.

Wilhelm Hofmeister: the Work and Life of a Nineteenth Century Botanist. By Prof. Dr. K. von Goebel. With Biographical Supplement by Frau Professor Ganzenmüller. Translated into English by H. M. Bower, and edited botanically by Prof. F. O. Bower. (Ray Society Volume (No. 111) for 1925.) Pp. xi+202. (London: Dulau and Co., Ltd., 1926.) 12*s*. 6*d*. net.

THE Ray Society has just published a translation into English of a volume which appeared in Leipzig in 1924 to celebrate the centenary of the birth of Wilhelm Hofmeister, a botanist to whom is generally assigned the premier place in plant-morphology during the nineteenth century. This version follows as a fitting sequel to the volume of Hofmeister's researches published in English in 1862 by the same Society under the title "On the Germination, Development and Fructification of the Higher Cryptogamia, and on the Fructification of the Coniferæ," which for more than sixty years has been held as a classic by all English-speaking students of plant-morphology. The volume last named was, however, not merely a translation of works already published by him in German: its text was specially revised and enlarged by the author himself for the Ray Society, so as to be a complete record of all known at that time on the subject to which it related. Thus on two occasions, far apart in date, the Ray Society has promoted the interest of botany by presenting in English works concerned with the same great discoverer.

The centenary volume was written by Hofmeister's most distinguished living pupil, Dr. K. von Goebel, now professor of botany in Munich: a man whose outstanding position in science has recently been recognised afresh by his election as foreign member of the Royal Society of London. He is the heir to Hofmeister's dominant place, not only as a formal morphologist but also as a philosophical biologist. This union of the study of form and function has indeed been stereotyped by the title given by von Goebel to his own great work, "Organographie."

Botanists, and biologists generally, recognise in Hofmeister the exponent of alternation of generations in plants. They admire his keen and unswerving perception of the homologies of those successive phases which in divers plants are so often disguised by differences of form and proportion. He first disclosed, in 1851, that underlying cycle of events which normally characterises Archegoniate plants, including the Coniferæ. The similarity of the constant cycle in them all was indeed shown to be so close that when Darwin's "Origin of Species" was published, the common underlying plan appeared at once to gain evolutionary significance.

Hofmeister's work on the Archegoniatæ is doubtless his best-known title to fame. But it is far from being the actual sum of his achievements. It is one of the great merits of von Goebel's book now under review, that it places the life-work of a master of technique and of thought in its true relation, not only to the period in which he lived, but also to the general march of science. It shows Hofmeister as a man of singularly alert mind and clear vision, coupled with a remarkable capacity and enthusiasm for work. There was something almost prophetic in his outlook on science. His perception of alternation was the natural precursor of the discovery of the cytological cycle as we now know it. But more significant still was his pursuit of causal morphology, as developed in his other great work, entitled "Allgemeine Morphologie." This book is unfortunately unpopular in style and almost plethoric in content. But it touched many matters that are still in eager debate: none more so than the inheritance of acquired or impressed characters. On the last page of that work he says: "It appears to me probable that only gradually, in the course of many years' development, the influential effects on outer form appeared and became hereditary." Twenty years later, Sachs advocated the same idea, saying with regard to the perpetual operation of gravity and light: "Many of these effects we are able to-day artificially to call forth or hinder; but others have become entirely hereditary and constant. Evidently one of the most fruitful regions of botanical research lies here before us." It is well to accord full weight to such expressions from great experimental botanists, while considering the later view put forward by Weismann with special relation to animals.

It is impossible in a short review to do justice to von Goebel's thoughtful estimate of his master's life and work. The pupil is, however, also a critic, and he does not hesitate to expose points where Hofmeister's views are out of harmony with later aspects of the science. This feature, associated with the broad outlook of an unusually penetrating mind, makes von Goebel's volume a most valuable addition to philosophical botany.

The remarkable wealth of facts early observed by Hofmeister, and the acute comparisons based on them, revealed the young bookseller as already a leader in his science. Recognition followed quickly. In 1851 he was awarded the honorary doctorate of philosophy of the University of Rostock. A few years later, in 1854, he received a call to the chair of botany in Heidelberg; and in 1863 he was appointed to Tübingen. As professor, he could not be called a popular lecturer. But the list of such pupils as Askenasy, Engelmann, Kienitz Gerloff, Müller, Pfitzer, Timiriassieff, Millardet, Zacharias, and von Goebel shows how powerful and prolific was his advanced teaching. He was, in fact, "a heaven-gifted genius such as in every science appears only at long intervals of time."

This volume presents Hofmeister both as a genius and also as a personality. His character is not only indicated by the pupil who saw him at near hand, in the laboratory and in the field, but also more fully by his daughter, Frau Prof. Ganzenmuller, in a chapter telling of his family life. Several vivid letters to his wife are quoted, and reveal a vivacious and very affectionate nature. But, as said in the translator's introduction to the English version: "The story which the daughter relates of her father's family happiness, and of his phenomenal success in a profession he was never trained for, becomes poignantly tragic as the tale of grievous bereavements quickly following one another reaches its sad climax in solitude of spirit. Her closing paragraphs, as well as his works, claim remembrance for one who, overtaken in 1877 by sickness and death, had persistently devoted almost his last broken powers to the science he had so brilliantly illuminated."

Reaction.	Species.	Author	*b*
Cleavage of egg .	Strongylocentrotus	J. Loeb[14]	0·99
" " .	Ascaris	Fauré-Fremiet[15]	2·50
Growth in plants .	Lupinus (moderate)	Vogt[16]	1·90
" " .	*Scirpus Kysoor* (tropical)	Bose[17]	9·50

When we consider further a given reaction in one and the same species, we may observe that *b* increases with the age of the individual:

Reaction.	Species.	Author.	*b*.
First cleavage of egg	Strongylocentrotus	J. Loeb[14]	0·99
Second " "	"	"	1·13
Heart-beat . .	*Amblystoma* larvæ, 8, 2-9, 1 mm.	Laurens[18]	1·41
" . .	*Amblystoma* larvæ, 13, 0-25, 4 mm.		1·50
Larval stage . .	Drosophila	Loeb and Northrop[4]	2·10
Pupal stage .			2·28
Imaginal stage . .			1·36 (see later for discussion)

I have calculated the constant *b* also for the rate of development in different stages of the beetle *Dytiscus semisulcatus*, according to observations by Blunck.[19] In this case also the value of *b* increases with age:

Period.	*b*.
1. Embryonic	1·10
2. First larval instar . .	1·14
3. Second " " . . .	1·26
4. Third " . . .	1·38
5. Præpupal	1·48
6. Pupal	1·60

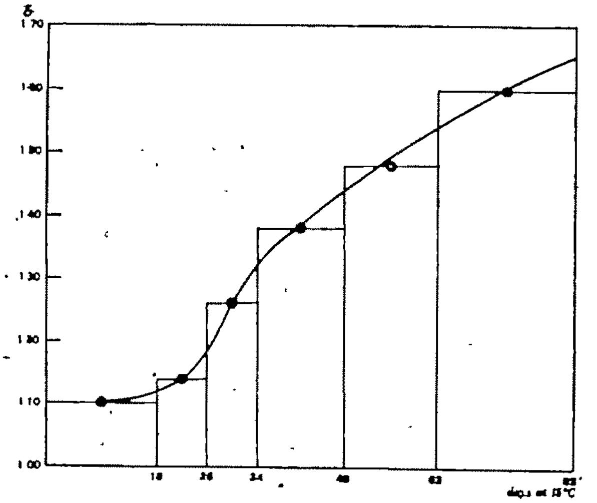


FIG. 1.—The constant *b*, which indicates the degree of protoplasmic viscosity, increases with the age of individual, development of *Dytiscus semisulcatus*.

These results, when plotted against time, give a regular S-shaped curve (Fig. 1). From Krogh's[20] experimental data concerning the embryonic development of the frog (*Rana fusca*), I have found that *b* increases with time in a similar way, as follows:

Period	The Beginning and the End of the Period characterised by Stages.	*b*.
1	Fertilisation—end of the first cleavage .	1·20
2	End of the first cleavage—closure of neural fold	1·64
3	Closure of neural fold—formation of external gills	1·76
4	Formation of external gills—formation of gills with 3 branches. . . .	1·92
5	Gills with 3 branches—embryo 7 mm. long	1·69
6	Embryo 7 mm. long—embryo 7·8 mm. long	2·52

The graph of these values plotted against time probably corresponds to the first part of an S-shaped curve, the most advanced stage in Krogh's experiments being embryos only 7·8 mm. long.

The following example will show that *b* is also increased under the action of narcotics:

Pulsation of vacuole, *Paramæcium caudatum*, normal (Khainsky[21])	1·60
Pulsation of vacuole, *Paramæcium caudatum*, under chloretone (Cole[22])	1·87

The next example, computed from Hennings'[23] experimental data, demonstrates that *b* increases not only with the age of individual, but also that it is higher in a dry than in a humid atmosphere:

Tomicus typographus.	*b* in Dry Atmosphere	*b* in Humid Atmosphere
Embryonic stage	2·02	1·87
Larval	3·52	2·98
Free beetle	2·90	2·44
Total development . . .	2·48	2·37

From these data it may be seen that the coefficient *b* varies not only for different biological reactions, but also that it changes even in one and the same reaction under varying external and internal conditions. It would be therefore impossible, at least at present, to identify biological reactions by means of our new formula. But the variations of *b* may be understood without great difficulty if we assume that *b* indicates the degree of protoplasmic consistency (or, physically, viscosity and rigidity). It has been partly demonstrated, partly made highly probable by different investigators, that the viscosity of protoplasm increases with the age of individual as well as under deeper narcosis (see F. Weber[25]). The case of embryonic development in *Tomicus typographus*, cited above, would then indicate that the protoplasm may become more viscous owing to loss of water in dry air.

The S-shaped curve which represents the increase of *b* with age fits well with my previous experiments made on cells of *Elodea densa*, in which the protoplasmic viscosity, plotted against the age of cells, also gives an S-shaped graph.[24] In the development of insects, it may be noted that *b* drops suddenly between the larval period and the imaginal stage (see above, Drosophila and Tomicus). This points to the possibility that protoplasmic viscosity decreases during metamorphosis, which then would involve some sort of rejuvenation. But as the material upon which my calculations are based is not sufficiently large, I do not venture to accept this idea as a definite explanation.

---

[14] J. Loeb, *ibid.*, 124, 1908.
[15] Fauré-Fremiet, "La cinétique du développement," Paris, 1925.
[16] Vogt, cf. Jost, "Vorlesungen über Pflanzenphysiologie," Jena, 1913.
[17] Bose, *Trans. Bose Research Inst.*, Calcutta, 1, 1918.
[18] Laurens, *Amer. Journ. of Physiol.*, 35, 1914.
[19] Blunck, *Zeits. f. wiss. Zool.*, 121, 1924.
[20] Krogh, *Zeits. f. allg. Physiol.*, 16, 1914.
[21] Khainsky, *Arch. f. Protistenk.*, 21, 1911.
[22] Cole, *Journ. Gen. Physiol.*, 7, 1925.
[23] Hennings, *Biol. Centralbl.*, 27, 1907.
[24] Bělehrádek, *C. R. Soc. de Biol.*, 92, 1925; *Publ. Fac. de Médec.*, Brno, 1925.

The difference in the constant b which exists between poikilothermic and homoiothermic organisms seems to indicate that the protoplasmic viscosity is regulated with regard to the thermal adaptation of a given species.

Any biological reaction is a complex of many physical and chemical processes forming a chain. In determining the temperature coefficient of such a complex, we in effect determine the temperature coefficient of only one of the underlying processes, namely, that which is least accelerated by rising temperature and is therefore the limiting factor of the whole complex (Blackmann's and Pütter's principle). In the majority of cases, however, the rate of molecular diffusion in the protoplasm is the limiting factor (see W. M. Bayliss[25]). As the rate of diffusion depends on the viscosity of the reacting system, our hypothesis is justified also from a purely physicochemical point of view.

Thus the protoplasmic viscosity may be studied by simply measuring the effect of temperature on any biological reaction in which the new formula holds good. Further investigations will show whether this way of determining the protoplasmic viscosity would be not only less injurious to the living system, but also more accurate than the existing methods of protoplasmic viscosimetry (see F. Weber[26]).

J. Bělehrádek.

Zoological Department,
King's College, London,
August 12.

Science and Psychical Research.

Having read with interest the correspondence in recent issues of Nature arising out of Dr. Tillyard's article on Sir A. Conan Doyle's "History of Spiritualism," I beg space for the following remarks which I shall try to confine so far as possible within the editorial limits stated in the issue of September 11 to be the main point of the reviewer's article of July 31, namely, "that scientific men generally presented an unscientific attitude to the subject of psychical research." But Dr. Tillyard in his article appears to prefer the substitution of the term 'supernormal phenomena' to the term 'subject of psychical research.' Therefore my remarks will deal almost wholly with that department of 'psychical research' which concerns itself with such supernormal phenomena as may be included under the head of *accounts given of communications between living persons and the* 'discarnate' spirits, or 'intelligencies,' or 'ghosts' of those who are normally called the dead, and thus omit here all reference to much of the material studied by the Psychical Research Society, for example, telepathy, etc., as quite irrelevant to this correspondence.

All the statements regarding the above-named accounts hitherto published and believed to be true by some of all descriptions of persons, including such as are or have been students of various branches of science, lack any evidence of a character which could make possible their submission to strict scientific investigation, the requirements of which I need not repeat in these pages. In this statement I include all the accounts given or referred to by Sir A. C. Doyle or his reviewer in the "History of Spiritualism." Recently when talking with Sir Ray Lankester about a review he had written of Sir A. C. Doyle's book, and the ghost-stories it contained, he brought to my notice the following quotation from some remarks made by Mr. T. P. O'Connor in the *Sunday Times* of August 15 in connexion with a conversation with Sir Edward Clarke, the chief counsel for the plaintiff in the case of O'Shea *v.* Parnell. In the course of this case it was proved that there was no 'fire-escape' in the house in question. "This," says Mr. O'Connor, "was not the first time I realized the truth of the statement that you cannot be quite sure that you know all the facts of any historical or personal transaction. I never trust implicitly any historical statement. I have rarely seen any of the historical transactions in which I myself have taken a part strictly recorded according to the facts." Sir Ray thoroughly endorsed Mr. O'Connor's attitude as to placing no reliance on such 'story-telling,' and holds that it applies equally to reputed researches by eminent scientists—all hearsay—and useless as evidence.

On all of the many occasions, within a period of more than fifty years, when I have given serious attention to allegations of facts made by students of the 'occult' or so-called 'supernormal phenomena,' I have found that the actual necessities for carrying out scientific investigation were unattainable, the consent of the 'medium,' whether 'professional' or not, being withheld.

Scientific men generally do not refuse to examine into any matters of reputed or seeming importance on the ground of certain alleged facts being impossible, or even highly improbable. They cannot, however, but refuse to make inquiry into any matter when the conditions of investigation, necessarily required, are denied or restricted and actual experiment thus excluded. As one example only of an unproved statement made in the course of the present correspondence, I quote that of Dr. Tillyard's in which he says that in a certain class of cases "the medium is actually in trance and does not know what is going on." I do not know what he means by the word 'trance,' but his statement would seem to be of some importance to spiritualists and the Psychical Research Society, as in the present dispensation of their doctrines the 'entranced' medium plays a most important part in the manifestations of occult phenomena generally. I am not aware, after making several inquiries into this point, of any thorough investigation having been made into the condition of a 'medium' reported to be 'entranced.'

Bryan Donkin.

September 17.

The present controversy, which the editor of Nature has wisely confined to a discussion of the "*scientific* study of what are called *supernormal phenomena*," is somewhat confused by the irrelevancies which have been introduced into the debate.

The entomologist, Dr. Tillyard, complains that his critics confuse psychical research with spiritualism, when the fact is that his original article was a review of a book on spiritualism and not on psychical research. Moreover, when he accuses Dr. Lotsy of making "the usual blunder of those who, knowing nothing of the elementary principles of psychical research, persist in regarding the medium as the 'guide' in the experiments," he himself is betraying his lack of acquaintance with the subject. This is readily excusable since, I believe, his experience with physical mediums is limited to less than a dozen sittings. Apart from this, Dr. Tillyard's statement strikes at the root of the present discussion. The majority of scientific men suspect that what Dr. Tillyard denies is true, namely, that the medium is the 'guide' in the experiments. In this they are right, although the words 'and his/her manager' might be added to the word 'medium.'

The conditions of experiment are usually arranged by the medium or by the manager in conformity with a set of arbitrary rules laid down by generations of spiritualists for reasons into which we need not enter here. The séances are of the nature of performances at which the 'investigator' takes his place in a 'chain' of believers, who see that he does not violate the rules, which are framed in such a way that any real investigation is impeded. Can Dr. Tillyard tell us of any single medium who can produce some simple raps, under conditions which render their normal production impossible? He will doubtless reply by stating that 'supernormal' phenomena are subject to certain conditions and it is only under certain conditions that they occur. This appears reasonable, but Dr. Tillyard's experience is too slight for him to be able to recognise that the conditions are not "just exactly what the researchers choose to make them" (NATURE, September 11, 1926, p. 370), but what the medium plus his manager or employer have chosen to make them.

---

[25] Bayliss, "Principles of General Physiology," London, 1918, p. 41 *seq.*

[26] F. Weber, *Abderhalden's Handb. d. biol. Arbeitsmeth.*, vol. 11, 2, 1. half, 1924.

In this respect the cordial invitations which are so often extended to prominent persons are highly suggestive. It is now becoming a common thing when a new medium appears for his or her manager to invite scientific men in other spheres of work, journalists, actors, etc., to be present at the experiments. Great care is taken to prevent the systematic attendance of critical psychical researchers and others with much experience of mediums, for these are not likely to be impressed by the trappings of a pseudo-investigation, and are also acquainted with those sources of error which, from their very nature, must remain unknown to the ordinary scientific worker, who has not specialised in this line of inquiry.

There is a good case for the scientific study of what are called supernormal phenomena. The difficulty lies in obtaining the opportunities for any such investigation under conditions satisfactory to those whose experience leads them to adopt a critical attitude towards the problems in dispute.

E. J. DINGWALL.

73 Corringham Road,
London, N.W.11.

The Egyptian Shadouf and the Rate of Human Work.

THE interesting paper by Drs. Haldane and Henderson in NATURE for August 28, p. 308, merits emphasis on two or three points. Above all, the mechanical beauty of the shadouf, in spite of its crude construction, deserves notice. It will be observed that trunnion bearings, which would wear and need lubrication, are replaced by almost frictionless hinges in the form of ropes. These ropes, in addition to their antifriction qualities as hinges, confer an important property on the system, namely, elasticity.

In short, the shadouf is a pendulum, and almost without doubt the men who work it move with it in its natural free period. If this is so, it would constitute a remarkable anticipation of recent developments in Germany, where many reciprocating machines have been constructed on resonance principles with marked gain in efficiency.

About the middle of last century, when most cranes and winches were operated by hand, it was necessary, for purposes of design, to have some standard of human activity. A widely accepted figure for such work was one-tenth of a horse-power or 3300 foot-pounds per minute. D. K. Clerk, a respected authority of that period, gave this rate as "the average net daily work of an ordinary labourer at a pump, a winch or a crane, for eight hours a day." "For shorter periods, from four to five times this rate may be exerted." Taking the rate given by Clerk for eight hours, we have 1,584,000 foot-pounds per day, in close agreement with the shadouf worker's 1,550,000 foot-pounds.

As to exteme rates of activity for short periods, comparisons are most difficult. Probably the highest rates are exhibited by professional wrestlers and strong men, whose feats are sometimes performed at a rate of the order of four horse-powers.

H. S. ROWELL,
Director of Research,
Research Association of British Motor
and Allied Manufacturers.

Chiswick, W.4,
August 30.

THE figures of 4290 foot-pounds per min. for raising water, and 4230 foot-pounds per min. for raising earth, given by Dr. Haldane and Prof. Yandell Henderson in NATURE of August 28, as examples of the rate at which work can be kept up for lengthy periods, are confirmed by the common experience of hill climbers. A man of average weight, dressed in climbing kit, and carrying a load of, say, 15 or 20 lb., may be assumed to weigh about 180 lb. To walk uphill at the rate of 1250 feet per hour, at low or moderate altitudes, is quite ordinary; while 1500 feet per hour is generally considered as distinctly fast. Such figures would apply to persons in good training, and to ascents lasting for, say, 4 hours. The rate to correspond with 4200 foot-pounds per min. would be 1400 feet per hour.

It would be interesting to measure the rate of oxygen consumption of persons walking uphill for lengthy periods; for given rates of ascent and for various gradients; and to compare the results with figures obtained from the same individuals working an ergometer in a laboratory. The question of gradient cannot be entirely ignored. Clinometer measurements of Alpine paths indicate that the economic gradient is about 18°, or 1 in 3. It certainly lies between 16°, which is unnecessarily flat, and 20°, which is uncomfortably steep.

P. J. H. UNNA.

4 Dean's Yard,
London, S.W.1,
August 31.

Antagonistic Action of Electrolytes and Permeability of Membranes.

THE problem of the antagonistic action of electrolytes in biological systems has attracted attention for a long time, but a similar effect on inorganic colloidal systems has been investigated only in recent years. This study has, however, thrown considerable light on the mechanism of such antagonistic action, and we are now probably able to give a rational explanation on the basis of these physico-chemical investigations. About a decade ago Clowes (*Jour. Phys. Chem.*, 20, 407, 1916) showed that a marked analogy exists between the transformation of an emulsion of oil-in-water into an emulsion of water-in-oil, or of blood plasma into a blood clot, or of a casein suspension into a casein clot. In all these cases salts of calcium promote and alkalis and salts of sodium inhibit the transformation of a system consisting of a non-aqueous phase dispersed in water into the reverse type of system, consisting of water more or less perfectly dispersed in a non-aqueous phase, and the ratio in which given electrolytes, say sodium or calcium chloride, exert a compensatory effect upon one another, is almost the same as that in which the electrolytes in question exert antagonistic or compensatory effects on one another in biological systems.

In some recent papers (*Zeit. anorg Chem.*, **142**, 345; 149, 139, 1925; *Jour. Phys. Chem*, **29**, 517, 1925) I have examined the behaviour of several colloidal solutions from this point of view, and have shown that a general explanation for all these cases of ionic antagonism is that the similarly charged ion goes to stabilise the suspension, which effect is antagonised by the presence of a coagulating ion. The equilibrium in biological systems, the inversion of emulsions, and the coagulation of colloids in the presence of mixtures of salts can all be explained from this simple view, which is also supported by experimental facts.

The effect of such non-electrolytes as the organic anæsthetics in antagonistic experiments is similar to the salts of calcium, as has been shown by Lillie and others. In these cases we are dealing with the coagulating effect of the non-electrolytes on the dispersoid system. Thus it is now known that copper ferrocyanide membranes, which also show under suitable conditions a reversible variation in permeability like protoplasmic membranes, can be coagulated by means of propyl and other alcohols, but in the presence of membrane-forming materials the coagulation of the membrane is retarded. This is to be attributed to an antagonism between the non-electrolyte and the electrolyte in question. Consequently a general statement of the observed antagonism in diphasic systems is that *all antagonistic actions occur between a peptising agent and a coagulating agent.* This antagonism need not be confined to two electrolytes only, but may occur between an electrolyte and a non-electrolyte. If the concentration of one of these is constant, then at a particular concentration of the other the whole system will be in equilibrium. In freely reversible systems the equilibrium ratio of these will be approximately constant, but this cannot be expected in systems which are irreversible. In the case of ionic antagonism, it has been found that the adsorption of similarly charged ions stabilises the suspension towards another coagulating ion and naturally, therefore, the nature of the electric charge on the surface of the dispersoid or emulsoid particles in the case of physiological systems must be of fundamental importance in showing a variable permeability under different conditions.

K. C. SEN.

Chemistry Department,
University of Allahabad,
India.

Lightning.

DR. SIMPSON'S rejoinder accompanying my recent letter (NATURE, August 7) indicates that I have signally failed to convey to him the ideas which I endeavoured to present. For this I am sorry. A more detailed discussion, being inappropriate for these columns, will be presented elsewhere, but two items of his rejoinder should be mentioned here and now. Dr. Simpson quotes and by implication interprets an isolated sentence. I fail to see how this implied interpretation can be considered to be compatible with the remainder of the paragraph from which the sentence was taken. Second, he is quite mistaken in thinking that the electronic darts which I pictured are but little different from the negative discharges which he considered. His discussion of the latter contains no suggestion of such darts.

N. ERNEST DORSEY.

August 17.

DR. DORSEY complains that my interpretation of the sentence which I quoted from his letter is incompatible with the remainder of the paragraph from which it was taken. If this is so it is not my fault, for the paragraph in question contains the two following incompatible sentences: "the branches are not outgrowths from the trunks but ingrowths to it" (which is the sentence I quoted), and "a branch may grow in length and may branch."

I can assure Dr. Dorsey that I did my best to understand his difficult letter and to explain the points in which his theory appears to differ from mine. I cannot, of course, expect him to agree with me, but I regret that he considers that he has cause for complaint.

G. C. SIMPSON.

August 31.

The Absorption Spectrum of Formic Acid Vapour in Relation to Molecular Associations.

THE absorption spectrum of formic acid vapour at room temperature and above (to 145° C.) consists of about thirty-five bands, lying between $\lambda = 2565$ and 2250 Å.U.; at the ultra-violet end of this band spectrum there appears to be a continuous absorption.

The law of distribution of practically all the bands may be represented with close approximation by the formula:

$$\frac{1}{\lambda} = 41700 + n \,.\, 1050 + p \,.\, 385,$$

where $n = -2, -1, 0, +1, +2$ and $p = -7$ to $+7$.

The null-band ($n = 0$, $p = 0$) is the strongest band and corresponds to

$$\lambda = 2398{\cdot}0 \text{ Å.U.}, \frac{1}{\lambda} = 41700 \text{ cm.}^{-1}$$

There are two fundamental periods of atomic vibrations in the molecule, $\alpha = 1050$ and $\beta = 385$ cm.$^{-1}$. It is important to mention that the larger fundamental period is of the same order of magnitude (about 1000 cm.$^{-1}$) as is obtained for a number of molecules with a C-O group: formaldehyde (V. Henri and Shou, $\alpha = 965$ cm.$^{-1}$), diacetyle (V. Henri and L. Light, 1100 cm.$^{-1}$), paraquinone (V. Henri and L. Light, 1110 cm.$^{-1}$), benzaldehyde (V Henri and Almasy, 945 cm.$^{-1}$), furfurol (V. Henri and Almasy, 1080 cm.$^{-1}$), acroleine (V. Henri, 1260 cm.$^{-1}$), phosgene (V. Henri and Howell, 902 cm.$^{-1}$) In the infra-red there is a strong carbon monoxide band at $\lambda = 9{\cdot}2\mu$, $1/\lambda = 1087$ cm.$^{-1}$. It is therefore quite probable that this period 1050 cm.$^{-1}$ of formic acid vapour corresponds to the vibration of the oxygen relative to the carbon atom.

With increasing temperatures (using a constant mass of 60 mgm. in the absorption tube, between the room temperature and 145° C.) the absorption limit approaches the visible, and more bands of the same kind appeared towards the visible end of the spectrum.

The simplicity with which the above formula represents all the bands leads to the belief that these bands are due to the absorption of one kind of molecular species. The fact that at elevated temperatures the number of single molecules (HCOOH) is much increased, while the number of double molecules $(HCOOH)_2$ is decreased, leads to the conclusion that the banded absorption spectrum is due to the single molecules. (At 145° C the ratio of single molecules to double is about 7 : 1, and at the room temperature it is about 0·3 : 1.)

LOUIS HARRIS,
National Research Fellow.

Institute of Physical Chemistry,
University of Zurich.

The Scope of Organic Chemistry.[1]

By Prof. J. F. THORPE, C.B.E., F.R.S.

THE chemistry of the compounds of carbon covers a wide field, wider than that covered by any other element. Its scope embraces all living matter, as well as the vast number of non-living substances which are produced through the agency of life. Moreover, it includes a very great number of compounds unrelated to life or to living processes which have been built up by the chemist in the laboratory by methods he has devised.

Already some 200,000 definite compounds have been tabulated in Richter's Lexicon and in the supplements thereto, and this number is increased yearly by several thousands through the agency of a band of zealous workers scattered over the globe. It may well be asked what is the good of continuing to increase this already astonishing number; and is the expenditure of time, labour, and energy justified which lead to the discovery of some new fact having, apparently, no useful application to any department of human activity?

The answers to these questions are quite clear and definite. We must acquire a knowledge of the simple before we can attack the complex with any hope of success. The element carbon has been used by Nature as the basis of organised life because the capacity of carbon to combine with itself is shared by no other element, and it is upon this capacity that Nature has relied in order to build up the tissues and reserve materials which form the living world around us. Moreover, since the compounds of carbon containing a moderate number of atoms of the element are usually crystalline or capable of becoming crystalline, and there are obvious disadvantages attaching to the use of potentially crystalline substances as the basis of living matter, it has been found necessary to employ the more complex carbon derivatives containing many hundreds of elemental atoms, which by reason of their high molecular complexities no longer possess, or seem capable of acquiring, a crystalline structure, but belong to the class of jelly-like or colloidal substances.

Until we can determine how a small number of carbon atoms combine one with the other, we cannot hope to obtain any insight into the manner in which the more complex natural substances are built up, or any information regarding the way in which they are utilised to bring about the changes occurring during animal and vegetable metabolism.

STRUCTURE.

The science of structural organic chemistry is only just fifty years old. It was born when the genius of van 't Hof gave to the world the clue upon which the three-dimensional formula we now use is based. It is therefore no inconsiderable achievement to have gained in so short a time a knowledge of many of the reactions and properties of the more simple complexes of carbon in combination with oxygen, nitrogen, and other elements. But much yet remains to be done before we can attack with any real hope of success the problems which the chemistry of Nature presents.

It is true that the knowledge already gained has led to the synthetic preparation of quite a number of natural products, many of which are of service in relation to human needs. Many of the alkaloids, colouring matters like indigo and alizarine, camphor, and a large number of natural products, have yielded the secrets of their structures and have been produced by laboratory methods and, where necessary, on the factory scale. But the synthesis of such compounds has not provided much insight into the mechanism leading to their production in Nature, and indeed the reason for their occurrence in the plant is not understood. They are, moreover, crystalline substances which either occur in the plant as such or are formed by the hydrolytic fission of some more complex plant materials. Their homogeneity is therefore not open to doubt, and their degradation into known fragments and the rebuilding of these fragments into the original substances, although by no means easy, is nevertheless comparatively simple when the difficulties attending the investigation of more complex natural products are taken into account. Even so, some of the simpler type, for example, strychnine, still resist the attack of the chemist.

BIOCHEMISTRY.

In its earliest days the science of organic chemistry dealt only with those compounds which were derived from natural sources, and it was regarded as certain that such substances could be produced only through the agency of life and by no other means. Since then this theory has been shown to be wrong by the preparation in the laboratory of many substances identical with those formed during the operation of life processes. Nevertheless, the more complex substances which Nature utilises in building up her animal and vegetable structures still show no signs of yielding the secrets of their constitutions, or the mechanism by which they are produced. Indeed, although we can imitate in the laboratory certain natural operations such as the hydrolysis of starch to glucose, we are still quite ignorant of the means by which glucose is converted, by the appropriate enzyme, into alcohol and carbon dioxide, neither can we imitate this process in the laboratory.

When once the chemist has passed beyond the crystalline and the distillable he enters a region full of difficulties, because he has few means either of purifying the materials with which he has to deal, or of determining their homogeneity when they have been purified. These are the real difficulties which confront the biochemist when he approaches his subject from the structural side of organic chemistry.

It is far from my object to disparage the wonderful work which has been done and is being done by physiologists and pathologists in their attack on the mechanism of normal and abnormal life processes. Their record speaks for itself. But too little is being done to approach the problems from the purely organic chemical side, and too few of the people engaged in biochemical research have an adequate knowledge of organic chemistry or the methods of the organic chemist. The number of organic chemists who are co-operating with biologists in their attack on natural processes is too few. Indeed, the very difficult question arises here as to how best to organise methods for dealing with problems which are essential borderland problems between two great sciences.

---

[1] From the presidential address to Section B (Chemistry) of the British Association, delivered at Oxford on August 5.

It seems that the best method to attack problems in borderland subjects is by co-operation between two types of trained investigators. In the case of biochemistry, for example, by the provision of trained students of two kinds, one trained in physiology but with a sufficient knowledge of organic chemistry to promote sympathy with and knowledge of the chemist's point of view, and the other trained as an organic chemist with a similar knowledge of the methods and requirements of the physiologist. The former would be a trained physiologist who would devote his final year to organic chemistry, the latter an organic chemist who would devote his final year to a study of physiology. This is, of course, no new idea, but is one which is being carried out in at least one institution in Great Britain in connexion with other borderland subjects.

It is the absence of any real attempt to approach biochemical problems from the chemical side that renders it particularly desirable that the need for some such scheme should be emphasised. It is true that the fault is largely on the side of the organic chemists who, for the most part, seem appalled by the difficulties attaching to the study of natural processes. The difficulties are indeed great, but not insurmountable. We are far from gaining any insight into the meaning of life, but it is not unlikely that we shall, in the near future, obtain some information regarding the mechanism of the action of the enzyme, the important agent in the non-living transformation of living matter into chemical products. It may be that organic chemists are waiting to see how Willstätter, who has already made great progress in enzyme chemistry, will surmount the difficulties confronting him, and it may well be that this great organic chemist will introduce new methods of attack which will open up fresh fields for investigation.

PETROLEUM.

The complex hydrocarbons which form the main constituents of crude petroleum belong to a section of organic chemistry at present too little explored. Although many millions have been made through the production and sale of petroleum products, it is safe to say that the percentage of profit devoted to research in oil products has been infinitesimal. It is true that in the United States large sums are given by the oil interests towards research in other subjects, but until quite recently none of these was, curiously enough, given for the purpose of improving our knowledge of the science on which the utilisation and isolation of petroleum products depends. The reason is not far to seek. The apparently inexhaustible supplies of petroleum render it unnecessary to devise means for economical working. The crudest and most wasteful methods were employed, because economy and the conservation of the natural product were not paying propositions.

This applies not only to the methods used in fractionisation, but also to those employed for the purpose of 'cracking' the higher boiling fractions into liquids of lower boiling point. For at the present moment it is the fraction up to 200° C. which is the important product, because it is the 'petrol' of the internal combustion engine. Time was, before the introduction of this particular machine, when the light fraction from crude petroleum was a drug on the market, and in many cases was actually set on fire at the refinery because no use could be found for it. In those days the chief product was the kerosene fraction which was used as lamp oil. At the present time the rapid increase in the use of the motor-car for personal and commercial transport indicates that at no distant period, if progress continues to be made in the same direction, the amount of the 'petrol' fraction will be insufficient for the world's needs. This point has already been reached in America, where approximately 70 per cent. of the world's consumption of petrol (gasoline) is effected. During 1925 the consumption of petrol in the U.S.A. approached 800,000,000 gallons a month, which is about twelve times the amount consumed in Great Britain.

The 'cracking' operation is now carried out on an enormous scale by numerous processes, all subject to patents, but differing from one another only slightly on the question of principle. All depend on the well-established fact that hydrocarbons of high molecular weight will break down into those of lower molecular weight if they are subjected to the requisite degree of temperature. Pressure appears to play an important part in the character of the product, as does also the surface action of the container or material used in the container to promote surface action. All are wasteful, because little or no research has been carried out on the true chemical nature of the cracking operation. Much permanent gas is always produced, consisting for the most part of ethylene and propylene. In the States the ethylene is allowed to go free, because its obvious utilisation in the form of ethyl alcohol is attended with difficulties, but the propylene is usually absorbed in sulphuric acid, and thus converted into *iso*propyl alcohol, useful as a solvent.

The production of these two unsaturated hydrocarbons provides a clue to the mechanism of the cracking process which is of some significance. If you break a long-chain saturated hydrocarbon, one of your products must be an unsaturated hydrocarbon, and it is evident that cracked spirit contains a considerable proportion of such unsaturated bodies. Moreover, the cracking processes at present in use do not produce aromatic hydrocarbons, and it is on the presence of a proportion of these aromatic hydrocarbons that certain special properties of petrol depend. For example, the tendency at the present time is to produce for motor-cars internal combustion engines of increased compression ratio, in order mainly to diminish the petrol consumption and thus increase mileage per gallon consumed. For some reason, which research has not yet ascertained, the use of petrol which does not contain the right quantity of aromatic hydrocarbons of the benzene type leads to 'detonation,' 'knocking,' or 'pinking' when ignited in cylinders giving more than a small compression ratio. This detriment diminishes the value of cracked spirit as such for any but low-compression engines, and many have been the devices suggested in order to overcome this difficulty.

A vast number of substances, selected more or less at random, have been tried as 'anti-knock' materials, and as an outcome it has been found that one, namely, lead tetraethyl, possesses the property, when present in exceedingly small quantities, of preventing the 'detonation' of the explosion mixture in the cylinder. For a time lead tetraethyl (ethyl gas) fell under a ban in the States owing to a fatal accident which attended the spilling of a certain amount in one of the American factories, but it is understood that further investigation has led to a revision of the view first formed, and that considerable quantities of 'ethyl gas' are now being used. I remember visiting Wilmington in 1924, when some 500 gallons of lead tetraethyl were being made daily. Although there was naturally a strong smell of the material in the factory building, and I remained for some hours there, no ill-effects were noticed.

It is obvious that the conditions which produce 'knocking,' and the reason why certain substances are 'anti-knock' compounds, and why the presence of aromatic hydrocarbons prevents the phenomenon, must be made the subject of systematic research.

The question is also one of national importance, because in the case of high-compression engines, such as those used in aeroplanes, it is essential that a petrol should be used containing a high percentage of aromatic hydrocarbons. In war-time these aromatic compounds will be required for the manufacture of explosives, and it is quite certain that there will not be enough for both purposes.

Nevertheless, it must be remembered that it is only at the moment that the low boiling fraction of petroleum is the chief marketable product. It is probable that progress in the future will tend more and more to produce a motor-car engine of the Diesel type, or one having a carburettor capable of effectively vapourising the higher fractions of petroleum. In these circumstances it may well be that the low fraction will become the less important part of crude petroleum, and that, instead of having to resort to 'cracking,' a process of synthesis, by which the lower hydrocarbons can be converted into higher ones, will have to be adopted. As a matter of fact there are methods known by which this can be effected. Pure *iso*amylene can, for example, be converted into diamylene by interaction with stannic or aluminium chloride, and the process can be carried further, so that perfectly good lubricating oils can now be made by the polymerisation of the lower unsaturated hydrocarbons.

Polymerisation and depolymerisation are therefore the two operations which the petroleum industry must investigate and establish on a firm scientific basis by research, so that it may be in a position to supply the public need for any particular form of engine which the engineer may evolve. Especially is it desirable to ascertain under what conditions polymerisation leads to the formation of aromatic and naphthenic hydrocarbons. Considerable attention has been directed within recent times to what may be termed in general the Bergius processes for depolymerising organic substances. The operation, which consists in heating the material under high pressure in the presence of hydrogen, was introduced in the first instance for the treatment of coal. There can be no question that great and fundamental changes are brought about in organic substances by the treatment whether a catalyst is present or not, and that a wide field for research is opened up thereby, but it is doubtful if, at the moment, general operations of this type can be regarded as commercial propositions. The plant is exceeding costly and the conditions subject to wide variations which are difficult to control. Actually, it has been ascertained that in the 'cracking' of the kerosene fraction of petroleum, hydrogen is unnecessary and can be replaced by nitrogen without affecting the character of the final product.

Little is known of the constituents of crude petroleum, or indeed of the fractions into which it can be separated after purification and distillation. Some of the simpler hydrocarbons of the pentane and hexane type have been isolated and the presence of cyclic compounds has been established. Many of them are classed under the head of 'maphthenes,' but these are of uncertain structure. No doubt many are present in the crude oil, but it is certain that others are formed during the distillation process. It is clear that much opportunity for research work offers itself here, and it is probable that small alterations in the method of distillation may cause deep-seated changes in the character of the distillate, causing it to be of greater service for particular purposes. The occurrence of hydrocarbons of the naphthalene series in petroleum products has also been clearly established. The higher fractions which constitute the valuable lubricating oils also need attention, for it is now certain that viscosity bears no relation to oiliness, that is, the capacity for acting as an efficient lubricator. The addition of small quantities of 'polar' substances of the type of fatty oils or acids confers increased oiliness on these compounds, and although we are now gradually reaching a stage when we know more about the effects of such ingredients, the field for research is still a large and important one.

The formation of free carbon occurs during both the distillation and 'cracking' process, in some cases to a very considerable extent. The utilisation of this carbon for the purposes of making electrodes is an important part of the industry, and the formation of carbon in a condition in which it can be used by the rubber tyre manufacturers is also likely to become practicable as an outcome of the thermal decomposition of hydrocarbons.

At present we know nothing about the structure of the hydrocarbons present in the lubricating oils. Indeed, it seems possible that these may not be long-chain hydrocarbons with which the organic chemist is familiar, but rather polymerised products formed from unsaturated components liable to be formed or destroyed under comparatively mild conditions. The relative ease with which the oil in the engine sump of a motor-car loses its oiliness through continued use is not characteristic of the stability usually associated with an organic hydrocarbon.

It is clear, therefore, that the need for systematic research into the character of petroleum products is urgent, and it is gratifying to note that the Anglo-Persian Oil Company has established a research laboratory at Sunbury-on-Thames, in which the important principles underlying the industry have been and will be studied.

DYESTUFFS AND INTERMEDIATES.

Prior to the War, Germany manufactured three-fourths of the dyestuffs required for the world's markets. Of the remaining one-fourth, one-half was made from German intermediates and was therefore dependent on Germany. Switzerland, although without a domestic source of raw materials, ranked second with about 7 per cent. of the world's production. Great Britain produced about one-tenth of her requirements, and France produced in French-owned and operated plants from 10 to 15 per cent. of her consumption. In order to meet the patent requirements of France and Great Britain, German manufacturers operated plants in those countries where the final assembling operations were completed. The small dye industry of the United States was almost entirely dependent upon German intermediates. At the present time Great Britain produces 80 per cent. of the dyestuffs required for its own use, and we are therefore in a position to review the conditions which have led to this remarkable change and to consider the procedure necessary to strengthen it.

It cannot be said that any fundamental advance in the chemistry of the dyestuffs has been made since Bohn discovered indanthrene in 1901, although great advances have been made since then in the preparation of new colours belonging to this and other known series. Consequently, the research work necessary in order to establish our position as a dye-making country has been mainly along known lines, involving the extension of reactions which had already been established rather than the discovery of new ones. Nevertheless, it is no inconsiderable achievement for our research chemists to have established a position such as that indicated above in so short a space of time, for many of the preparations, the details of which could only be found in the patent literature, had to be worked out *de novo* and the correct conditions found for their adaptation to the technical scale.

It is probably along the lines of decreased cost of production that research work in the immediate future will be mostly engaged, and especially is this the case with the intermediate products from which the dyestuffs are derived. Moreover, the intermediate products are of the greatest importance for other industries, for example, the fine chemical industry, the perfumery, and the explosives industries, and any improvement in the processes for their manufacture or the production of new compounds having enhanced value from the commercial point of view is of the greatest importance to all these industries alike. The parent substances of the intermediate products are the hydrocarbons of coal-tar or the coke-oven by-products. The operations required to convert these hydrocarbons into the finished intermediates often involve many stages, any one of which depends for its cost on the purity and yield of the product. There is thus a wide field for research into the improvement of technical methods which may well occupy the attention of our dyestuffs chemists for some time to come.

On the other hand, the question of fundamental research into new processes, both for the preparation of new intermediates and new dyestuffs, must not be lost sight of. The intermediate determines the character of the dyestuff, and it is always possible that a new intermediate may be discovered which will yield a dyestuff with just that difference of shade as to catch the public fancy, and will lead to the replacement of the older dyestuff on the market. The sulphonic acids of naphthol, naphthylamines, and amino-naphthols are cases in point. These substances are used extensively for the preparation of azo dyes. There is a great number of these compounds theoretically possible, but only a few have found technical application, owing mainly to the high cost of producing the others. The high cost is nearly always caused by poverty of yield, an objection which may be at any time removed by the discovery of an improved process. The same argument holds good for the dyestuffs themselves.

It is futile to say that the vast field of organic chemistry has been thoroughly explored for the production of new types. At any moment one or other of the men or women engaged in fundamental research may repeat Bohn's discovery of 1901, and obtain a new compound which will be the forerunner of a new series of dyestuffs. It is perhaps too much to ask an industry which is struggling to hold its own to expend large sums on the prosecution of abstract research, most of which will be of no use to it, but it is not too much to expect that the industry will take every means to foster and encourage abstract research in our university institutions, and even to give some lead as to the direction in which its experience leads it to think that advances may be made. There is at present no organisation which can bring the manufacturers of dyestuffs and intermediates into touch with the work being carried on in our university laboratories, and it is possible that if at the present time a valuable discovery were to be made it would be unrecognised as such, and, following the usual course of academic research, would be published and thus lost to the country. What is required is a lead from manufacturers which will indicate the matters which they regard of importance, but which they do not consider as likely to yield results sufficiently quickly to justify them in employing their own research staff for investigating them.

This aspect is of all the more importance at the present time, when organic chemistry is entering on a new phase which will undoubtedly revolutionise many of the existing processes of manufacture. It is now recognised that the presence of a small quantity of a catalyst may either alter the course of a reaction or may lead it to proceed to completion where otherwise a totally inadequate yield would be obtained. The catalyst may either be added or the containing walls of the reaction vessel may act in this capacity. The well-known example of the oxidation of naphthalene to phthalic anhydride by vanadium pentoxide is an example of this, but similar cases are continually recurring, and it has only recently been found that the classical method for preparing ketones by the distillation of the calcium salt of the appropriate acid can be utilised in the most unexpected directions if the thorium salt instead of the calcium salt is employed.

Francis Bacon and Scientific Method.

By Dr. C. D. BROAD.

I.

FRANCIS BACON, who died on April 9, 1626, and whose tercentenary is to be celebrated at Cambridge on October 5 of the present year, was born at York Place, Strand, on January 22, 1560/61. His father was Nicholas Bacon, Lord Keeper to Queen Elizabeth, and his mother was Anne Cook, daughter of Sir Antony Cook, who had been tutor to Edward VI. Bacon went to Trinity College, Cambridge, at a very early age; he was only fifteen when he finally went down in 1575. He was sent to France by his father, who died while he was there, leaving Bacon ill provided for. He decided to follow the career of a lawyer, and was admitted to Gray's Inn on November 21, 1576. During Elizabeth's reign Bacon had much legal work to do, and received many promises of preferment, but he was not greatly rewarded either in money or in offices. Under James I. his advancement was rapid. He rose to be Lord Chancellor and Baron Verulam in 1618 and Viscount St. Albans in 1620–21.

This was the culmination of Bacon's career. On May 3, 1621, he pleaded guilty to a charge of corruption; was fined 40,000*l.*; imprisoned in the Tower during the King's pleasure; made incapable of sitting in Parliament or holding any office of State; and banished from the verge of the Court. The King soon freed Bacon and remitted his fine; but the fallen statesman retired to his estate at Gorhambury, and devoted the rest of his life to those literary, scientific, and philosophic labours which had always been his main interest. His most important philosophical and scientific works are the "De Augmentis" and the "Novum Organum." There are in addition a great many fragments and sketches which throw much additional light on his scientific and methodological theories. Bacon died a martyr to experimental science, and might well be made the patron saint of the cold storage industry. In extremely cold, snowy weather he stopped his coach near Highgate, bought a chicken, and stuffed it with snow, in order to see whether this would preserve the meat. He caught a severe cold, which was aggravated by the damp bed into which he was put at Lord Arundel's mansion, where he had stopped for the night, and he died in his sixty-sixth year.

In order to understand Bacon's dissatisfaction with the science of his time, we must try to imagine a state of affairs in which physics and chemistry were in much the same position as psychology and sociology are now. There were various sects or schools of physicists, following various masters, wrangling with each other, and producing much heat, little light, and less fruit. Existing scientists are divided by Bacon into two classes: (1) the extreme rationalists who rush to wide general principles from a few common-place and badly analysed facts, and then profess to explain everything by means of these principles; and (2) the mere empiricists, who investigate with extreme diligence but no scientific method some small region of phenomena, and then put forward theories of the universe in terms of the small corner of it with which they happen to be best acquainted. Nothing satisfactory can be reached in either of these ways. The theories of the rationalists are more plausible than those of the empiricists, but they lead to no practical results and give us no control over Nature. The empiricists (*e.g.* the alchemists) have sometimes stumbled by chance on useful practical results. But each of these is isolated from the rest, and Nature cannot be controlled practically until its structure and laws are understood theoretically. So Bacon demands that the sciences shall be built up again from better foundations and by a new method, which shall combine the careful observation and experiment of the empiricists with the generality and systematic connexion of the rationalists. Like other philosophers of his time, Bacon made the mistake of thinking that, because a good method is necessary in order to accomplish anything, it is sufficient in order to accomplish everything. He compares it to a ruler or a compass in drawing; and, like Descartes, he thinks that it will reduce all human intellects to a level.

Now Bacon holds that science has so far failed, partly because the human mind has not had an adequate, trustworthy, and properly selected set of data to work upon, and partly because it has not applied a suitable instrument of interpretation to the data which have been available. He thinks the first defect more serious than the second; for he says that important generalisations could be gained even by the present imperfect logical processes from an adequate natural history, whilst even the most perfect logical instrument would be powerless to elicit truth from the present scanty and unreliable data. In order to remedy this evil, Bacon holds that the first necessity is to prepare the mind for collecting a proper natural history and for interpreting and generalising from this history. The mind of any grown man is a highly distorting mirror, and our first business is to plane and polish it as far as may be. The factors, innate and acquired, which cause bias and error are called by Bacon "Idols." Certain of these are common to the human race, *e.g.* the tendency to ascribe to Nature the particular kind of orderliness and simplicity which is pleasing to men. These are called "Idols of the Tribe." Others vary from individual to individual; *e.g.* some men tend to dwell on resemblances and neglect differences, whilst others have the opposite bias. These are called "Idols of the Cave." Then, again, the suggestions and associations of language are a fruitful source of error; since words and phrases embody theories which are often false and observations which are often mistaken. These are called "Idols of the Market Place." Bacon admits that these three kinds of Idol can never be completely eliminated. But we can be put on our guard, so that we allow for them and thus render them harmless. Finally, there are false systems of philosophy and science erected by bad logic on flimsy foundations. These are called "Idols of the Theatre"; and there is no reason why they should not be completely removed, partly by pointing out their fallacies and their unfruitfulness, and partly by substituting good reasoning and properly attested data.

The human mind has, however, many deficiencies as well as positive sources of error. When the latter—the Idols—have been removed, it is time to provide aids to supplement the former. The senses have two defects. In the first place, they are sensitive only for a small range of stimuli. Secondly, their deliveries are always infected by subjectivity; they tell us of things, not as they are in Nature, but as they affect a particular organism at a particular time and place. The first kind of defect can be remedied to a large extent by suitable instruments. The second can be remedied by comparison between different senses of the same observer, or the same sense of different observers. Bacon holds that the deliveries of the senses, when properly compared, criticised, and neutralised, are trustworthy, and are the only possible foundation of science.

When the mind has been thus purified and helped, it is time to give it directions for collecting a complete natural history. Bacon recognised that the actual collection of such a natural history would be a work which would take much time, trouble, and expense, and in which many men would have to co-operate. He hoped to secure such co-operation, and to confine himself to giving directions and to completing the logical principles for interpreting and generalising the facts. Unfortunately he received no help either in money or in kind, and so he was forced to collect his data for himself, a task for which he was obviously ill-fitted.

Bacon's scheme for a complete natural history was as follows. It was to consist of an account of the normal course of Nature, of abnormalities spontaneously produced in the course of Nature, and of results deliberately produced by the interference of man. Bacon attached very great importance to deliberate experiment as compared with passive observation. He also attached great weight to the observation of spontaneous abnormalities. They set us free from prejudices, and they suggest means of producing new substances and changes artificially. Bacon explicitly recognised that there is no fundamental distinction between natural and artificial products. In the history of the normal course of Nature we are not to neglect what is commonplace or to omit what is filthy. The method of selection is to be the following. Data are to be chosen, not for their intrinsic interest or for their immediate practical usefulness, but for their capacity to throw light on the structure and laws of Nature. Bacon's views on practical applications in science are admirably just. On one hand, he regards the practical control of Nature as the ultimate end of science, and ability to produce observable results as the ultimate test of any scientific theory. On the other hand, he fully recognises that Nature can be controlled practically only by being understood theoretically; and he constantly asserts that to aim directly at particular applications is fatal to pure science and short-sighted even from the point of view of practice.

Bacon gives rules for recording and arranging the data of the natural history when they have been collected. The following are the most interesting. All data that can be accurately measured should have their values recorded; where accurate measurement is impossible, upper and lower limits should be assigned. All difficult experiments must be fully and carefully described, so that others can criticise and, if necessary, repeat them. The data must be tabulated and classified from the very first. But we must recognise that at first the natural history will almost certainly contain some alleged facts which are not genuine, and that our first classifications will be partly inappropriate. If, however, the bulk of the data recorded are genuine facts, they will suffice to establish the general laws and structure of Nature; and, in the light of this, the few errors will stand out as anomalies and can be reinvestigated and corrected. Similarly, it will be necessary to return to the natural history again and again as our knowledge of the general laws and structure grows, and to reclassify the data in the light of this increased knowledge. Probably a work like Beilstein's "Dictionary of Organic Chemistry" would be a good example of what Bacon meant by a natural history. Yet of course the classification of compounds within this dictionary depends entirely on chemical theory, whilst Bacon wanted his natural history to be as free from theory as possible. The solution of this apparent contradiction is that the natural history and the theories induced from it act reciprocally and successively on each other. The first and crudest form of the natural history involves the minimun of theory and gives rise to the crudest inductions. The natural history is now corrected and reclassified in terms of these inductions. It thus imbibes an additional dose of theory, and becomes the basis for more accurate inductions which in turn react on itself.

(*To be continued.*)

Antarctic Weather.

THE recent publication of Dr. Simpson's interesting Halley Lecture of 1923 focusses attention once more on the little-known causes which are responsible for the weather of the Antarctic continent. In his lecture Dr. Simpson dealt particularly with the meteorological conditions as they affected adversely Capt. Scott's journey to and from the South Pole, and justified Scott's own view that the conditions on the last stage of the return journey were such as could not have been foreseen. This impossibility of forecasting weather conditions is of course shared by the Antarctic continent with many other regions of the earth, but there is some reason for believing that the contrasts in weather conditions from year to year and from day to day are very pronounced, at least in the region of South Victoria Land, to which area these remarks chiefly refer.

A visitor's first sight of the still active volcano forming the summit of the ice-clad Ross Island is indeed prophetic of the contrasts he will later experience; he will be no less surprised to discover that the continent, roughly circular and of radius some 1200 miles, is almost entirely covered with ice and snow, though it could, so far as precipitation is concerned, be classed almost as a desert. The general surface circulation is anticyclonic, the air flowing outward from the continent with an easterly component due to the earth's rotation. Superposed on the normal distribution of wind velocities appropriate to the anticyclone is a fairly frequent and high south-easterly wind. These blizzards are inclined to commence more suddenly in winter than in summer, and to occur more frequently during the darker months. On the floating Ross Barrier the yearly excess of precipitation over loss from the surface is only some 8 in. of solid ice, on the average. On the plateau, the net gain to the surface is probably a good deal less than this, the gain being balanced approximately by the downward flow of ice in glaciers of various types. The ice covering differs from that in other regions of the globe in that it does not melt appreciably on land and often pushes a floating 'tongue' for many miles into the sea before a point is reached where melting can set a limit to its advance. Practically the whole of the small snowfall must be formed during blizzards; it is also during blizzards that evaporation from an ice surface is a maximum, at least in the winter months.

Though possibly not in the most logical manner, this leads us to consideration of the blizzard of the western Ross Barrier—that blight of English expeditions. On account of its geographical position and the lower temperature of the Barrier, the pressure over it is higher than over the Ross Sea. This causes a preponderance of surface air-flow from the south and east, on the western side of the Barrier; any increase of this pressure difference—for example, in the form of a moving pressure wave—causes a blizzard. Simpson has indeed showed that blizzards occurred in McMurdo Sound, which lies at the north-west corner of the Barrier, when the pressure difference between that place and Amundsen's headquarters, at the north-east corner, increased; high northerly and light southerly winds, or calms, occurring when the pressure difference decreased. Even when no snow is being formed, the air during a blizzard is filled with vast quantities of loose snow scooped up from the surface, and, at the same time, the temperature generally rises. These characteristics and the gustiness of the blizzard suggest a thorough mixing of the cold surface air with warmer air above it. Blizzards may be of short duration or may last a week or longer; that during which Scott and his party perished lasted for at least ten days. The position of a party storm-bound for many days in a tiny tent is not particularly comfortable, especially when the sun is low, and one can readily imagine the earnest—even fierce—and interminable discussions which accompany the blizzard: Is a wind of 60 miles an hour and a temperature of $-30°$ F. worse or better than a wind of 50 miles and a temperature of $-40°$ F.? How much cream goes to the making of cream cheese? Is it better to sleep with the fur side of the sleeping bag inside, or with the skin side inside?

The western barrier blizzard occurs most frequently in the winter and the adjacent months. To appreciate the reason for this, it is necessary to consider the intensity of radiation to and from the surface, bearing in mind that air receives or loses heat chiefly by contact with the surface. On the snow-covered Barrier, the surface is peculiarly sensitive to radiation on account of the low specific heat and low heat conductivity of the loose snow covering, in comparison with the corresponding constants for the sea which bounds it on the north. Over the sea, convection is operative, and there is a normal temperature gradient in the air above it. The same is true over the Barrier when the inward directed radiation is sufficiently intense, the surface temperature being, however, naturally unable to rise above freezing point. When outward directed radiation predominates, the snow surface rapidly cools and an inverse temperature gradient is established in the air above, provided the horizontal air flow is not too great. This results in a large daily amplitude of temperature on the Barrier—a variation which is almost exactly in phase with the sun's altitude. In appropriate conditions, a mean amplitude of 20° F., corresponding to a variation in the sun's altitude from 10° to 30° above the horizon, has been measured, a range which equals the mean daily amplitude in India, where the sun nearly reaches the zenith and is below the horizon for almost twelve hours.

Due to the same causes, the yearly variation of temperature lags only eight days behind the sun. For the summer 1911–1912 the mean temperature on the plateau for the midsummer month was $-9°$ F., with a mean temperature of $-19°$ F. for the following month. These figures are suggestive of what is likely to occur on the plateau in the depth of winter when the temperatures on the Ross Barrier, which is almost at sea-level, fall at least to the minus seventies. Except in summer, the mean temperature of the Barrier is fixed largely by the frequency of the southerly blizzards, each of which causes a rise in temperature. The low Barrier temperatures, which played so great a part in the disaster to Scott's party, were such as could be expected to occur occasionally; what was entirely unexpected was the length of the cold spell, or, in other words, the unusual paucity of blizzards in late February and March. When the blizzard did come, it was of unusual duration and came at a critical time, when the party was within eleven miles of One Ton Depôt.

March and April are probably critical months, since the formation of a permanent winter ice covering in McMurdo Sound seems to be conditioned largely by its ability to reach a sufficient thickness between blizzards, before the winter weather sets in.

Travel on the Barrier at a time when the sun is setting, or has set for the winter, is indeed an unpleasant business, and considerable advantage is gained by choosing a time for the commencement of a long journey so that Christmas falls practically in the middle of the period. Apart from the necessity of avoiding the bad weather of the autumn, one should strive by this means to avoid the bad sledging surfaces associated with low temperatures. We have no quantitative information about the relative friction at temperatures about and far below 0° F., or in fine and coarse-grained snow, but the differences are known to be very important, and the great wear of the sledge runners is quite sufficient indication of the increased friction at really low temperatures. On cold, freshly-fallen snow of a 'floury' consistency the effort of hauling is so great that one has the feeling that the friction is a friction, not between snow and runner, but between adjacent snow grains.

Much more data are required before the weather of the Antarctic can be known in more than its broad outlines—data which can only be gathered by concerted action and by the permanent occupation of temporary observatories. The present poverty of the country is such that no well-found expedition is likely to be launched in the near future, but the time will come when further information will be urgently required, and this will be the time for insisting on the importance of such conditions as will obtain the fullest scientific value for money expended. It is hoped that the Scott Polar Research Institute, the formal inauguration of which has recently taken place at Cambridge, will have some influence in determining questions of this nature. C. S. W.

Obituary.

Prof. F. W. Gamble, F.R.S.

A distinguished English zoologist, a remarkably fine teacher and a man of a singular charm of character, has been lost to science by the death, on September 14, of Prof. Frederick William Gamble, Mason professor of zoology and comparative anatomy in the University of Birmingham. He was born in Manchester on July 13, 1869, and was educated at the Manchester Grammar School and at the Owens College. At the College he came under the influence of the late Prof. A. Milnes Marshall, and catching his enthusiasm for the study of animal morphology, devoted himself to zoological studies. After taking his degree with first-class honours in the newly established Victoria University and gaining the Bishop Berkeley research fellowship, he went abroad and studied for a time in the University of Leipzig. The first two papers from his pen, one on our rare British Nudibranchs, published in 1892, and the other on the British marine Turbellaria, published in 1893, were descriptive and systematic in character, but already they showed evidence of the tendency of his mind towards the experimental side of the subject.

After a short period as a junior demonstrator, Gamble was made lecturer and senior demonstrator in zoology in the University of Manchester, and in 1896 he completed his account of the flatworms and Mesozoa for the "Cambridge Natural History," a most interesting and valuable contribution to that excellent text-book. It was about this time that the lug-worm (Arenicola) was introduced as a type in the schedule for the first M.B. examination of the Victoria University; and finding from laboratory experience that the current accounts of the structure of this worm were inadequate and in many respects inaccurate, Gamble and his colleague J. H. Ashworth prepared and published in the *Quarterly Journal of Microscopical Science* a very careful and elaborate description of its anatomy. This study led to the important discoveries by Ashworth, at a later date, of the structure and function of the giant nerve cells and nerve fibres of the Polychaeta.

While the work on Arenicola was still in progress, Gamble's interest was attracted to the colour changes in the 'Phantom' shrimp *Hippolyte varians*, and, working now in partnership with a colleague in the botanical department, Mr. (now Sir Frederick) Keeble, a series of experiments were made at the fisheries' station at Piel which led to very interesting and remarkable results. The discovery of a blue nocturnal phase in all the colour varieties of this shrimp was in itself a novel and startling fact, but when the researches were extended to the higher forms of Crustacea, many other very important systematic and physiological results were obtained. In 1903 another paper by the same authors, working on the coast of France, appeared in the *Quarterly Journal of Microscopical Science*, on the bionomics and physiology of the remarkable turbellarian worm *Convoluta roscoffensis*, in which it was proved that the green corpuscles of the Convoluta represent a phase in the life-history of a flagellate organism allied to the genus Carteria, and that this organism infects the eggs after they are laid. It is not an exaggeration to say that this study in symbiosis has become one of the important classics of the subject. It is frequently referred to by later writers as the chief authoritative statement on the physiological relationship of host and guest.

It is not possible in this place to refer in detail to other scientific work Gamble did when this partnership was dissolved. It was characterised by the same love of the experimental method, accurate observation, and cautious deduction that was shown in his earlier writings.

With all his love for scientific research Gamble combined all the great qualities of a conscientious and explicit teacher. He spared no pains to make his lectures and demonstrations effective, with the result that he earned the respect and gratitude of a large number of his pupils and colleagues. In the two admirable little books which he published, "Animal Life" and "The Animal World," he has left some indication of the way in which he presented the problems of biology to an unscientific audience; and his account of the Radiolaria in Lankester's "Treatise on Zoology" shows his power of mastering the literature of a large subject and presenting the substance of it in an intelligible way to the more advanced student.

By the death of Gamble many of us have lost a most sincere and devoted friend. His quiet, modest manner, his constant readiness to help his colleagues and his pupils, and his unblemished character, endeared him to a wide circle of friends and acquaintances. He was elected a fellow of the Royal Society in 1907 and appointed professor of zoology in the University of Birmingham in 1909. He was president of Section D of the British Association at the Toronto meeting in 1924, where he delivered a very interesting address dealing principally with the question of the metabolic gradients.

Gamble married, in 1904, Ellen, daughter of the late Rev. J. M. Bamford, of Arnside, who survives him. He left no children.

We regret to announce the following deaths:

Prof. Rudolf Eucken, from 1874 until 1920 professor of philosophy in the University of Jena, and author of many works on philosophy, on September 14, at eighty years of age.

Dr. Paul Kammerer, of the Biologische Versuchsanstalt, Vienna, known for his experimental work on the inheritance of acquired characters in amphibia, on September 23, aged forty-five years. [He committed suicide under peculiar circumstances].

12/x/26

News and Views.

THE report of the Government Chemist upon the work of the Government Laboratory for the year ended March 31, 1926 (London: H.M. Stationery Office, 1926; 1s. 6d. net), though mainly a statistical document, is a standing witness to the value of this adjunct to the Government services. Unlike their medieval predecessors, Sir Robert Robertson and his merry men are not called upon to produce gold from base metal, to read the stars and to cast horoscopes; their task is the more prosaic but far more practical one of safeguarding the revenue and, to a certain extent, the health of the country, by means of chemical tests. Their work, however, extends beyond this, for in addition to serving the Board of Customs and Excise, the Board of Trade and the Ministry of Health, they do much chemical work for other Government departments, such as the Ministry of Agriculture and Fisheries, the Air Ministry, the Office of Works, the War Office, the Post Office, and the Inland Revenue. Not content, apparently, with these primary duties, the comparatively small staff of the Government Laboratory undertakes occasional research work of no mean importance, and provides representation on a number of scientific committees. Chemical analysis is, however, its main activity, and the number of samples analysed during a year, no less than their diversity, inspires us with a feeling of profound respect, if not of awe. During the year 1925–26, no fewer than 445,606 samples were examined, of which more than 110,000 related to beer and brewing materials, 106,395 to wines, 48,587 to spirits and spirituous preparations, 72,289 to tobacco, 61,003 to sugar and sugar products, 39,391 to tea, and 13,128 to cocoa and chocolate. The number of samples of imported beer, cocoa-goods, and imported spirits and spirituous preparations was considerably in excess of the number analysed in 1924–25.

THE work of the Government Laboratory indicates in no uncertain way the trades that are especially marked out to bear the burden of taxation, and it also reflects important changes in legislation. Thus in the year 1924–25 no samples of silk were examined in the Laboratory, but last year, following the imposition of duties, 12,237 samples were taken and tested, of which 10,313 were from imported materials, 1803 from exports, and 121 from home factories. Developments, industrial and fiscal, in the Irish Free State have been responsible for recent fluctuations in the number of tobacco samples examined. The Safeguarding of Industries Act necessitated the examination last year of 9645 samples of imported goods, whilst the Dyestuffs Act accounted for 195 samples, as compared with 535 in the previous year. Although mainly of interest to the analytical chemist, the report contains many items that will appeal to the student of affairs, and the layman's perusal of it leaves the impression that on the score of impurities and adulterations, the public have little reason to complain. From the large number of miscellaneous samples examined for the Post Office, it is interesting to note that, although 'gold thread' figures in the list, there is no reference to 'red tape'; analyses of lubricating oil for H.M. Stationery Office suggest a welcome acceleration of motion in that department; and the recovery of radium from disused compass-dials, gun-sights, etc., for the Treasury evokes memories of a war, and of a Damocletian weapon in the form of an axe that never fell.

A BRIEF Reuter message from Batavia in the daily press of September 27 announces the discovery by Prof. Heberlein of what is said to be a complete skull of the type *Pithecanthropus erectus*, the well-known Java skull. The discovery was made at Trinil, the village near which Dubois in 1892 found the skull-cap, thigh bone, and two teeth, to which the name *Pithecanthropus erectus* was given and about the human character of which so much controversy has since raged. Should later detailed information confirm the character of the new find, its importance will amply reward the patience, time, and money which have been expended, since Dubois' discovery was made known, on searching the neighbourhood for further relics of this earliest known and most primitive of the human types. Dr. Aleš Hrdlička, the American anthropologist, on his return last year from an anthropological tour of the sites on which relics of early man have been found, pointed out the importance of an early investigation in Java, where he had seen in the hands of natives an abundance of relics of man, apparently of considerable antiquity, which were being lost to science. It is therefore gratifying to note the announcement that the American Museum of Natural History intends to raise funds to carry on the work of excavation.

THE sixth (interim) report of the Sea Action Committee of the Institution of Civil Engineers is dated October 1925, and deals with researches carried out in 1924 or early in 1925. Its publication by the Stationery Office in September 1926 cannot therefore be called premature. The report contains summary reports on the periodical examinations of the steel test-pieces exposed at various harbours, but it is pointed out that "no really definite results can be expected until the bars are taken up for final examination." The experiments on painted specimens are also at an inconclusive stage, but the results are fairly consistent in showing that some of the paints are decidedly better than others. The biological work carried out for the Committee consists in series of experiments on the toxicity of various compounds to Teredo larvæ and to adult Limnoria. It is concluded that "substances that are toxic to Teredo do not necessarily confer any very high degree of protection against Limnoria." No comment is made on the discrepancy between this result and that obtained by the American Committee, the report of which, published in 1924 and summarised at the end of the present one, states that "the toxicity of the various compounds was approximately the same" for Limnoria and for the Teredinid Bankia. Prof. Barger reports that experiments by Dr. C. M. Yonge at Plymouth have shown that organic arsenic compounds of the type of D. M (phenarsazine) are the most effective in poisoning the larvæ of Teredo. Tests on adult Limnoria at Edinburgh by Dr. F. D White proved that it was not specially susceptible to organic arsenic compounds, the most effective substance being fluorenone, which, however, is too expensive for practical use Dr. Yonge found that the poisons had no repellent effect on the Teredo larvæ, which settled as readily on wood impregnated with D. M. as on untreated wood, although in the former case they were speedily killed by the poison.

THE paper by Dr. Huber-Stockar, formerly chairman of the electrical department of the Swiss Federated Railways on the Electrification of Railways, which was read to the World Power Conference at Basle, is of interest at the present time. Dr. Huber-Stockar points out that when a railway is once electrified it never returns to steam traction At first sight it is difficult to understand why so many railway companies are hesitating whether to adopt electric traction or not. The delay is due partly to economic considerations Electrification involves expenditure, and this expenditure is not justified unless the traffic increases. Every new capital expenditure makes the railway more sensitive to a decrease in traffic. Electrification on a modest scale has not much effect on the prosperity of the railway. The hesitation of railway companies is also partly due to the difficulty in deciding which system is the best. State owned railways are as much interested in economic considerations as privately owned railways. In Europe a number of countries have experienced beneficial effects from electric traction which have justified its adoption. Favourable factors for changing to electric traction are cheap electric power and expensive coal and manual labour. The conditions are also favourable when the traffic is heavy and the gradients are long and steep. Dr Huber-Stockar concludes that no definite and easily applied rules can be given for determining whether a railway is ready for electrification or not. It would be a great help to engineers if details of installations and working results were always given in similar forms, so that they could be readily compared.

THE excavations at Beisan of the Palestine Expedition of the University Museum, Philadelphia, which were resumed on August 24, have already produced finds of importance in throwing light on the extension of Cretan influence in this direction. In the *Times* of September 23, Mr Alan Rowe, field director of the Expedition, records the discovery of cult objects, one a cylinder terminating in a pig's head, which is compared with and closely resembles a Cypriote vase, a basalt model of a chair of Minoan type, and a model of a table, also of Minoan type. The chair, although Cretan in form, bears Egyptian emblems—a winged Set animal, a vulture with outstretched wings, and the *ded* pillar emblem with arms and hands holding the Sign of Life. These finds, taken in conjunction with those of 1925, which, however, were of later date, point to a strong Cypro-Mycenæan influence in the religion of Beisan from 1375 B.C onwards, of which the final phase was the Philistine domination ended by David about 1000 B.C. A bronze axe-head with a blade at one end and four curved prongs at the other, is similar to an axe-head held by a king figured on the gate of the Hittite capital in Anatolia. This would accord with the fact that about the time this temple of Amenophis IV. was being built the Hittites were advancing in northern Syria The discovery of faience objects bearing the cartouche of Amenophis III. below the level of the floor of the temple confirms the attribution of this building to Amenophis IV. (1375–1358 B.C.).

AT the recent meeting of the British Association in Oxford, a registering balloon ascent was made by the Meteorological Office from the quandrangle of Keble College, in the presence of the guests assembled for the Meteorological Luncheon held on August 10. The balloon and meteorograph fell at Caxton, near Cambridge, a distance of 94 km, N E. by E The balloon reached a height of 20 1 km. before bursting The meteorograph employed was a light barothermograph without clock, but it is possible to infer from the known approximate vertical velocity of the balloon that the total time of flight from ground to ground again was about 1½ hours. This indicates an average horizontal velocity of about 18 m. per second. The balloon was seen to enter a cloud of mammato cumulus form at a height of about 1½ km; the record shows a small lapse rate of 4° per km. just below that height. From this point upward to 3 0 km. the atmosphere was in a slightly unstable condition with regard to saturated air; then there occurred traces of a reduced lapse rate, while above that again slight instability prevailed up to 7 km It is probable that 3 km. marked the upper limit of the clouds seen from the ground The stratosphere was found at 9 9 km., with a temperature of 231° Abs, and above that not more than 2° change of temperature, plus or minus, occurred at any point up to the maximum reached. The ascent was made in the south-westerly current to the south-east of a depression centred south-east of Iceland, with a gradient wind of about 8 m. per second.

A FUND for research fellowships, to be known as the "Eric Knight Jordan Research Fellowships in Geology," has lately been established by Dr. and Mrs David Starr Jordan as a memorial to their son, who died on March 10 last. This fund is to be administered by the Stanford University, of which Dr. Jordan was the first president. The founders attach two conditions to the gift: first, that their son's name shall be perpetuated in the foundation; and secondly, that the principal sum shall be forever kept inviolate, only the interest thereon being used. The founders as an initial step have contributed a sum of about 1000*l*, but expect to add to this later on, and invite friends of their son to contribute also E K. Jordan in his all too short life (1903–1926) had shown great promise. No less than eleven important papers stand to his name, all published in the last six years. Beginning with one on recent mollusca, followed by a temporary digression into the subject of Hawaiian fishes, the remainder are concerned with the tertiary and quaternary molluscan faunas of localities in Lower California and Mexico, or expeditions in connexion therewith.

Profs. H. Benndorf and V. F. Hess are at present engaged in writing a comprehensive treatise on "Atmospheric Electricity and Allied Phenomena," to be published next year. As is well known, the funds available for the libraries of the Austrian universities are far from adequate, and it is extremely difficult to maintain scientific journals, especially the bulletins and proceedings of scientific institutions and societies of foreign countries. Profs. Benndorf and Hess write asking physicists and meteorologists in all English-speaking countries to send them reprints of their publications. Papers are required on atmospheric electricity dealing with the electric field of the earth and atmosphere, atmospheric ionisation, electricity of thunderstorms, electric properties of rain and snow, radioactivity of the earth and atmosphere, rays of cosmic origin, electric currents in the atmosphere, the aurora, theories of the origin of electro-atmospheric phenomena, and propagation of electric waves round the earth. Any reprints on these subjects would be gratefully received; they should be addressed to Prof. Benndorf or Prof. Hess, Physikalisches Institut, Universität, Graz (Steiermark), Austria.

During the past summer Prof. G. F. Sleggs, professor of biology at the newly established Memorial University College of Newfoundland and oceanographer to the Newfoundland Government, a former graduate of the Oceanography Department of the University of Liverpool, has carried out biological and hydrographical research in Bonavista Bay, Trinity Bay, Conception Bay, and other important Newfoundland fishery grounds. Samples of water have been obtained from a wide area and from accurately known depths for a study of plankton and temperature variations. A drift bottle experiment has also been carried out, a satisfactory proportion of the bottles having already been recovered. The work is in co-operation with the North American Committee on Fishery Investigations and is the first of its kind to be officially supported by the Newfoundland Government.

Among many brightly written and well illustrated articles in the *Scientific American* for September is one on the decreasing level of the great lakes. From a diagram, showing the variations in level of Lakes Huron and Michigan from 1860 to the present year, it would appear that apart from minor fluctuations a general lowering of level set in about 1890, after which the level has never reached previous maxima and has generally stood well below previous minima. Since 1909 the level, with one or two exceptions, seems to have been steadily falling. It is now about two feet lower than it was in 1860. The Chicago drainage canal, which was opened in 1900, has a flow of 8800 cubic feet a second, while other canals and artificial outflows from Michigan, Huron, and Erie account for 57,000 cubic feet a second. It is, however, pointed out that during the period 1917–1925, while the lakes stood at their lowest level, the rainfall deficiency over the lakes and their drainage area was at least two inches a year, and in some areas in certain years rose to six inches. Thus it is by no means certain that canal construction has been entirely to blame in robbing the lakes of water, though, if the decrease continues, the construction of weirs will become necessary.

In view of the recent discussion at the British Association, attention may be directed to a brief historical review of the question of the species concept by Fridthjof Okland in *Naturen* (1926, pp. 75-87). From this he draws the following conclusion: "Even if we realise how uncertain the species concept is, biologists can and must continue to work with some such delimitation of forms. At the same time the obvious hopelessness of finding any biological concept of the species that shall be universally applicable gives distinct proof that the limits between forms are often more apparent than real. Our classification does not always give a true picture of relationships and connexions in living Nature." On which one is impelled to ask: Can it, and should it?

The twenty-fourth annual report of the Rhodesia Museum, Bulawayo, for 1924, records the appointment of Mr. A. Frost to the post of geologist, vacant since 1915. Mr. Frost arrived soon after the discoveries of platinum ore in the Transvaal and found his time almost entirely occupied in reporting on samples submitted by prospectors. A special platinum exhibit was arranged, illustrated by maps and sections. A platinum panning, supplied by Mr. Milligan, of the Anglo-French Exploration Co., is available for prospectors to see and 'tail out' for themselves. It is to be hoped that some of the many who receive assistance will become members of the Museum, which is so poor that it does not possess even a rock-cutting apparatus.

The Meteorological Department of the Government of India issued during the early part of August a forecast of the probable amount of rainfall during August and September, together with a memorandum on the rainfall experienced in June and July. The monsoon was very weak in June but normally active in July. The June rains were generally in defect, but in July there was a marked improvement. The inferences from the data most likely to have influence on the rains of August and September, show that the monsoon rainfall of the two months is likely to be normal in north-west India and normal or in excess in the Peninsula. Forecasts which are required by the Indian Government were issued by Mr. J. H. Field, Director-General of Observatories.

The Atlantic weather, which has been brought to general notice more than usual of late by the disastrous hurricane in Florida and the West Indies, is thoroughly discussed in the *Marine Observer* published by the Meteorological Office, Air Ministry.

The issue for October deals with wind and fog at coast stations in the British Islands and in the south-west approaches to Great Britain and Ireland. It is concerned also with the sea temperature over the North Atlantic computed from observations for the period 1855 to 1917. In the south-west approaches to Great Britain, by far the greatest frequency of fog and mist occurs with easterly and south-easterly winds, while on the coasts of England the greatest frequency in October occurs on the south-west and east. The sea temperature around the coasts of Great Britain in October is 10° to 15° warmer than in a corresponding latitude on the American side of the Atlantic. The Meteorological Office is dependent on the Admiralty and the mercantile marine for its observations, and the present issue of the *Marine Observer* especially asks for observations in tropical revolving storms. Observations of hurricanes, cyclones, and typhoons are required from as many ships as possible in the vicinity of these storms for the development of the "Laws of Storms."

Dr. S. G. Barker, head of the Physics Department of the British Research Association for the Woollen and Worsted Industries, has been appointed Director of Research in succession to Mr. H. J. W. Bliss, who has resigned.

A correspondent writes advocating the use of the word "bioplasm" to denote living protoplasm; "protoplasm" without an adjective would then denote dead protoplasm. We see little advantage in the suggestion: it would merely encumber biology with another superfluous technical term and introduce an element of uncertainty for future readers into the interpretation of a vast mass of biological literature.

The Chemical Society will hold its first ordinary scientific meeting this session on Thursday, October 21, at 8 p.m. At the following meeting, on October 28, the lecture founded in memory of the late Dr. Hugo Müller will be delivered in the lecture theatre of the Institution of Mechanical Engineers at 8 p.m., by Prof. S. P. L. Sorensen, of Copenhagen, who has chosen as his subject: "The Composition and the Characterisation of Proteins."

The inaugural sessional address of the Pharmaceutical Society of Great Britain will be delivered by Dr. J. F. Tocher, University of Aberdeen, on October 6. The address will follow the presentation to Mr. J. G. Jones of the Pereira Medal. This is a silver medal provided and endowed out of the proceedings of a fund raised by subscription in 1853–4 as a memorial to the late Dr. Jonathan Pereira, a former professor of materia medica of the Pharmaceutical Society. The promoters of the fund resolved "that the medal should be awarded as a prize for researches or proficiency in Materia Medica," and it is presented annually for competition among the students in the advanced course in the Society's School.

The publication of a golden jubilee number of its journal, entitled "A Half-Century of Chemistry in America, 1876–1926," marks the commemoration of the fiftieth anniversary of the American Chemical Society. The origins and developments of the Society are described by members who were themselves present at the first meetings, among the earliest being the Priestley centenary, which was held at Northumberland, Pennsylvania, on August 1, 1874. The journal contains reviews of the contributions made by American chemists to the various branches of chemistry, and it is illustrated by photographs of those who have been officers of the Society during its fifty years' existence.

The present number, vol. 10, part i., of the *Annals of the Royal Botanic Gardens, Peradeniya*, also forms Section A (Botany) of the *Ceylon Journal of Science*. The *Annals* will thus appear in future in this new form but there will be no break in the series and no change editorially. The *Ceylon Journal of Science* has been established by the Ceylon Government, and in the first instance will consist of seven sections, namely, A, botany; B, zoology and geology (*Spolia Zeylonica*); C, fisheries (the *Bulletins of the Ceylon Fisheries*); D, medical science; E, mathematics, physics, and meteorology (including *Bulletins of the Colombo Observatory*); F, chemistry; G, archæology, ethnology, etc. Each section will be a separate publication with its own editor, appearing independently and with separate pagination.

The Royal Botanic Gardens, Kew, and the British Museum (Natural History) continue to issue excellent sets of coloured post-cards which form in many respects complementary series. Kew provides illustrations of striking plants in cultivation; the new series include stove and greenhouse plants, roses, orchids and decorative plants, and the cards show, often very beautifully, the characteristic habit of the plant, sometimes in its typical position in the garden, sometimes in its natural habitat. The British Museum cards are confined to British plants; they are more formal in character, but very clear, and add illustrations of characteristic floral features as revealed by dissection. Both series should help to disseminate more widely a knowledge of flowering plants, garden favourites as well as interesting native plants. The British Museum series includes two sets (each set contains five cards) illustrating British orchids.

Applications are invited for the following appointments, on or before the dates mentioned:—An organiser of agricultural education for the Administrative County of Cambridge—The Clerk of the County Council, County Hall, Cambridge (October 18). An assistant naturalist in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary of the Ministry, 10 Whitehall Place, S.W. 1 (October 18). A junior technical officer in the Ignition and Electrical Department of the Royal Aircraft Establishment—The Superintendent, R.A.E., South Farnborough, Hants (October 23, quoting A. 126). A senior lecturer in economics in the University of Cape Town—The Secretary, Office of the High Commissioner for South Africa, Trafalgar Square, W.C.2 (October 30). A lecturer in the department of physics of Transvaal University College—The Registrar, Transvaal University College, Pretoria (October 31). Male investigators in industrial psychology, having had training in experimental psychology—The Secretary, National Institute of Industrial Psychology, 329 High Holborn, W.C.1. A lecturer in electrical distribution and an instructor in machine drawing at Goldsmiths' College—The Warden, Goldsmiths' College, New Cross, S.E.14 An assistant in the physiology department of the University of Edinburgh—The Professor of Physiology.

Our Astronomical Column.

MARS.—Mars is drawing near to opposition; it will be nearest to the earth (distance 42¼ million miles) on Oct. 27, in North Declination 14° 52′. The distance will be 8 million miles greater than in 1924, but this is far more than offset for European observers by its being 32° farther north Observations have already begun, but no results have yet been published

M E. M. Antoniadi gives in the August issue of *L'Astronomie* a new map of the planet, based chiefly on his own observations made with the great Meudon refractor between 1909 and 1924. He rejects the narrow rectilinear network of canals, and those shown on his map are represented as broad diffused shadings. A very large number of round dark markings (the *luci* of Lowell) are shown: there are six on the Lacus Solis, and five more on the bands connecting it with the neighbouring dusky regions. This region of the planet appears to be specially unstable, since the drawings at different oppositions show notable discordances. It should be specially scrutinised at present. M. Antoniadi gives an interesting drawing, made at the suggestion of the late M. Camille Flammarion, showing the aspect of the planet from Phobos, the inner satellite. The planet subtends an angle of 42° from Phobos, and consequently a zone 22° in radius at each pole of Mars is permanently hidden. Also only 136° of the equator is visible at once, and the centre of the disc is seen under a much larger scale than the edges, since it is 2000 miles nearer. These points have been carefully attended to in the drawing, which is very instructive. The planet would appear to rotate in the opposite direction to its real rotation, owing to the rapid orbital movement of Phobos; the terminator would move quicker than the markings in the ratio of three to two (about).

SUNSPOTS AND MAGNETIC STORMS.—The August number of the *Publications of the Astronomical Society of the Pacific* gives an abstract of a paper by S. B. Nicholson on "The Magnetic Classification of Sunspots associated with Terrestrial Magnetic Storms." The author, working from data collected at Mt. Wilson, states that the spots which synchronise with the occurrence of magnetic storms are usually those with complicated magnetic polarities, classified as γ or $\beta\gamma$. Moreover, in most cases where there is a large spot and no corresponding magnetic disturbance, the polarities of the spot or group of spots are generally found to be unipolar or bipolar with regularly distributed polarities. These are interesting results which promise to go far in explaining some of the anomalies met with in the study of these two phenomena, the general relationship of which is so well established.

As mentioned in NATURE last week (p. 459), a large group of sunspots crossed the sun's central meridian on September 19. Two days later a marked magnetic disturbance was registered by the Greenwich magnetographs. There was, however, no sudden commencement, characteristic of magnetic storms, but at the culmination of the disturbance at about 6 hr. on Sept. 21, the declination magnet was nearly 40′ from its normal position. At this time the centre of position of the two sunspots was 1·7 days or 22° west of the central meridian. It may be noted that the leader spot of the group, which approximated in type to those commonly found to be bipolar, showed considerable changes of structure suggestive of complicated magnetic polarities. The Mt. Wilson observations of the polarities of this group of spots may be expected to appear in the December number of the *Publications of the Astronomical Society of the Pacific*.

ABUNDANCE OF FIREBALLS.—Mr. Denning writes that between Sept. 12 and 20 as many as seven fireballs were observed from various parts of England. On Sept. 12 one was seen from Bristol in Lyra, shooting from a radiant at 290° + 54°. On Sept. 15 a meteor twice as bright as Jupiter was noted from Oswestry with path from 340° − 17° to 328° − 27½°. It left a bright streak for twenty minutes. On Sept. 17 a splendid object was visible from near Bristol, Sheringham, and Whitstable. It exhibited an exceptionally long course, for the observer at Sheringham saw it come up apparently from beyond the crest of the North Sea, while the one at Whitstable followed it until it disappeared on the horizon of the English Channel or Normandy in France. The path must have ranged over 600 or 700 miles; radiant on north-east by east horizon. On Sept. 18 a fireball was noticed in the eastern sky from Faversham, Kent, and on Sept. 20, at 1^h A.M. G.M.T., another was viewed from London, which the observer described as falling like "a large drop of molten metal." On Sept. 20, at $19^h\ 2^m$ G.M.T., a splendid meteor was seen from Weymouth; Bude, Cornwall; Bruton, Somerset; Downend, near Bristol, and other places. It emanated from a radiant at 60° + 36° and pursued a lengthy flight of about 320 miles from above the North Sea about 90 miles east of Bridlington to 25 miles south of Portland Bill in Dorset

THE NORMAN LOCKYER OBSERVATORY.—The report of this Observatory for the year ended on March 31 last begins with a weather analysis which shows that the number of clear nights was 165, being 32 in excess of the preceding year.

The 12-inch prismatic camera on the Frank McClean telescope was used for obtaining stellar spectra for classification and parallax work. The classification is now automatic, being based on numerical measures of line intensities. The parallax work has been on the B stars; it is based on a revised classification of spectral type, combined with estimates of the width and character of lines. Several photographs of Mira Ceti were obtained near the maximum last December, when the magnitude was 3·1. The next maximum will be on Nov. 4, when the star will be nearly in opposition with the sun. This telescope was worked chiefly by Mr. Edwards.

The 9-inch prismatic camera on the Kensington telescope was worked by the Director, Dr. W. J. S. Lockyer. Special attention was given to stars with bright hydrogen lines. The interesting star ϕ Persei, of type Bope, was followed for an entire period, 110 photographs being secured on 79 nights between Sept. 9 and Jan. 13.

Prof. Sampson of Edinburgh has tested the method of producing widened spectra by using a clepsydra for moving the plate. He finds that the widened spectra are as trustworthy as the original ones and much more convenient for measurement.

Research Items.

Ancient Bronze from the Transvaal.—At the meeting of the South African Association for the Advancement of Science held at Pretoria in July last, Mr. Percy Wagner presented a communication on the making of bronze by the ancient inhabitants of the Transvaal, which is published in the *South African Mining and Engineering Journal* of July 26. Tin mining and smelting were practised by an unknown people in the Transvaal long before the advent of the whites. Some years ago a lump of bronze was found alongside a furnace on a farm, Blaauwbank No. 433, about 40 miles west of Warmbaths. The bronze was remarkable in that it included 3 per cent. nickel and 2 per cent. arsenic. Some regarded this bronze as an accidental product due to the reduction of a composite ore; but a recent discovery has placed it beyond question that the ancient miners deliberately set out to make bronze. Recently on the same farm, Blaauwbank No. 433, have been discovered near a dry watercourse, thirty distinct smelting furnaces, with hand-cobbed tin and copper ore alongside. 'Slugs' and 'frills' of bronze were found in the furnaces. In regard to the presence of nickel in the bronze, there is at Blaauwbank a nickel lode carrying at the outcrop masses of apple green 'nickel-bloom' which remotely resembles malachite. The accidental introduction of this material may have led to its continued inclusion intentionally when its special qualities had been appreciated. The point is one of considerable archæological interest, as it is stated that no other ancient mines are known that could have furnished in one locality the ores for producing a nickeliferous bronze, and a nickel-bronze was known and in use in early Mesopotamia and Egypt.

The Family 'Trinity.'—In *Man* for September, Prof. Radcliffe-Brown puts forward an interesting theory to account for the relations of father, mother, and child in the primitive family. It has been pointed out that the natives of Muruа (New Guinea) regard the incidence of childbirth as in the nature of a welding of personalities—a trinity of father, mother, and child. But this same conception is found among a great many primitive peoples. In the Andamans, for example, the family does not really exist as a properly constituted group until the birth of the first child—the relationship between husband and wife is not simply created by marriage. It is illustrated by teknonymy, the custom whereby one of the spouses addresses the other as "mother of," "father of" the child. The imposition of a special taboo points in the same direction. It differentiates the family as a group. It is only the first child that counts, the later born children being regarded as multiples of a single personality. This principle operates also in the polygynous family, where either the wives are, like the children, multiples of a single personality, especially if they are sisters, or the husband is separated into a number of units, each with a wife and her children—the form typically taken by the polygynous family in Africa. The other method, however, may be adopted there also, when a man marries two sisters, or where a wife is childless and another wife is obtained to bear children. The same principle applies to polyandry, but only when the husbands are brothers.

The Tabanidæ of the Canadian Prairie.—The biology of the blood-sucking flies belonging to the family Tabanidæ forms the subject of a recent paper by Prof. A. E. Cameron in the *Bulletin of Entomological Research* for July 1926 (vol. 17, Part I.). Hitherto most of what is known concerning these insects in North America has emanated from the United States, and information concerning the Canadian forms is very meagre. The genus most abundant in species is Tabanus, its most prevalent member being *T. septentrionis*. Of the genus Hæmatopota there appears to be but a single representative, *H. americana*, while the most abundant species of Chrysops is *C. mœrens*. Previous to the settlement of western Canada, the principal hosts of Tabanidæ were the larger game animals. The moose, deer and elk are still to be found in the northern regions where the white settler has not penetrated, and, along with the barren-ground caribou, these animals are the chief native hosts of prairie Tabanidæ to-day. In cultivated districts they attack live-stock and human beings indiscriminately. The theory that Tabanidæ are the insect-transmitters of infectious anæmia of horses appears to be very uncertain and requires critical investigation, as the disease may be rife on one farm, while on adjacent farms, which enjoy apparently similar environment, the animals may be devoid of any symptoms of the complaint. Tabanidæ are well known to be strong fliers, and if they do convey the disease it would appear that not all horses are equally susceptible to infection. Prof. Cameron discusses the technique of rearing the larvæ of these insects, and describes and very clearly figures both the larvæ and pupæ of a number of species.

New Plant Illustrations.—In *Curtis's Botanical Magazine*, vol. 151, part iii., Dr. Stapf figures and describes nine new Asiatic plants now in cultivation, namely, *Actinidia kolomikta*, *Rhododendron saluenense*, *Jasminum Beesianum* (which bears beautiful glossy black berries in cultivation in England), *Polygonum campanulatum*, *Pyracantha atalantioides* figured in flower and *P. yunnanensis* in fruit, *Primula siamensis*, *Berberis lycioides* which has the additional attraction for the cultivator that its decorative 'barberries' make a delicious jam, and *Fritillaria Olivieri*. In addition, a Spiranthes is described from the Argentine, a beautiful Cordyline from New Zealand, a Mammillaria from Mexico and a Mesembrianthemum from South Africa, but this distribution of the new records of cultivated plants shows the preponderating influence of new introductions from Asia in our gardens at present.

Burr-Knots on Apple and Crown Gall.—Certain varieties of apples have on their stems, generally at nodes, tumour-like swellings which sooner or later pass over into a crowded mass of wart-like projections. Some of the apple stocks most frequently used in England bear these 'burr knots,' and such stocks have been forbidden entry into the United States under the assumption that these structures were a form of a pathological condition known as 'hairy-root,' which has been found to be associated with the crown-gall organism *Bacterium tumefaciens*. Probably all British workers will, however, endorse the conclusions of R. G. Hutton, H. Wormald and A. W. Witt, in the *Journal of Pomology and Horticultural Science* (vol. 5, No. 3, July 1926), that these structures indicate the position of dormant, stem-borne root initials, and that if placed under moist conditions they will readily give rise to roots. One American worker, C. F. Swingle, has recently published a similar view, and the British workers publish a useful bibliography of earlier references to these structures, which, however, omits the important paper by Dr. A. W.

Borthwick (*Notes from Royal Bot. Gard., Edinburgh*, vol. 16, 1905), in which valuable anatomical data are supplied. Dr. Borthwick's paper supplied practically conclusive evidence that these structures were really root initials, but in view of the American point of view, it is good to have this later confirmation that all attempts to isolate a pathogenic organism from burr-knots have given negative results.

STATISTICS OF FIELD EXPERIMENTS IN AGRICULTURE.—The growing importance of field experiments in agriculture has led to the development of technique for eliminating errors of experimentation, and R. A. Fisher (*Journ. Minis. Agric.* 33) has investigated statistically the relative value of different methods of arranging field plots. A valid estimate of error can be obtained by finding the standard error, the square root of the variance, and a method of replication has been devised whereby this estimate can be obtained from the actual yields of the trial year. Great care is necessary that the arrangement of unlike plots shall be such as to provide a valid estimate of error, and a random arrangement appears to be the most suitable. For simple trials in which every possible comparison is of equal importance, the Latin square provides the most efficient arrangement, one Latin square being selected at random out of the total number possible. For more complex experiments in which comparisons involving single factors—*e.g.* with and without phosphate—are required, replication of randomised blocks is necessary in order that no possible interaction of the factors may be disregarded. With this method the conclusions drawn from the single-factor comparisons will be given, by the variation of non-essential conditions, a very much wider inductive basis than could be obtained by simpler methods without extensive repetitions of the experiment.

GRAVITY DETERMINATIONS AT SEA.—In 1923 Dr. F. A. Vening Meinesz made a submarine voyage from Holland to Java by way of the Mediterranean and the Indian Ocean. Gravity observations were made at thirty-one points, and the results of their isostatic reduction (carried out by the U.S. Coast and Geodetic Survey) were presented at the recent annual meeting of the American Geophysical Union. The average anomaly for all the stations with regard to sign is 0.012 dyne by the Bowie formula. It is of special interest that for ten stations in the Indian Ocean far from land the average anomaly is 0.009. Thus isostatic equilibrium beneath the Indian Ocean is as perfect as it is under the continental regions that have so far been investigated. Dr. Meinesz made additional submarine observations between Holland and Port Said in 1925, and these are now being reduced in America. At present Dr. Meinesz is continuing his work in a submarine voyage to Java via the Atlantic, the Panama Canal and the Pacific. Special attention is being devoted to the continental shelves and the oceanic deeps.

MAGNETIC SURVEY OF FRANCE.—An account of the latest magnetic survey of France, begun in 1921, is given by A. Baldit in *La Nature*, August 21, 1926; it is hoped to complete the survey this year. Earlier surveys of France were made by Lamont (in 1856–7, with 44 stations), Perry (33 stations, 1868–9), Marié-Davy (20 stations, 1875), and Moureaux. The latter made two surveys, one including 80 stations (1884–1885), the second, extending over eight years, 1888–95, being much more detailed, and including 617 stations. In regard to the density of the network of stations, the latter was the first survey of France approaching modern standards for a civilised country. It revealed many hitherto unexpected irregularities in the isomagnetic lines, some of which could be correlated with geological features of the country. The present survey is still more detailed, being intended to include 1440 stations; these are not uniformly distributed, being specially dense where the magnetic features of the country are of particular interest. Six observers have been engaged in the work since 1922. The instruments used are not new, and are of standard type, the magnetometer being of Mascart's design, and the inclinometer of d'Abbadie's. The accuracy anticipated is to 1′-2′ for declination, 2′ in dip, and about 20 γ in horizontal force. The period of the survey is one of magnetic calm, and the accidental errors due to disturbance are therefore minimised.

ATLANTIC OCEANOGRAPHY.—A summary of the important oceanographical work of the German *Meteor* expedition of 1925 is given by Dr. H. R. Mill in the *Geographical Journal* for July. The object of the expedition was to survey the ocean depths, including physical and chemical work, of the South Atlantic between lat. 20° S. and the Antarctic circle. The most important work began in June 1925 with the first cross-section of the Atlantic along the parallel of 40° S. from South America to Africa. Profile II. was westward along the parallel of 29° S. Profile III. was eastward on the parallel of 48° S. Then followed Profile IV. westward along the 35th parallel, and Profile V. eastward along the 55th parallel with a dip southward to lat. 64° S., where a sounding of 4380 fathoms was obtained somewhere to the east of South Georgia—the exact position is not yet published. Finally Profile VI. was run west along the Tropic of Capricorn. Echo soundings were checked from time to time with wire soundings. Bottom samples, serial temperatures, and salinity observations were taken throughout the voyage. The upper air was investigated with kites and pilot balloons. The full results of this expedition will throw much light on oceanographical problems in the Southern Ocean.

ELECTRIC LAMP FIRE-DAMP DETECTOR.—It is nearly fifty years since Mr. E. H. Liveing first designed a method for measuring fire-damp in mines by sending an electric current through two spirals of platinum wire over one of which the mine air was passed: the increased luminosity produced by the combustion of the methane-air mixture on the heated wire gave a measure of the methane present in the air. The apparatus in skilful hands would certainly measure fire-damp, but its value lay rather in its promise than its practical utility. The Liveing principle has been the foundation on which many inventors have built, and has lately been embodied in the electric-lamp detector of Messrs. C. S. W. Grice and A. G. Gulliford. In the new detector the current of the lamp accumulator can be switched through a small length of fine platinum wire in a chamber to which the mine air has access through a wire mesh. The length of fine wire—3 mm.—between its metal clamps is so adjusted that the wire fuses when the methane reaches 3 per cent. of the atmosphere: below this percentage the wire glows brightly and indicates the presence of gas. It is evident that the utility of the invention will depend on how far the conductivity of the wire and the voltage of the accumulator can be maintained constant under working conditions.

SWEDISH RAINFALL.—In the note in NATURE of August 28, p. 318, on the Swedish rainfall statistics for 1925, the fact was overlooked that the means for each month and for the year are compared with the figures for 1925, which adds to the value of the volume.

The Alloys of Aluminium and Silicon.

THE very great interest at present being taken in the aluminium alloys containing from about 10 per cent. to 13 per cent. of silicon, is shown by the fact that no less than three of the papers presented to the Institute of Metals at the recent meeting at Liège dealt with this material.

Both from the practical point of view, regarding the material as one of considerable promise for the production of light alloy castings, and from the theoretical, these alloys are of more than usual interest. It has been known for some time that the structure may be greatly affected by the addition to the molten metal of small amounts of various 'modifying' reagents. Many theories concerning the reason for this change of structure have been propounded, but, hitherto, no completely satisfactory hypothesis has been available. Figs. 1 and 2, reproduced by courtesy of the Institute of Metals, illustrate the change in structure of the 10 per cent. alloy brought about by the addition, at 750° C., of 5 per cent of sodium hydroxide. Fig. 1 represents the material in the ordinary chill cast state, and Fig. 2 the same after the 'modifying' treatment. The mechanical properties also are greatly improved when the alloy possesses the second type of structure.

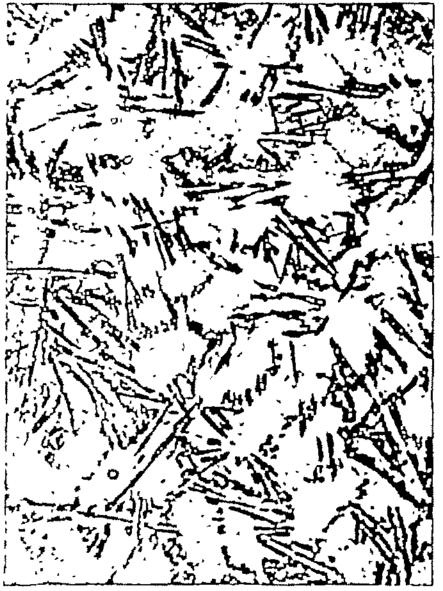


FIG. 1.—9·86 per cent. Si, 0·45 per cent. Fe. Chill cast. Unetched. ×200.

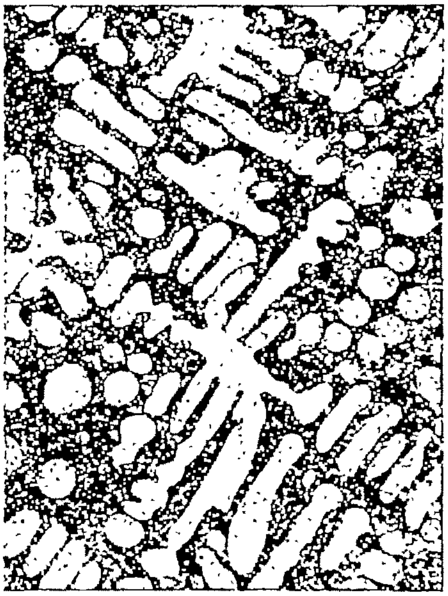


FIG. 2.—9·86 per cent. Si, 0·45 per cent. Fe. Same alloy as Fig. 1, but modified with 5 per cent. NaOH at 750° C. Chill cast. Etch HF. ×200.

Of the three papers now before us, that by Dr A. G. C. Gwyer and Mr. H. W. L. Phillips (with an appendix by Dr. Stockdale and Mr. I. Wilkinson which is concerned with the mechanical properties of the alloys) is the most important. The properties of the material in the 'normal' condition are not very remarkable, but the addition of a small amount of a suitable metal or salt to the melt before it is poured endows the casting with far superior strength and ductility.

In the normal state these alloys consist of a simple eutectiferous system, with small limits of solid solubility at each end. The thermal-equilibrium diagram has been redetermined, and the eutectic point placed at 11·7 per cent. of silicon and at a temperature of 577° C. After 'modification' the eutectic contains an appreciably greater amount of silicon and is formed at a lower temperature, both the composition and the temperature being dependent on the rate of cooling and the treatment of the metal. Further, when the molten metal is stirred or remelted after 'modification,' or left in the molten state for an undue length of time after the addition of the modifying material, the normal structure and properties are obtained.

There are clear indications, therefore, that the 'modified' metal is in an unstable state. The authors mentioned now offer a new explanation of their own, which appears to approach far more nearly to the truth than anything which has yet been suggested.

This theory may be briefly stated as follows: When the aluminium-silicon alloy is raised to a temperature considerably higher than its melting point, it is probable that the silicon and aluminium are in true solution. When solid the greater portion of the silicon is present, dispersed in crystals of a size readily visible under the microscope. A small quantity, of the order of 0·5 per cent. at room temperature, remains in solid solution in the aluminium, but this may be disregarded at the moment. In solidifying, the silicon and aluminium pass from atomic dispersion to the crystalline form. At some stage during the process, therefore, the silicon and aluminium aggregates will be of colloidal dimensions. It is well known that the colloidal state is an unstable one, and that colloid particles tend to coalesce. Their rate of growth may be accelerated or diminished by the addition of protective agents.

Having regard to all the facts which have come to light, it appears to the authors that the most satisfactory explanation of the behaviour of 'modifying agents' is to assume that they function as colloid protectors. They do not, of course, confer complete protection upon the colloidal silicon and aluminium, but simply retard their aggregation. From the changes in the crystalline form of the constituents brought about by the process of 'modification,' it is probable that the protector itself is a colloid. It does not, however, appear that the assumption is justified that when sodium compounds are used for 'modifying,' the protector is necessarily metallic sodium. As a result of this action, the formation of the normal eutectic is inhibited, and aluminium continues to be precipitated from the metal until the super-solubility line is reached.

It is also shown that the protection of the modified structure can be obtained without the use of the ordinary reagents provided that the rate of cooling is sufficiently rapid.

From the theory that certain substances hinder the aggregation of the colloid particles, it should be possible to discover also other substances capable of accelerating this aggregation. The compound FeAl$_3$ is such a substance, and it has been experimentally substantiated that the presence of iron in melts of these silicon-aluminium alloys is detrimental.

A diagram has been drawn up for the 'modified' alloys indicating the manner in which under-cooling alters the normal process of solidification. The amount of the substances added to effect the 'modification' has been considered, and with sodium hydroxide, and for an alloy of about 12 per cent. of silicon, it is put at about 5 per cent. of the weight of the metal. Excess results in a deterioration of the mechanical properties.

The time which is allowed to elapse between the addition of the castings is also of importance, and, for the usual composition of alloy, should be about half an hour.

Since the general theory propounded is independent of any special constituent, it should be sufficiently general to apply to systems other than that immediately under consideration. This is shown to be the case, and exactly analogous results have been obtained in the systems copper-aluminium, aluminium-nickel, aluminium-manganese, lead-antimony, and copper-antimony.

The importance of the colloidal state in alloys at the moment of solidification, and of under-cooling, is thus shown to be far greater than has hitherto been generally appreciated. F. C. T.

The Twelfth International Physiological Congress in Stockholm.

EACH international congress, as a rule, discloses some special interest in one or another field of physiological science, as well as serving as a sure guide to the virility of the science in general. Contrasted with the last congress, held three years ago in Edinburgh, the present congress had no one central interest comparable to that excited by the isolation of insulin, but the fine attendance of the foremost representatives, with a considerable number of the younger workers, from all the continental European countries, was a welcome evidence of the general recovery of physiology from the devastating effects of the War, and of the steady and persistent advance in almost every branch of this science.

The congress in Stockholm was as beautifully arranged as in Edinburgh, and as regards the welcome and hospitality offered there is no need to say more than that it could not have been bettered. The scientific programme of the congress opened with an address by Sir Frederick Gowland Hopkins on "The Mechanisms of Biological Oxidations," in which he outlined the position attained by workers in this field, with especial reference to the work done in his own laboratory at Cambridge.

The routine work of the congress was divided into four sections which were grouped according to subjects, facilitating the attendance by each member at the discussions on those papers in which he was particularly interested.

Great interest was aroused by a number of papers dealing with the fundamental processes of life, as, for example, the communications of the recent important researches of Adrian upon the afferent impulses conducted by the single nerve fibre, and of Hill and Downing upon the measurement of heat production in nerve. An interesting summary was given by Kato (Tokyo) of his theory of decrementless conduction in the narcotised region of nerve, in which, as is well known, he is opposed to the findings of Keith Lucas and Adrian. The problem was the subject of a lively debate, and is probably now near to solution. Muscle physiology was represented by Embden, by Hill, and by Meyerhof.

Another point of great interest was the question with regard to tissue metabolism, mainly represented by Dale's school, in relation to insulin and to such problems as the development of rigor.

In the realm of the central nervous system, an interesting communication was made by Samojloff (Kasan) upon the nature of spinal inhibition. His experiments tend to support the theory of a liberation of some chemical substance affecting the synopses or the cellular structures in the spinal cord. Magnus (Utrecht) made a further contribution to the subject of local and segmental reflexes in the decerebrated animal.

Metabolism was represented by Lusk and Benedict, Boothby, Knoop, Mendel, Noyons, and de Barenne. A noteworthy tendency lay in the simplification of technique, and the applicability of the new methods to clinical practice. A summary was given by Mann (Rochester, Minn.) of his work on the dehepatised animal. Interest in the question of vitamins seems recently to have diminished, very few communications being made.

The study of digestion has now definitely shifted out of the hands of Pavlov's school to America, from whence the pupils of Carlsson, and particularly Ivy, brought communications dealing with the phases of gastric and pancreatic secretion.

Circulation was represented from America by Wiggers (Cleveland), who discussed the fractionate nature of ventricular contraction. The British school was represented by Anrep, who gave papers upon the central and reflex regulation of the coronary circulation (mainly in regard to the innervation of the coronary blood vessels), and upon the electrical measurement of coronary circulation during the single cardiac cycle. Heymans (Ghent) communicated the results obtained with his method of cerebral perfusion as applied to the study of the respiratory and cardio-inhibitory centres. Frédéricq (Liège) summarised the results of his recent work upon chronaxie, especially in relation to the influence of the vagus and sympathetic cardiac nerves.

Prof. Loewi (Graz), in one of the most interesting papers of the congress, gave an account of the various factors affecting the rate of destruction of the chemical substance determining the inhibitory action of the vagus upon the heart. The work of this school would seem to bring us one step nearer to comprehension of the ultimate mechanism of peripheral inhibition.

An important contribution to the problem of hæmophilia was made by Howell (Baltimore), who brings evidence that the determining factor in this condition lies in an unusual stability of the blood platelets. In a second communication, Howell discussed the chemical nature of the anti-coagulant substance heparin, which is so largely and successfully replacing hirudin in the experimental laboratories of the United States and Great Britain.

With regard to the chemistry of blood, Nicloux (Strasbourg), although unfortunately unable to be present in person, contributed a new spectroscopic method for the determination of small quantities of carbon monoxide in gas mixtures, applying his method to the determination of minimal quantities of it in blood. In a further paper this author presented a new determination of the oxygen content of methæmoglobin, fixing it at half the oxygen content of oxyhæmoglobin of the same blood.

In the present congress demonstrations played what might perhaps be called a secondary part. Many, such as those of Adrian, Kato, and Hill, were in demonstration of communications. Especially interesting in this group was a demonstration by Brinkman (Groningen) of his method of registering the attainment of *p*H equilibrium in H_2CO_3-bicarbonate buffer solutions. Barcroft gave a summary of his recent work on the spleen, supplemented by a demonstration. This seems, at last, to find some definite and important physiological function for an organ which has baffled physiological thought for centuries. Lim (Peking) gave a demonstration of a dog with transplanted stomach. Of especial interest also was a demonstration by Y. Henderson (New Haven) of his method of measuring the circulation by inhalation of ethyl iodide. This seems to be the simplest and most tangible method up to the present, and most probably will find a great future application.

America, as in eleven successive congresses previously, sent a strong contingent of workers, and as was only as fair as it was unanimous, the twelfth congress accepted the invitation of the American Physiological Society that the thirteenth congress be held in America in 1929.

It is, perhaps, of especial interest to mention also the good attendance from Russia, showing that the worst period in that country is approaching an end. Dr. Orbeli (Leningrad), who was present, did not, unfortunately, submit any summary of the results of his experiments upon the sympathetic innervation of voluntary muscle, a problem on which we know him to have been engaged for several years. Prof. I. P. Pavlov, the *doyen* of the congress, showed no sign of diminished activity in spite of his advancing years. There were no communications from his laboratory, although he informs us that a full description of his work on the cerebral cortex is being published in English towards the end of the present year.

The thanks and appreciation of all the members of the congress to their colleagues and hosts in Sweden was expressed by Profs. Gley, von Frey, and Starling at the final meeting of the congress at Upsala, and also previously and more lightly by the same representative speakers at the banquet given to the members of the congress by the City of Stockholm.

The Geological Search for Oil.

ONCE more the ubiquitous problem of the origin of petroleum is forced on our attention, this time as a practical matter rather than as a philosophical thesis. Dr. Murray Stuart writes a paper in the recent issue of the *Journal of the Institution of Petroleum Technologists* in which 'working hypotheses' in the geologist's search for oil form the main theme, the principal argument being that all exploration for petroleum is handicapped at the outset by the fact that little, if anything, is known concerning its origin. We appreciate the laws governing migration and accumulation of oil; we contemplate favourable geologic structures, providing the strata involved are oil-bearing, which are located with remarkable precision; but unless the oil manifests itself by seepage or in some indirect manner, there is little to guide the search. To this extent, it may be noted, the geology of petroleum differs from the geology of, for example, metalliferous ore deposits.

One of the earliest and best known working hypotheses in oil-geology is that attributable to David White, whereby the degree of progressive devolatilisation (or metamorphism) of coal is interpreted as a measure of the chances of obtaining oil or gas in commercial quantity in associated deposits, the percentage of fixed carbon (pure coal basis) being the determining factor. White's law has found ample vindication in the West Virginia oil-fields, but it is not of universal application, as pointed out by Wade in a recent paper on "The Search for Oil in Australia"; the author, however, seeks to amend the law to the extent of excluding the idea of subsequent 'metamorphism' in favour of carbon ratio variation being interpretable in terms of normal processes of sedimentary deposition. He visualises his carbonaceous material as part of a sheet of sediment in which transition from conglomerate ". . . through sand and shale to oil-bearing shale, . . . through something equivalent to Torbanite into more or less pure carbonaceous material . . ." is perceptible; carbon ratio variations are thus functions of original influences (mother-substance, environment, etc.), not of subsequent change in the course of geologic time. From this point of view is deduced the hypothesis that, assuming the carbon ratio of a fresh-water or estuarine coal seam to be favourable (*i.e.* 50 to 55), the seam will probably pass through torbanite into oil shale when traced in the direction from which the material composing the seam was initially derived. In the case of coals deposited under marine conditions, lateral variation into petroleum or into oil-shale (depending on the nature of the organic material incorporated in the sediment) is probable. A further hypothesis states that ". . . when formations containing abundant fossil-wood occur the underlying marine formations may contain liquid petroleum," and has been reasoned by the author in previously published papers.

The occurrence of oil in dolomitised limestones of lagoon formation furnishes the author with a contrasted, though in some respects parallel, line of argument; he examines this environment from a biochemical point of view, directing attention to the rôle of foraminifera and other protozoa, and also bacteria, in promoting essential mother-substance, whence he formulates the hypothesis that "all dolomitised limestones of lagoon formation are worthy of thorough investigation, provided that they prove, on microscopic examination, to be foraminiferal."

What we may term the 'coal-to-conglomerate' hypothesis of the author raises problems at least as controversial as those of the origin of petroleum itself, though there is considerable novelty, if not practical import, in the views he puts forward. For the "many examples known in the world of coal seams and lignite seams passing laterally into either oil-shales or oil deposits" there are as many in which no coal-oil association is apparent. The tracing of a coal seam into an oil-shale seam in existing economic circumstances would be little reward to the geologist bent on locating commercial oil-pools; but the chances of lateral variation from coal to petroleum would seem, according to the author's reasoning, to be somewhat localised. On the other hand, where coal, lignite, or torbanite is in evidence in deposits suspected or proved to contain oil, the hypothesis clearly merits the test: only by this method and in several different cases will its validity, hence its practical value, be established.

University and Educational Intelligence.

Cambridge.—The John Winbolt Prize has been awarded to H. Bateman, Trinity College, and R. J. Smith, St John's College, for a joint dissertation on a theoretical investigation of some elastic problems in thin rectangular plates.

Edinburgh.—In the Royal Botanic Garden, on Tuesday, September 21, the Right Hon. Sir Herbert Maxwell unveiled a tablet to the memory of the late Sir Isaac Bayley Balfour, who was Regius Keeper of the Garden from 1888 until 1922.

The Wigan and District Mining and Technical College sends us a Calendar giving, in 142 pages, particulars of courses, some of them leading up to the final degree examinations of the University of London, in mining, mechanical and electrical engineering, chemistry, physics, mathematics, building trades, cotton technology, commerce, art, and art crafts. In 1925 six students obtained University of London degrees. Among other specialities is a two-years' Post Office engineering course.

The London School of Economics and Political Science announces in its summary programme for 1926–27 a series of important public lectures by eminent authorities, open to the public without fee or ticket. These include, in addition to single lectures by Profs. Laski and de Paula and Mr. William Cash, a series of three by Prof. Toynbee on international history since the War, six by Prof. Salvemini on Italian communes in the thirteenth century, ten on office machinery, and twelve on accounting in public offices.

The Battersea Polytechnic's prospectuses for 1926–27 offer full day and evening courses in preparation for the University of London's intermediate and final degree examinations in science, engineering, and music. In consultation with the Incorporated National Association of British and Irish Millers, the London Flour Millers' Association, and the Board of Education, a two-year day course in science and engineering with special reference to the flour milling industry has been organised. Courses for health visitors and sanitary inspectors and in arts and crafts are provided. A separate prospectus deals with the Polytechnic's Domestic Science Training College. Another of London's Technical Colleges from which we have lately received a prospectus is the Cordwainers'. This provides both day and evening courses in the technology of boot and shoe manufacture and leather goods manufacture.

The East London College announces in its calendar for 1926–27 the institution of a fund for the encouragement of original investigation by the staff and students, and an important addition to its resources for such purposes in the form of a bequest by the late Sir Sidney Lee of 5000*l*. for bursaries for post-graduation work in English literature. Three research studentships of the value of 50*l*. each for one year are awardable annually in July to students completing a three-years' course at the College. Special and advanced lectures announced include: a course of six on short electric waves in wireless, by J. H. Morrell, and six (for graduates) on biology of fresh-water algæ, by Prof. Fritch and Dr. Carter. In its recently constituted department of dramatic study and research there will be a weekly seminar for collective work on a dictionary of British drama. In aeronautical engineering a three-years' course is arranged, and students attending the last two years of this are able to take aeronautics instead of hydraulics in the new subject, 'Mechanics of Fluids,' in the B.Sc. (Engineering) degree examination. The College Council has recently purchased the freehold of a house in South Woodford for use as a hall of residence for men students. One for women students on the borders of Epping Forest with accommodation for thirty-two has already been opened.

The Northern Polytechnic, Holloway (formerly Northern Polytechnic Institute), gives, in its prospectus for 1926–27, particulars of its important Department of Chemistry and Rubber Technology. It is the only institution listed under the heading of rubber technology in the Universities Bureau's summary of specialist studies in the universities and university colleges of Great Britain and Ireland. The courses are carried on in collaboration with the Institution of the Rubber Industry and provide suitable preparation for students proposing to enter for the examinations for the associate diplomas (A.I.R.I.) awarded by that body. An influential committee, representative of all sections of the industry, co-operates with the governors, and the workshops contain a full range of modern experimental rubber-plant. In addition to the advanced courses there is a Rubber Trades School, for boys of 14 or 15 years of age. The technical chemistry three-years' courses are designed for prospective analytical and works chemists. They include chemical technology, glass-working, chemical engineering, and (a two-years' course) plumbing. A series of important special public lectures have been arranged for the coming session, beginning with one by Raymond Unwin on October 14 on town planning.

The Municipal College of Technology, Manchester, has resumed publication of its *Journal*. Volume 12, just issued, records investigations undertaken by members of the College between 1919 and 1924. It contains original articles on: losses in resistance connectors in single-phase commutating motors (Miles Walker), the discharging capacity of side weirs (G. S. Coleman and Dempster Smith), the aromatic character of the glyoxaline nucleus (F. L. Pyman), ferrous materials and corrosion (E. L. Rhead), values of the smallest zeros of harmonic functions (J. Prescott and H. V. Lowry), a null method for ionisation potentials (L. S. Palmer and W. Hubball), and a direct-reading refractometer (A. Adamson). The prospectus of the College for 1926–27 shows that since 1919–20 from ten to thirteen research scholarships have been awarded by it each year. The scholarships are open to graduates of any university in the British Empire and other persons possessing special qualifications for research. In awarding three of them, preference is given to Manchester ratepayers and their sons and daughters. Courses of advanced study and research are offered in mechanical, electrical, municipal, and sanitary engineering (including sea outfall and coast defence works), applied chemistry (including textile fibres, paper manufacture, metallurgy, rubber, brewing and allied industries, coal tar and dyestuffs, photography and photographic processes), textile industries, applied physics, and mining engineering.

Contemporary Birthdays.

October 5, 1861. Sir Thomas L. Heath, K.C.B., K.C.V.O., F.R.S.
October 7, 1842. Sir Philip Magnus, Bart.
October 8, 1850. Prof. Henry Louis le Chatelier, For. Mem. R.S.
October 8, 1857. Sir Richard C. Garton, G.B.E.
October 9, 1879. Prof. Max T. F. von Laue.
October 9, 1863. Prof. Albert Charles Seward, F.R.S.

Sir THOMAS HEATH, who was born in Lincolnshire, was educated at Caister Grammar School and Clifton College, passing thence to Trinity College, Cambridge, where he graduated 12th wrangler, whilst also acquiring distinction in classical studies. Entering the public service, he was early attached to H.M. Treasury, fulfilling successively the highest offices. Since 1919 he has been Comptroller-General, National Debt Office. Among many dissertations and works, he is the author of "A History of Greek Mathematics" (2 vols., 1921). Sir Thomas is an honorary fellow of Trinity College, Cambridge, and Hon. D.Sc. Oxford.

Sir PHILIP MAGNUS, to whom very hearty congratulations are due on the approaching anniversary of his eighty-fourth birthday, was educated at University College School, graduating thence at the University of London. Organising director and secretary of the City and Guilds of London Institute from 1880 until 1888, he was afterwards and for nearly thirty years the able and zealous secretary of its Technology Department.

Prof. LE CHATELIER'S name is associated with important discoveries in several branches of chemistry. In conjunction with Mallard he conducted elaborate investigations on the ignition and explosion of gaseous mixtures, in which principles of fundamental importance were established. His thermo-electric couple inaugurated a new period in the measurement of high temperatures. One of the pioneers of micro-metallurgy, he was among the first to introduce exact methods into the science of industrial silicates. Prof. le Chatelier was elected a foreign member of the Royal Society in 1913, and allotted the distinction of its Davy medal in 1916, in respect of his eminence as a chemist.

Sir RICHARD GARTON was educated at Owens College, Manchester, and the University of Marburg. As honorary secretary of the British Empire Cancer Campaign he has carried out work of widespread importance.

Prof. MAX VON LAUE, Nobel laureate, 1915, was born at Pfaffendorf, near Coblentz. His studies were conducted at the Universities of Strasbourg, Munich and Berlin. In 1912 he occupied a chair in the University of Zurich, and was afterwards at Frankfort. Since 1919 he has been professor of theoretical physics in the University of Berlin. Prof. Max von Laue was allotted the Nobel prize in physics for 1915, for his discovery of the diffraction of Rontgen rays in crystals.

Prof. SEWARD, Master of Downing College, Cambridge, professor of botany in and vice-chancellor of the University, was educated at Lancaster Grammar School and St. John's College, Cambridge. The Royal Society awarded Prof. Seward a Royal Medal last year for his fruitful studies in palæobotany, which have proved of direct stratigraphical value to geologists, enabling the principles and facts of one science to aid, and even solve, the problems of another.

Societies and Academies.

PARIS.

Academy of Sciences, August 30.—**Bigourdan**: The regularity of the diurnal movement and the possibility of verifying it by means of observatory clocks (see also NATURE, September 18, p. 425).—Boris **Delaunay**: The theory of parallelohedra.—G. **Polya**. The linear functional operations exchangeable with the derivation and the zeros of the sums of exponentials.—Mlle. N. **Bary**: The analytical representation of a class of continuous functions.—A. **Kovanko**. The integration of suites of functions capable of summation.—Kyrille **Popoff**: The convergence of series and celestial mechanics.—**Krawtchouk**: The method of N. Kriloff for the approximate integration of the equations of mathematical physics.—N. **Bogoliouboff** and N. **Kriloff**: The justification of Rayleigh's principle by the order of the error committed at the *n*th approximation.—Jacques **Bourcart**: An attempt at the morphological interpretation of the Bouches de Cattaro.—Lucien **Daniel**: Researches on the grafting of garlic and cabbage.—Antonin **Němec**: Chemical methods for determining if agricultural soils are in need of nitrogenous or potash manures. Details of the analytical methods and limits of nitrate and potash suitable for sugar beet, barley, and oats.—Raymond **Hamet**: The inversion of the normal action of adrenaline.—E. **Ducloux** and Mlle. G. **Cordier**: The virus of sheep scab treated with various aldehydes.

CAPE TOWN.

Royal Society of South Africa, August 18.—L. P. **Bosman**: The nature of the co-enzyme of lipase. The lipase extract (from sheep's pancreas) is dialysed against distilled water and the lipolytic actions of the dialysate and the 'inside' liquid on ethyl butyrate are studied. The inside liquid loses approximately 50 per cent. of its hydrolytic power. The dialysate, while having no hydrolytic power, when coupled with the inside liquid, restores the lipolytic power of the original extract. The dialysate was investigated and the so-called co-enzyme was found to be inorganic salts.—W. **Rose** and J. **Hewitt**: Description of a new species of Xenopus from the Cape Flats. The new species, *Xenopus gilli*, differs from *X. laevis* in that tentacles are not apparent and that there is in the mouth an organ which is either a posteriorly attached tongue or a deflated air-sac.—J. H. **Power**. Notes on the habits and life histories of South African Anura with descriptions of the tadpoles.—C. von **Bonde**: The vascular system of the Plagiostomi, with special reference to the common dogfish (*Squalus acutipinnis*, Regan). The author has previously worked out the morphology of the vascular system of the South African dogfish *S. acutipinnis* and it is now compared with the structure typical of the Plagiostomi in general. The absence of vascular loops round the gill-arches together with the absence of a precardiac extension of the dorsal aorta presents an interesting feature. The arterial circulation of the cephalic region also shows a distinctive difference from the normal distribution of the carotid arteries in the Plagiostomi.—Neville S. **Pillans**: The African genera and species of Restionaceae.—H. G. **Fourcade**: A new method of aerial surveying.

ROME.

Royal National Academy of the Lincei: Communications received during the holidays.—T. **Levi-Civita**: Einsteinian motions in second approximation.—Ferruccio **Zambonini** and S. **Restaino**: Double sulphates of the rare earth and alkali metals (vi.). Cerous potassium sulphates. In addition to the double salts already described, this system forms the compound, $Ce_2(SO_4)_3 \cdot 4{\cdot}5\,K_2SO_4$, which is stable in the presence of solutions containing from about 5 per cent. to 1·2 per cent. of potassium sulphate.—G. **Bruni** and A. **Ferrari**: Crystalline structure of certain bivalent chlorides. Anhydrous magnesium, manganous and cadmium chlorides are found to be of rhombohedric structure with the respective axial ratios, 2·45, 2·34, and 2·20. Zinc chloride appears to exhibit a rhombohedric or hexagonal structure, the dimensions of its structure indicating its structural similarity to magnesium chloride.—Silvio **Minetti**: Investigation of the singularity of $f(x) = \sum_{n=0}^{n=\infty} a_n x^n$, where $a_n = g(n)$ for n a positive integer with $g(n)$ wholly transcendental.—Mauro **Picone**: The isolated singularity of harmonic functions in two or more variables.—Oscar **Zariski**: Conformable representation of the area bounded by a lemniscate on a circle.—Luigi **Fantappiè**: The polydromy of linear analytic functionals.—A. M. **Bedarida**: A new rectilinear congruency.—Harry **Levy**: Einsteinian motions of a disgregate medium with spherical symmetry.—Arnaldo **Belluigi**: Evaluation of the damping in seismographic pendulums.—Rita **Brunetti**: Theory of the polarisation of independent X-rays.—G. **Natta** and A. **Reina**: Oxides and hydroxides of cobalt: Crystalline structure of cobaltous oxide and hydroxide. The results of X-ray analysis show that cobaltous oxide belongs crystallographically to the monometric system and has an elementary cell of side a 4·22 Å.U. of the sodium chloride type, containing four molecules. The precipitated and crystalline forms of cobaltous hydroxides are structurally identical and are of the uniaxial rhombohedric type.—Raoul **Poggi** and Angiolo **Polverini**: Destruction of filter-paper by alternate oxidising agents applied to quantitative analysis.—Adolfo **Quilico**: Röntgenographic investigation of metallic hydrides: copper hydrides. The so-called hydrides obtained by reducing cupric oxide by means of hydrogen prove to be either pure copper or copper containing occluded hydrogen in proportion insufficient to modify appreciably the crystal lattice. The products formed in the reaction between hypophosphorous acid and copper sulphate vary with the temperature employed and consist either of amorphous copper containing occluded hydrogen or of a mixture of this with cuprous oxide.—C. **Sandonnini**: Heats of mixing of water with acetic acid and with isopropyl alcohol.—Emanuele **Quercigh**: The nature of stibiobismuthinite. This mineral, found in Nacozari, Mexico, consists of an isomorphous mixture of bismuthinite and antimonite, with or without inclusions of sulphur.—C. **Acqua**: The virus of the polyhedry of the silkworm in relation to modern theories on the filterable virus.

Official Publications Received.

Canada. Department of Mines: Geological Survey. Memoir 148, No. 129 Geological Series: Geology and Mineral Deposits of Windermere Map-area, British Columbia. By J. F. Walker. (No. 2088.) Pp. 69. 20 cents. Summary Report, 1924, Part C. (No. 2091.) Pp. 236C. (Ottawa: F. A. Acland.)

Education Committee for the County Borough of Brighton. Technical College, Richmond Terrace, Brighton. Day Courses, Session 1926–27. Pp. 79+9 plates. Evening Courses, Session 1926–27. Pp. 48. (Brighton.)

Almanach České Akademie věd a umění. Ročník 36. Pp. 240. (Praze.)

Académie Tchèque des Sciences (Česká Akademie věd a umění). Bulletin International: Résumés des travaux présentés. Classe des sciences mathématiques, naturelles et de la médecine. 23e année (1923). Pp. 15+266. 25e année (1925). Pp. iv+236. (Prague.)

Premier Congrès International pour la Protection de la Nature, Faune et Flore, Sites et Monuments Naturels (Paris, 31 mai–2 juin, 1923). Rapports, Vœux, Réalisations. Pp. viii+352. (Paris: Paul Lechevalier.

Instituts scientifiques de Buitenzorg: "'sLands Plantentuin." Treubia: Recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 6, Supplément, Avril 1926: The Bloodsucking Arthropods of the Dutch East Indian Archipelago. vii: The Tabanids of the Dutch East Indian Archipelago (including those of some neighbouring Countries) By Dr. J. H. Schuurmans Stekhoven, Jr. Pp. 551+18 plates. Vol. 8, Supplément, Juillet: Die Jugendstadien der malayischen Thysanopteren. Von H. Priesner. Pp. iii+264+16 Tafeln. (Buitenzorg: Archipel Drukkerij.)

Ceylon Administration Reports for 1925. Part 4: Education, Science and Art (D). Administration Report of the Director of Agriculture for 1925. Pp. D60. (Colombo: Government Record Office.) 1.25 rupees.

Bureau of Education, India. Education in India in 1924–25. Pp. iii+59. (Calcutta: Government of India Central Publication Branch.) 1.6 rupees; 2s.

Memoirs of the Department of Agriculture in India. Entomological Series, Vol. 9, No. 5. Experiments on the Transmission of Rinderpest by Means of Insects. By S. K. Sen. Pp. ii+59-186. (Calcutta: Government of India Central Publication Branch.) 2.4 rupees; 4s. 3d.

The Hundred and Fourth Report of the Commissioners of Crown Lands, dated 29th June 1926. Pp. 36. (London: H.M. Stationery Office.) 4s. net.

The Indian Zoological Memoirs on Indian Animal Types. 1: Pheretima (The Common Indian Earthworm) By Prof. Karm Narayan Bahl. Pp. v+72. (Lucknow: The University.) 1.8 rupees.

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1925 May 19–1926 May 18. Pp. 8. (Cambridge.)

The Journal of the American Chemical Society. Vol 48, No 8a; Golden Jubilee Number, August 20, 1926: A Half-Century of Chemistry in America, 1876–1926; an Historical Review commemorating the Fiftieth Anniversary of the American Chemical Society. Edited by Charles A. Browne. Pp. xiv+254 (Easton, Pa.: American Chemical Society.)

South African Sugar Association. Proceedings of the Fourth Annual Congress held at Durban on April 12th to 16th, 1926. Pp. 109. (Durban: South African Sugar Association.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 48 (Division of Chemistry Series No. 66): Fumigation with Hydrocyanic Acid Gas; Concentration and Distribution as influenced by Fumigation Procedure. By R. J. Smit and Dr. T. J. Naude. Pp. 22. Science Bulletin No. 49: Experiments in Veld Management, First Report. By R. R. Staples. Pp. 35. (Pretoria: Government Printing and Stationery Office.) 3d. each.

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 4, No. 7: Résultats des mesures photogrammétriques des Aurores boréales observées dans la Norvège méridionale de 1911 à 1922. Par Carl Størmer. Pp. 108+48 planches. (Oslo: A. W. Brøggers Boktrykkeri A/S.) 12 kr.

D. Kgl. Danske Vidensk. Selsk. Skrifter, naturvidensk. og mathem. Afd., 8 Række, 11, 1: La surface de la planète Jupiter 1919–1924. Par C. Luplau Janssen. Pp. 58+7 planches. (København: Andr. Fred. Høst and Søn.) 10 kr.

The East London College (University of London). Calendar, Session 1926–1927. Pp. 184. (London: East London College.)

Ministry of Agriculture and Fisheries: Standing Committee on River Pollution.—River Pollution and Fisheries: a Non-Technical Report on the Work during 1925 of the Standing Committee on River Pollution appointed in 1921. Pp. 23. (London: H.M. Stationery Office.) 6d. net.

The British Mycological Society. Transactions, Vol. 11, Parts 1 and 2, August 26th. Edited by Carleton Rea and J. Ramsbottom. Pp. 166+6 plates. (London: Cambridge University Press.) 15s. net.

University of London, University College: Faculty of Medical Sciences. University Centre for Preliminary and Intermediate Medical Studies. Courses for Dental Students, Session 1926–1927. Pp. vi+237-262+10. (London: University College.)

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 14, No. 2, August. Pp. 299–556. (Plymouth: Marine Biological Association.) 10s. net.

Conseil Permanent International pour l'Exploration de la Mer. Bulletin hydrographique pour l'année 1925. Pp. 49. Bulletin hydrographique: Appendice supplémentaire d'observations de surface anglaises pour la période 1916–1923. Pp. 64. Bulletin hydrographique: Appendice 1 et 2 pour les années 1923 et 1924. Pp. 20. Rapports et procès-verbaux des réunions, Vol. 40. Rapport Atlantique 1925 (Travaux du Comité du Plateau continental Atlantique) (Atlantic Slope Committee). Pp. 60. (Copenhague: Andr. Fred. Høst et fils.)

Transactions of the Royal Society of Canada. Third Series, Vol. 20, Section 4. On some Minerals from the Ruby Mining District of Mogok, Upper Burma. By Frank D. Adams and R. P. D. Graham. Pp. 113–136. (Ottawa: Royal Society of Canada.)

Aeronautical Research Committee: Reports and Memoranda. No. 1104 (Ae. 211): Further Experiments on the Relation between Skin Friction and Heat Transmission. By Miss Dorothy Marshall. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (D.1. Special Technical Questions, 132.—T. 2062.) Pp. 19+12 plates. 1s. net. No. 1012 (M. 35): Some Comparative Fatigue Tests in special relation to the Impressed Conditions of Test. By H. J. Gough and H. J. Tapsell. Work performed for the Engineering Board of the Department of Scientific and Industrial Research. (M.C. 79, 157, 167, 167A.) Pp. 21. 1s. net. No. 1021 (E. 19): The Effect of Metallic Sols in delaying Detonation in Internal Combustion Engines. By Ft.-Lieut. C. J. Sims, assisted by Dr. E. W. J. Mardles. (I.C.E. 516.) Pp. 11. 6d. net. No. 1013 (E. 18): Report on Dopes and Detonation. By Prof. H. L. Callendar, assisted by Capt. R. O. King and Flying Officer C. J. Sims. (E. 4. Engines 56.—T. 2151, I.C.E. 506.) Pp. 54+12 plates. 2s. net. No. 1022 (M. 36): An Experiment to determine if Slip can be detected during the Unloading Portion of a Cycle of repeated Tensile Stresses. By H. J. Gough, S. J. Wright and Dr. D. Hanson. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (B. 1.a. Metals, 46.—T. 2165.) Pp. 6+8 plates. 6d. net. (London: H.M. Stationery Office.)

Government of India: Department of Industries and Labour, Public Works Branch. Irrigation in India: Review for 1924–25. Pp. 57. (Simla: Government of India Press.)

International Hydrographic Bureau. Special Publication No. 13: Tide Predicting Machines. Pp. 110+34 plates. (Monaco.) 0.50 Swiss fr.

Denkschriften der Schweizerischen Naturforschenden Gesellschaft: Mémoires de la Société Helvétique des Sciences naturelles. Band 63: Vol. 63. Pp. viii+344. (Zürich: Schweizerischen Naturforschenden Gesellschaft.)

Prospectus of University Courses in the Municipal College of Technology, Manchester. Session 1926-27. Pp. 206. (Manchester.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 78. The Blattidae of French Guiana. By Morgan Hebard. Pp. 135-244+plates 12-17. (Philadelphia, Pa.)

R. Osservatorio Astrofisico di Catania. Annuario 1926. Pp. 30. Catalogo Astrofotografico Internazionale 1900.0. Zona di Catania fra le declinazioni +46° e +55°. Vol. 2, Parte 2a: Declinaz. da +47° a +49°, ascens. retta da 3h a 6h. (Fascicolo N. 10.) Pp. viii+48. L' Attività del sole nell' anno 1925. Per G. A. Favaro. Pp. 16. (Catania: R. Osservatorio Astrofisico.)

Proceedings of the Imperial Academy. Vol. 2, No. 6, June. Pp. xix-xx+241-298. (Ueno Park, Tokyo.)

Annals of the (Mededelingen van het) Transvaal Museum. Vol. 11, Part 4: Some Changes in Nomenclature, New Records of Migrants and New Forms of S. African Birds, by Austin Roberts; Descriptions of some S. African Birds' Eggs, by Austin Roberts; Some new S. African Mammals and some Changes in Nomenclature, by Austin Roberts; The Dolichopodid Genus *Diaphorus* in South Africa, by C. Howard Curran; The Ethiopian *Cerceris* species, by Dr. H. Brauns; The Sphegidae of South Africa, Part 7, by Dr. George Arnold. Pp. 217-376+plates 40-44. (Pretoria: Transvaal Museum.)

Proceedings of the Indian Association for the Cultivation of Science. Conducted by Prof. C. V. Raman. Vol. 10, Part 1. Pp. 96+4 plates. (Calcutta.) 3 rupees; 4s.

The Indian Forest Records. Entomology Series, Vol. 12, Part 10: On some Indian Coleoptera. Part 1: Description of a New Species of Fornax from India (Melasidae, Col.), by E. Fleutiaux; Part ii: (a) Description of the Early Stages of Fornax gardneri Fleut (Melasidae, Col.), (b) Description of the Larva of Atractocerus emarginatus Cast. (Lymexylonidae, Col.), by J. C. M. Gardner. Pp. 271-283+1 plate. (Calcutta: Government of India Central Publication Branch.) 4 annas; 5d.

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 27: Studies on Peat. Part 1: The Thermal Decomposition of Peat under Reduced Pressure. By Dr. Joseph Reilly and Gerald Pyne. Pp. 329-341. 1s. Vol. 18 (N.S.), No. 28: Velocity of Formation of 3·5 Dimethylpyrazole-4-Diazonium Chloride. By Dr. Joseph Reilly and Honorah H. Bestable. Pp. 343-349. 6d. (Dublin: Royal Dublin Society; London: Williams and Norgate, Ltd.)

Papers from the Geological Department, Glasgow University. Vol. 8 (Quarto papers from 1924 to 1925). Pp. iii+164+6 plates. Vol. 9, 1926. Pp. iii+140. (Glasgow: Jackson, Wylie and Co.)

International Hydrographic Bureau. Special Publication No. 14: Echo Sounding, iv. Pp. 28+20 plates. (Monaco.) 50 Swiss centimes.

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1926 (with Appendices). Pp. 37. (London: H.M. Stationery Office.) 1s. 6d. net.

Apia Observatory, Samoa. Report for 1923. Pp. 78. (Wellington, N.Z.: W. A. G. Skinner.)

The Journal of the Institution of Petroleum Technologists. Decennial Index, Volume 1 to 10, 1914 to 1924. Compiled by George Sell. Pp. 116. (London.) 7s. 6d.

Svenska Hydrografisk-Biologiska Kommissionens Fyrskeppsundersökning år 1925. Pp. 43. (Göteborg: Elanders Boktryckeri A.-B.)

Field Museum of Natural History. Anthropology, Memoirs, Vol. 1, No. 1: Report on the Excavation of the "A" Cemetery at Kish, Mesopotamia, Part 1. By Ernest Mackay. (Field Museum—Oxford University Joint Expedition.) Pp. 63+20 plates. Report Series, Vol. 6, No. 5: Annual Report of the Director to the Board of Trustees for the Year 1925. (Publication 235.) Pp. 185-525+plates 63-79. (Chicago, Ill.)

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge. Vol. 65, No. 1. Pp. xxxi+67+4 plates. (Philadelphia, Pa.)

Cornell University: Agricultural Experiment Station. Memoir 92. The Flora of the Cayuga Lake Basin, New York; Vascular Plants. By Karl M. Wiegand and Arthur J. Eames. Pp. 491. (Ithaca, N.Y.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 525: A Unicontrol High-Frequency Radio Direction Finder. By F. W. Dunmore. Pp. 23-35. (Washington, D.C.: Government Printing Office.)

Diary of Societies.

SATURDAY, OCTOBER 2.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Midland District) (at Icknield Hall, Letchworth), at 11 A.M.—G. T. Hill and others: Discussion on Letchworth, its Ideals and Municipal Undertakings.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at 90 Deansgate, Manchester), at 4.—S. G. Smith: Notes on Foundry Practice.

ELECTRICAL ASSOCIATION FOR WOMEN.—Visit to All-Electric Farm of Mr. Borlase Matthews, Greater Felcourt, East Grinstead.

MONDAY, OCTOBER 4.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—Capt. W. J. Liberty: The History of Artificial Lighting.

INSTITUTION OF AUTOMOBILE ENGINEERS (The College, Loughborough) (Loughborough Graduates' Centre), at 7.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Dr. E. K. Rideal: Recent Advances in Catalysis.

INSTITUTION OF THE RUBBER INDUSTRY (London Section) (at Engineers' Club, Coventry Street, W.), at 8.—Dr. E. A. Hauser: The Problem of Rubber Latex Concentration and the Industrial Application of Concentrated Latices.

TUESDAY, OCTOBER 5.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall, Westminster), at 7.—A. H. Barker: Panel Heating.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-on-Tyne), at 7.30.—Dr. C. J. Smithells: Preparation and Metallography of Metal Filaments.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Automobile Club), at 8.—H. K. Thomas: The Debt of the Country to the Automobile (Presidential Address).

WEDNESDAY, OCTOBER 6.

INSTITUTION OF SANITARY ENGINEERS (at Caxton Hall, Westminster), at 6.30.—G. B. Chilvers: Housing Problems, with special reference to Subsidies and Rural Needs.

INSTITUTION OF AUTOMOBILE ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—H. K. Thomas: The Debt of the Country to the Automobile (Presidential Address).

INSTITUTION OF THE RUBBER INDUSTRY (Birmingham Section) (at Grand Hotel, Birmingham), at 7.—Dr. E. A. Hauser: What is Rubber?

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 20 Trongate, Glasgow), at 7.15.—The Functions and Scope of our Society—Discussion opened by Chairman.—Demonstration of Lighting.—G. Moore, Jun.: Notes on the Testing of Disinfectants by the Rideal-Walker Method.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—A. Chaston Chapman: On the Presence of Compounds of Arsenic in Marine Crustaceans and Shell Fish.—A. R. Tankard and D. G. T. Bagnall: The Examination of Fish for Formaldehyde.—K. Sandved: Potentiometric Titration of Tin with Potassium Bromate.—R. R. T. Young: The Determination of Nicotine in Tobacco.

THURSDAY, OCTOBER 7.

HOSPITAL FOR SICK CHILDREN (Great Ormond Street), at 4.—Dr. Cockayne: Rickets as it is seen to-day.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 7.30.—L. S. Gullivan: Informal Illustrated Lecture on Architecture for Workers in the Building Trades:—The Job.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (in Chemical Department, Bristol University), at 7.30.—F. H. Carr: Insulin and its Manufacture.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 8.30.—The Master of Sempill: Aero Engine Fuels of To-day and To-morrow.

FRIDAY, OCTOBER 8.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—N. J. Griffin: A Survey of Modern Airless Injection Oil Engines.

SATURDAY, OCTOBER 9.

BIOCHEMICAL SOCIETY (at Cambridge).

PUBLIC LECTURES.

SUNDAY, OCTOBER 3.

GUILDHOUSE (Eccleston Square, S.W.1), at 3.30.—Sir Richard Gregory: The Worth of Science.

MONDAY, OCTOBER 4.

UNIVERSITY COLLEGE, at 5.—R. J. Lythgoe: The Special Senses. (Succeeding Lectures on October 6, 11, 13, 18, 20, 25, and 27.)

WEDNESDAY, OCTOBER 6.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 6.—G. Wood: Calculating Machines.

UNIVERSITY COLLEGE, at 7.—A. H. Barker: The Engineering Plant of University College Hospital.

THURSDAY, OCTOBER 7.

BEDFORD COLLEGE FOR WOMEN, at 2.—Prof. Wilson: Introduction to Physics.

UNIVERSITY COLLEGE, at 3.30.—Sir Flinders Petrie: Influences of Egyptian Art.—At 5.15.—Dr. T. G. Pinches: Recent Discoveries in Babylonia. (Succeeding Lectures on October 14 and 21.)

KING'S COLLEGE, STRAND, at 5.—Dr. C. Da Fano: Histology of Nerve Tissues and Paths of Conduction in the Central Nervous System. (Succeeding Lectures on October 14, 21, 28, November 4, 11, 18, 25, December 2 and 9.)—At 5.30.—Prof. E. V. Appleton: Wireless Telegraphy. (Succeeding Lectures on October 14 and 21.)

FRIDAY, OCTOBER 8.

UNIVERSITY COLLEGE, at 5.—R. K. Cannan: Biological Oxidation-Reduction. (Succeeding Lectures on October 15, 22, 29, November 5, 12, 19, and 26.)

SATURDAY, OCTOBER 9.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Mrs. Robert Aitken: Life in a Red Indian Family.

SUNDAY, OCTOBER 10.

GUILDHOUSE (Eccleston Square, S.W.1), at 3.30.—Dr. Bernard Hollander: Sound and Unsound Mind.

CONGRESSES.

OCTOBER 13 TO 26.

GERMAN SOCIETY FOR THE STUDY OF DISEASES OF DIGESTION AND METABOLISM (at Berlin).

OCTOBER 25 TO 28.

ITALIAN CONGRESS OF SURGERY (at Padua).

SATURDAY, OCTOBER 9, 1926.

CONTENTS.

PAGE
Geography and Town Planning 505
Anti-Fundamentalism. By Dr. B. Malinowski . 506
Aids for the Spectroscopist. By H. D. 509
Rubber: Natural or Synthetic? 510
Our Bookshelf 512
Letters to the Editor:
  The Kerr Effect in Wireless Transmission.—Prof. E. V. Appleton 514
  Early Egypt and the Caucasus.—Sir Flinders Petrie, F.R.S. 514
  Variability of Species.—Dr. R. A. Fisher and E. B. Ford 515
  The Atomicity of Electricity as a Quantum Theory Law.—Dr. Oskar Klein 516
  The Rôle of the Cerebellum in the Co-ordination of Animal Movement.—Prof. Frederick R. Miller and Dr. N. B. Laughton 515
  The Action of Silica on Electrolytes.—Prof. J. N. Mukherjee 517
  The British Patent Office.—Ernest E. Towler . 517
  Apocryphal Medical Science.—Prof. Aldo Castellani, C.M.G., Dr. George C. Low, Dr. David Nabarro, and Sir Ronald Ross, K.C.B., F.R.S. 518
  Kammerer's Alytes.—Dr. G. K. Noble . . 518
  Variation of Penetrating Radiation on the Jungfrau.—W. Kolhörster and G. von Salis . . . 518
Function and Design. By Prof. J. B. Leathes, F.R.S. 519
Francis Bacon and Scientific Method.—II. By Dr. C. D. Broad 523
The Tropical Cyclone. By E. V. Newnham . . 524
The Reported Conversion of Hydrogen into Helium 526
News and Views 527
Our Astronomical Column 531
Research Items 532
Jubilee of the Mineralogical Society . . . 535
Classification of Amœbæ 536
Ventilation in Factories 536
International Agreements affecting Port Sanitary Work 537
The Measurement of Ocean Currents. By H. W. H. 538
University and Educational Intelligence . . . 538
Contemporary Birthdays 539
Official Publications Received 539
Diary of Societies and Public Lectures . . . 540

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Geography and Town Planning.

TWO papers presented to Section E (Geography) at the recent Oxford meeting of the British Association—one on Manchester, the other on London—formed the introduction to an important discussion on "Regional Work in Geography." The Town Planning Act, 1919, made possible the reshaping of existing towns and the determination of the lines of future growth. Thirty-seven joint committees have now been formed, including altogether more than five hundred authorities and covering an area of some six million acres. The regions affected differ considerably in area. The Manchester and district region has an area of more than one thousand square miles, and includes about a hundred local authorities; Worthing and district consists of three councils and about fifteen thousand acres. The object of these committees is to lay down in general the lines of road development, housing schemes, and localisation of industries. These somewhat procrustean methods of shaping the geographical future of our towns and countryside are advocated on two main grounds. Some urge the increased industrial efficiency of the region, in which case, road building and the settlement of industrial sites are paramount. Others give precedence to the preservation of historical associations and of scenic beauty, as illustrated by Prof. Abercrombie's work on the future development of east Kent.

That the haphazard growth of our centres of population should no longer continue is eminently desirable; that pushful industry should no longer, like a flood, swallow up all other regional functions is equally desirable. But who is sufficient for these tasks of regional reorganisation? In the light of present developments, should we now approve or disapprove of the purchase of Trafford Park, Manchester, as a public recreation ground? Once the new coal pits of the Sherwood district are raising their maximum output, are we able and do we desire to overcome the enormous attraction the new coalfield will exert on innumerable industries with their regional associations? Few administrative authorities wish to strangle the goose that lays the golden egg.

One danger of this rapid development of regional planning is the lack of knowledge of how the present adjustment has come to be. No doubt economic or administrative pressure can be sufficiently exerted to compel a certain town plan, but if undue pressure is exerted on what would be its normal growth, there will be a tendency towards restricted growth, possibly deformity and decline. To predict the lines of future urban development is asking much of the prophetic powers of man. His only guide is a clear understanding of the growth of places which offer parallels to his own.

This study has been strangely neglected, and the geography of a place has too often been confounded with its economics or the history of its people. Mr. Fitzgerald showed that we are not yet in a position to assess the physical factors continuously emphasising the nodality of Manchester-Salford, and the civic factors which make for the urban independence of the surrounding textile towns. Yet this assessment must be made before the question of federation can be reasonably approached. Economically there would appear to be every reason for the amalgamation of Manchester and Salford. Actually, the citizens of the twin cities are separated by more than the width of the Irwell. Trafford Park, with more than a hundred different industrial undertakings and more than twenty-five thousand work-people, is such an integral part of the Manchester-Salford industrial centre that it would seem an anomaly for it to remain within the two areas of the urban district of Stretford and the rural division of Davyhulme. But what should be the boundary determinants of a single municipal authority, and what weight should be given in particular to historical precedents, to economic necessity and to physical conformity and advantage?

The latter, or site factor, makes the primary appeal to the student of geography. Liverpool has not been able to hold the cotton textile industry at the port. In spite of the serious handicap of haulage of raw material eastwards and manufactured goods westwards across thirty miles of difficult country, cotton has been attracted to the upper Mersey basin within the Pennine and Rossendale gritstone moors. But while Liverpool has failed to accomplish this economic enterprise, Manchester has improved on the handiwork of Nature by converting the unnavigable Mersey-Irwell river into a navigable ship canal. It is this estimate of the extent of man's control over the site of his economic activities which makes town planning for future generations so difficult.

Mrs. Ormsby in her paper on London pointed out the practical difficulties in the acquisition of data upon which town planning must be made. The larger and more complex the area, the greater is the need for some kind of 'plan.' But it is precisely in these cases where extensive co-operation and collaboration is required. In London, for example, the geography—both pure and historical—of each small area needs intensive study before a correct view of the whole can be made. A prerequisite is therefore the development of a technique which will enable the results of workers in different centres to be correctly and fully co-ordinated, and also will ensure in the maximum degree similar lines of investigation and the elimination of the personal equation. Mrs. Ormsby defined the first step in the geographical survey as the production of a base map (scale six inches to a mile) to show so far as possible the general physiographical conditions underlying present distributions. This map should show ground forms by selected contour lines of reasonably close interval and surface deposits, especially such as gravels and clays. The plotting of population distribution at various periods is equally important and much more difficult. It is to be hoped that the research committee of the British Association at present investigating the method of construction and reproduction of a provisional population map of the British Isles will be able in the near future to consider the best methods of plotting urban populations.

The similar plottings of houses of different character, of factories and industries in conjunction with the site and population, indicate the lines of historical adjustment. It is essential that these lines, however much they may be deflected, shall be continued unbroken in all schemes of town planning of existing and old-established human settlements.

Anti-Fundamentalism.

The Ascent of Man by Means of Natural Selection. By Alfred Machin. Pp. xx + 325. (London: Longmans, Green and Co., 1925.) 7*s.* 6*d.* net.

MOST European students are inclined not to take Fundamentalism very seriously; but its power and expansion in the United States are truly alarming. Nor is there any certitude that it will not jump the Atlantic. As a symptom, moreover, it is disquieting. It shows how frail is the hold which science has on modern civilisation; how easily its scope can be mistaken; how strong is the antagonism against the cold light of research, when it dispels man's claims to be the aim of creation. Fundamentalism is certainly not only the most ludicrous but also among the most depressing phenomena of recent intellectual life.

It is well, however, to realise that we cannot blame only the 'crude mystic' and 'uncouth Methodist or Baptist' for Fundamentalism—the Rationalist, as he likes to call himself, is quite as much at fault. There is a tendency among the left wing of scientists to puff up any general principle of science into a metaphysical truth; to build a regular mythology around it; to coin it into dogmas and to make it drag a heavy load of moral responsibilities. Monism, energetics, relativity, the fourth dimension have all been paths from science into dogmatics, and recently we have seen even a new decalogue built upon a crude misapprehension of biological and eugenic ideas. Evolution has been mishandled more frequently than any other principle at the hands of a Hegel and a Comte, of a Herbert Spencer and an Ernst Haeckel. The present book is yet another attempt to play into the hands of fundamentalists by making evolution a rival and an enemy of other metaphysical and religious systems.

The writer takes as his motto the fine phrase by Sir Arthur Quiller-Couch: "The *Origin of Species*—the biggest book of this century, and a new Gospel for the next to think out." Mr. Machin seems to take the expression 'new Gospel' too literally. "The Teaching of Evolution *v.* the Teaching of Religion" is the heading of one of the concluding chapters. In this the author seriously discusses whether Christianity could not be, and should not be, replaced by Darwinism. This latter is naturally made to win the contest, though in an essentially pacific manner. "In the midst of all these contending factions, evolution in the light of natural selection puts forward an olive branch, offers a solution of their various problems, and an explanation of their numerous difficulties" (p. 298). The rôle of a peacemaker is notoriously invidious, and it is to be feared that the solution will not be accepted graciously by the belligerent brands of Christianity and of other creeds. The peacemaker puts himself in a still more precarious position by drawing up a list of "charges which evolution makes against Christianity."

When, however, the charges are laid down, it is not only the orthodox Christian but also the man of science who feels taken aback. For "the practical impeachment [against religion] is this: . . . religion does not teach patriotism as the first of all the virtues; it does not teach the fundamental necessity of economic laws; it does not recognise that patriotism, diligence, and self-denial are the primary virtues, from which alone the sentiments of morality and brotherly love can spring. As a minor charge it will be asserted that there is no true place in Christian philosophy for the recognition of the imperative need for recreation, for physical sports" (p. 298).

'Patriotism' is a word which covers a multitude of sins. Mr. Machin, however, leaves us in no doubt as to his real meaning. His is a patriotism which would be dear to the militarist or even war-time propagandist. We are told that "all developments in the arts of civil life are governed by the arbitrament of war" (p. 175); and, again, that "in the struggle between the different societies it is war—the arbitrament of the sword—that decides the issue" (p. 216). "The first and most obvious fact is that providence is on the side of the big battalions" (p. 216). "Clearly there has been a constant struggle for existence between different tribes" (p. 174). This sort of apotheosis of militaristic ideas would be distasteful to most students, especially as it is presented as the main ethical claim of science as against religion. Science is not specially concerned with the preaching of any type of morality, and the recent ethics of militarism have not brought them nearer to our heart. But the real question for the student is as to the truth and validity of the above assertions. The historian, the anthropologist and the sociologist are bound to deny them categorically. When we are assured that "War between human societies corresponds largely to the struggle for existence in nature" (p. 171), the author commits a mistake made already by early Darwinian enthusiasts and long since repudiated by Kropotkin in "Mutual Aid," Novicow in his "Critique du darwinisme social," and many others.

Mr. Machin adds to this another fact: "The arbitrament of war, it has been remarked, is decisive. Societies that are destroyed by other societies are eliminated from the history of the human race" (p. 173). In this the inaccuracy of his generalisation is blatant. Could there be quoted the case of a single society that has been *exterminated* by war? Even white man has to use subtler and more complicated poisons to deal with his brown coloured brethren before he destroys them completely. In fact, we are dealing here with some of the most difficult and fully discussed questions of anthropology and the science of history. The author seems to be unacquainted with the vast literature of the subject. He advances off-hand solutions of questions upon which volumes have been written, and is thus unable to contribute anything to the advancement of our knowledge. His use of terms is often loose, his logic not above criticism, and his acquaintance with facts very indirect. It is remarkable that in a previous chapter he himself criticises the application of the 'struggle for existence' to human history. He inveighs against Treitschke, Nietzsche, and Bernhardi—the classical trio of British war-time propaganda—only to repeat their mistakes in the crudest manner in the later part of his book.

Another discovery which evolution "as religion" has allowed the author to make is "the importance of wealth." "Evolution is thus primarily not an account of the growth of brain power, of 'goodness,' of social subordination, of increasing differentiation, or the development of super humanity, but of these only as they may have contributed to the improvement of man's estate, to his increasing understanding and control over his environment—to his growing prosperity" (p. 218). This sounds like an exaggerated statement of historical materialism pure and simple. Here again we have a restatement of a point of view so much repeated and debated that it has grown stale for the sociologist. Yet the author, judging from his quotations, is unaware of the existence of Marx, Loria, H. Cunow, and of such of their opponents as Benedetto Croce, Schmoller, and others.

Against the charges of social Darwinism and extreme Marxism the author might shelter himself behind a number of chapters in which he extols altruism and righteousness, parental love and filial piety, the obedience to law and general good temper. Mr. Machin does not even forget the amenities of life, sports and amusements, music-halls and moving pictures, which all form the virtues of the evolutionary metaphysician. Only to religion does he remain decidedly unfriendly and unfair. "The office of civil government, and more particularly of religion, is then essentially negative. . . . Progress, the advancement of individual and national prosperity is not due to religion" (p. 246). Many similar unfriendly sentiments might be adduced from Mr. Machin's chapter on law and religion.

These many virtues and ethical commandments of evolutionism—such as military truculence, Rotarian graspingness, parental love, righteousness, and love of amusement—are, however, not welded into any consistent scheme. At best it is made plausible that they are not inconsistent with the loosely conceived Darwinism. This might be considered satisfactory if we agreed with the author to regard Darwinism as a form of religion. Regarded as a mere scientific method or system of thought, Darwinism, or the theory of natural selection, cannot yield such a multitude of virtues.

Here we come to the really important question concerning the book. Apart from its metaphysical claims—with which it is quite impossible to come to any understanding—the book has a serious and methodologically interesting aim. One of its purposes is to apply the principle of natural selection to the development of culture and to illuminate several aspects of human civilisation in this manner.

To the average sociologist the promise of applying Darwinism to the study of culture sounds as would to the physicist another device for circumventing the first law of thermodynamics by a new plan for establishing perpetual motion. Natural selection, in the sense in which it is used by biologists, does not act on individuals of the human species, because culture stands between man and the selective action of Nature. In the very process of procreation man shows a radical difference as compared with the animal, in that he can and does control fertility and is able to protect the offspring beyond any limits which animals can reach. Mr. Machin, in fact, has seen this point and treated it more fully and intelligently in several of his chapters than most sociologists and anthropologists have done. Beyond parental care, 'mutual aid' is, as Kropotkin has shown, the rule in humanity rather than the 'struggle for existence.' The human individual, again, does not merely rely on anatomical endowment—he has the whole of material culture at his disposal. He is not adapted to his environment merely by his physiological processes and instincts—he has developed knowledge, belief, and tradition. In brief, the animal under conditions of Nature, and man under conditions of culture, show different forms of mating, of co-operation, of practical dealing with environment, in short, of adaptation. Cultural process is not identical with natural evolution, and biological principles cannot be directly applied to the study of man. This is the reason why even such brilliant attempts as those of Bagehot, of Gumplowicz, or of Enrico Ferri have not led very far, and anthropology from Bastian and Tylor up to Frazer and Westermarck has not attempted to apply natural selection to the comparative study of human society. There is, in fact, a considerable methodological literature on the subject of the delimitation between natural and cultural science—to mention only such names as Dilthey, Paul Barth, H. Rickert—and the new attack of the so-called historical school against anthropological evolutionism has justifiably pointed out the dangers of borrowing a method, a terminology, and a conceptual apparatus by one science from another.

Of all this Mr. Machin is apparently unaware. His anthropological quotations do not reach very far beyond Herbert Spencer, who is decidedly not sufficient as a source book and intellectual arsenal of anthropology and sociology. Of this it is impossible to make a valid charge against the present book, for Mr. Machin frankly calls himself a layman in the preface and admits that "this essay is based, in the main, on the works of the two giants of evolution theory—Darwin and Spencer." Nor is it possible to contradict him on this point, for the present book contains no original research, no addition to method, and no really new principles. Perhaps the one exception to this is the discussion of the difference between the regulation of animal and human fertility in the second section of the book. This discussion, however, has no direct bearing on the main anthropological part of his contribution.

There is one aspect, however, under which this book is of considerable importance in spite of its serious shortcomings; and that is the reason why it has been necessary to criticise it more fully instead of damning it with faint praise. Although any attempt to apply the principle of natural selection to the evolution of human culture must, in the opinion of the reviewer, prove unsuccessful, such an attempt raises once more the capital problem of anthropology. Mr. Machin's book reminds us again that man has evolved from lower animal species and that this cannot be denied by any one except the crazy fundamentalist. Human culture again, has evolved from the state of Nature, from a zero level, so to speak. Both these facts bring up the problem: What is the action of natural conditions upon man? What is the difference between human relations to the environment and animal adjustment, what is the difference, in short, between evolution in biology and evolution in culture? The anthropologist of to-day is satisfied with pointing out, negatively, that the cultural process differs from the biological one. This is sufficient reason not to mix them up, but it is not a sufficient reason not to compare them. Only comparison can bring out the essential similarities as well as the differences in either process. Most modern anthropologists of the so-called historical school have been busy pooh-poohing the concept of human evolution and the study of the origins of institutions and the causes of progress.

All these questions are constantly raised by the argument of the book reviewed. Some of the arguments may have to be rejected, but they will have to be replaced, for Mr. Machin has the great gift of seeing the problem and formulating it clearly—a gift of more value in science than the facility to solve irrelevant and imaginary questions. The author is handicapped by his out-of-date reading, by his adhesion to his authorities, and by a lack of first-hand acquaintance with his material. But in honesty of thought, lucidity of exposition, and clarity of style the book is often excellent, and through these virtues it is especially fitted to suggest the real problems to the anthropologist. It is a work which no student of man should omit to read. Science does not thrive by mere avoidance of errors, but by resolute grappling with real problems. From this point of view Mr. Machin's book is a more valuable contribution to anthropology than many modern works which startle us with revelations about the 'diffusion' of culture from Egypt, Atlantis, Yucatan, or some other Garden of Eden. Anthropology will become a useful science only after it has realised once more that the problems of evolution of culture cannot be shirked any more than the problems of evolution of species. If Mr. Machin's book helps in combating anthropological fundamentalism—the bitter opposition to evolutionary thought within the science of man—it will have fulfilled its mission, even though we must reject it as the "new Gospel."

B. MALINOWSKI.

Aids for the Spectroscopist.

(1) *Tabelle der Hauptlinien der Linienspektra aller Elemente nach Wellenlange geordnet.* Von Prof. H. Kayser. Pp. vii + 198. (Berlin: Julius Springer, 1926.) 24 gold marks.

(2) *Atlas de spectres d'arc: tableaux d'analyse pour les recherches spectrochimiques.* Par Dr. Jacques Bardet. Pp. 55 + 54 planches. (Paris: Gaston Doin et Cie, 1926.) 240 francs.

ONE of the outstanding features of recent progress in experimental physics is the remarkable development of research in spectroscopy. This is largely due to the efforts of theoretical workers who, although the precise physical meaning of their assumptions cannot always be assigned, have nevertheless achieved amazing success in constructing semi-empirical rules for the analysis of spectra. The generality and extremely suggestive character of these rules have inspired fresh investigations of the spectra of the majority of the elements, with the result, among others, that lists of spectrum lines which were once regarded as complete are being augmented to a surprising extent and at an unprecedented rate.

Such an accumulation of data, provided they be accurate, is an unqualified blessing, but its attainment is not unattended by considerable danger. Rapidity of progress does not always allow the application of the rigid and impartial criticism of every detail of the experiment which alone can ensure freedom from error. If, for example, a group of, say, seven lines is predicted in a spectrum, and the experimenter who has already obtained six of them ultimately finds the seventh, and weakest, on a well-exposed plate, the new line runs some risk of missing the stringent test for impurities which is its due. On the other hand, if an unexpected line, or one of uncertain behaviour, appears in a spectrum, it may be rejected as a possible impurity on the 'safety first' principle (a principle, by the way, which in practice often means 'safety only'), and the existence of an important line thereby lost sight of. We have known of recent examples of these and other sacrifices to the ideal of early publication which, in the long run, delay rather than advance progress.

(1) In order to minimise such dangers as these, Prof. Kayser, to whom spectroscopy already owes so much, has placed the scientific world under yet another debt of gratitude by the preparation of the first of the books before us. The table of 'Hauptlinien' at the end of volume 6 of his monumental 'Handbuch der Spektroscopie" (1913) has long been familiar to every spectroscopist, and in the new volume he has adopted the same general method of presentation as was employed therein. The progress of the last thirteen

years, however, has made some changes of detail necessary. The wave-lengths are now given only in international angstroms, Rowland's scale having become obsolescent. The values recorded are the weighted means of all the observations available, and are given only to such a degree of accuracy as the compiler considers trustworthy. The limits of wave-length included have been extended at both ends of the scale, and the table includes fainter lines than the earlier list, so that the total number of lines (now about 19,000) is almost doubled. In the Schumann region, owing to the fact that, of necessity, only the stronger lines are at present observable, all the recorded lines are included. Another modification of the original table is the indication of the degree of ionisation (where it is known) of the element to which a line belongs. Thus, λ 5889·965 is no longer recorded as Na, but as NaI. About 15 per cent. of the stronger lines can at present be so classified.

It is needless to point out the value of such a book as this, or to comment on the excellent manner of its production. It is obviously indispensable to every experimental spectroscopist.

(2) The atlas of M. Bardet is designed to encourage and facilitate the use of spectrum analysis by chemists. It comprises 48 principal plates and a few supplementary ones intended to illustrate special features of the process. Each plate of the main set shows the prismatic spectrum of iron as seen in the microscope, with an adjacent scale of angstroms. Above this spectrum vertical lines are drawn at the positions occupied by the lines of the various elements (the chemical symbol, approximate wave-length and intensity being placed against each line for identification), and it is intended that the experimenter, having photographed the spectrum of the material to be examined in contact with that of iron, shall compare his negative with the atlas and so identify the unknown lines. The 48 plates are divided into six series, in each of which the iron spectrum over the range λ 3500-λ 2500 is shown in 8 plates. In the first series the adjacent lines include all the lines of the elements with fairly simple spectra, and the most characteristic lines of the remaining elements, as they appear in the spectrum of the arc. The remaining series show, in greater completeness, the positions of the lines of the more complicated spectra, each series being devoted to a particular group of elements. In this way over-crowding of lines is satisfactorily avoided.

The iron spectra, though originally drawn by hand, are faithfully copied, and simulate the appearance of photographs remarkably well. The wave-lengths are taken from the tables of Exner and Haschek, and are given in terms of Rowland's scale. The method of using the atlas (in which full use is made of the *raies ultimes* of de Gramont), together with instructions relating to the whole process of spectrum analysis, is given in detail in an accompanying brochure, which contains also a preface by M. Urbain in which the neglect of spectrum analysis by chemists is discussed and deplored.

Both in design and in execution the work is excellent, and the accompanying notes testify to the wide experience of the author in this branch of study. The production should prove of great value not only to chemists but also to all who have occasion to use spectrum analysis. The author is to be congratulated on meeting an obvious need so effectively, and it may be confidently predicted that his work will be widely used. When, however, M. Urbain, in the preface, claims that M. Bardet " est probablement le seul homme au monde qui, d'un rapide coup d'œil jeté sur un spectre, puisse énumérer immédiatement les principaux corps qui l'ont produit," he is presumably thinking only of chemists. There are spectroscopists of much longer experience than M. Bardet who acquired this faculty many years ago.

H. D.

Rubber: Natural or Synthetic?

Synthetic Rubber. By Dr. S. P. Schotz. Pp. 144. (London: Ernest Benn, Ltd., 1926.) 21*s*. net.

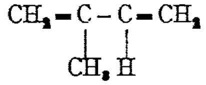
THE meaning of the title of this book, although sufficiently clear to satisfy the general public, is, from a scientific point of view, entirely unsatisfactory. The author evidently feels this when in the first few lines he writes:

> " Even samples of natural rubber probably differ widely in details of constitution. To attempt to reproduce a synthetic rubber of exactly the same constitution as a specific natural rubber would be difficult and futile. Fortunately it is possible by synthetic means to obtain substances which are constituted similarly to natural caoutchouc as far as the linking of the various hydrocarbon groupings is concerned, having similar physical properties and offering the same resistance to chemical reagents and mechanical influences. The whole development of this coming industry is tending in that direction."

It is therefore clear that the word ' rubber ' is applied to a number of substances or, rather, mixtures of substances which possess certain physical properties in common which are more or less standardised.

Natural vegetable products are rarely found in a chemically pure state: if the substance is a solid of relatively low molecular weight, it is usually capable of being obtained in a state of purity by some method of crystallisation. If the vegetable product is a liquid, it can frequently, but not always, be purified by fractional distillation either under ordinary conditions or under reduced pressure. When the substance is a colloid of high and unknown molecular weight, the above-mentioned methods of purification are not available. It is true that, in the case of most natural caoutchoucs, the greater part, if not all, of the comparatively small amount of 'impurities' it contains can be removed by selective solvents, leaving a residue of presumably pure matter which on analysis gives figures corresponding to the general formula $(C_5H_8)_x$. On subjecting this matter, or the unpurified caoutchouc, to destructive distillation, various hydrocarbons are produced mostly possessing the same percentage composition, but of lower molecular weights than the original substance, and amongst them the key substance to the synthesis of caoutchouc is found. This is the simple hydrocarbon, isoprene, C_5H_8, boiling at about 33°-34° C.

Isoprene was first obtained by Himly in the year 1835 by the destructive distillation of rubber, and was later examined by a number of chemists, but its structure was first determined by Sir William Tilden as being β-methyl butadiene:



$$CH_2=\underset{CH_3}{C}-\underset{H}{C}=CH_2$$

Tilden obtained isoprene by the destructive distillation of both caoutchouc and turpentine, and satisfied himself that the light hydrocarbons obtained from both sources were identical. He further found that, on keeping for a short time, the very mobile isoprene became viscid and, after a period of some years, produced a white solid which had most of the properties of india-rubber. He also examined the catalytic action of a large number of substances on isoprene and came to the conclusion that isoprene was the parent substance of caoutchouc. Other chemists afterwards worked upon the production of isoprene, but almost entirely from a scientific point of view, and the possibility of a commercial synthesis of rubber was not seriously considered until about 1910, when the shortage of rubber and its rise in price to about 10*s.* per pound caused a large amount of work to be undertaken to see whether rubber could be produced commercially.

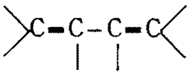
The problem was attacked seriously both in Great Britain and in Germany. Messrs. Strange and Graham organised a group of research workers in the former, and in the latter the like work was undertaken by the Farbenfabriken vorm. F. Beyer and, to a lesser extent, by the Badische Anilin- u. Soda-Fabrik.

At first the work in both countries consisted chiefly in exploring any possible routes by which isoprene could be produced cheaply. The most obvious method, namely, the cracking of turpentine, was soon abandoned, as the yield of isoprene was too small to be remunerative. Of organic compounds containing 5 atoms of carbon, the most promising seemed to be normal pentane, isopentane, and isoamyl alcohol, occurring in fusel oil.

Normal pentane itself is not, theoretically, a good starting-point, as it contains a straight chain of 5 carbon atoms and, unless isomerisation took place during the series of reactions, only an isomer of isoprene could be obtained. The isopentane route was also explored, but was not persevered with owing to the difficulty of obtaining the raw material in sufficient quantity at that time. Isoamyl alcohol was found to be a good raw material, but it could not be obtained either in sufficient amount or at a suitable price.

The English workers then attempted to get increased quantities of isoamyl alcohol by a fermentation process and, with the help of Prof. Fernbach of the Pasteur Institute, a bacterium was isolated which, acting upon starchy material, produced not isoamyl alcohol but normal butyl alcohol and acetone in a yield of nearly 50 per cent. of the starch taken. Meanwhile the German chemists seem to have reached more or less the same conclusion as their English rivals.

It was known by this time that hydrocarbons possessing the conjugated double linking



$$>C=\underset{|}{C}-\underset{|}{C}=C<$$

were capable of being polymerised into rubber-like substances. As substances of this type containing 5 carbon atoms were not easily obtainable, the German work concentrated upon members of this group containing 4 and 6 atoms of carbon. The 4-carbon substance, C_4H_6, known as butadiene, divinyl, or erythrene, was obtainable in various ways, but no completely satisfactory raw material was obtainable and the Fernbach bacillus was not available to them. They therefore concentrated chiefly upon the 6-carbon member β-γ-dimethyl butadiene or di-isopropenyl. This substance could be obtained fairly readily from acetone, which was reduced to pinacone, from which di-isopropenyl was obtained without difficulty.

The English group, now having plentiful supplies of *n*-butyl alcohol, worked almost exclusively upon the best method of converting this substance into butadiene, which was by now known to polymerise into a substance having similar properties to the polymer produced from isoprene. The raw materials and methods of producing the hydrocarbons C_4H_6 and C_6H_{10} having been provisionally settled, work now concentrated upon methods of polymerising these into rubber-like substances. Here both groups, almost simultaneously, hit upon the same method, namely, by means of metallic sodium, but the English group, owing to a priority of a few days in the date of the patent specification, succeeded in upholding their patent rights both in Great Britain and in Germany.

It appeared afterwards from the work of Harries on the ozonides of rubbers that so-called sodium rubbers were not identical with the rubbers obtained by simple heat polymerisation. They had, however, remarkably good properties as regards elasticity, etc., and Harries in a paper in the *Annalen* looked upon sodium butadiene rubber as being the best synthetic rubber produced. These rubbers were capable of being vulcanised like natural rubber, which improved their properties considerably, but the 6-carbon rubber, although made on a considerable scale in Germany during the War, did not possess the elasticity of its lower C_4 homologue and was very prone to undergo destruction by oxidation in air. On the other hand, a sample of sodium butadiene rubber recently examined after keeping for a period of thirteen to fourteen years was found to possess its original properties practically unimpaired.

The important question arises: Will synthetic rubber ever supplant the natural substance? This in the opinion of the writer of the present article is entirely a matter of price. Rubber can be produced on well-managed estates at about 8*d.* per pound. At the present artificial price of 1*s.* 8*d.* per pound synthetic rubber is bound to come shortly, and the probable source will be American petroleum.

Reverting to Dr. Schotz's book: it gives a clear and not too technical account of the art of making synthetic rubber as known to-day. It is fairly free from mistakes, but some have been noticed. On p. 58 bauxite is classed as a hydrated iron compound. On p. 64 1:3 dimethyl butadiene should be 2:3. The book is somewhat marred by the introduction of plates, dealing with machinery for rubber manufacture, which have no connexion with the subject matter. On the whole, a very readable and interesting account is given of a very technical subject.

Our Bookshelf

British Museum (Natural History). Catalogue of the Machæridia (Turrilepas and its Allies) in the Department of Geology. By T. H. Withers. Pp. xv+99+8 plates. (London: British Museum (Natural History), 1926.) 7*s.* 6*d.*

On account of their sabre- or blade-shaped form, the name Machæridia is proposed for the group of Palæozoic fossils which comprises the genera Lepidocoleus, Turrilepas, Deltacoleus, and Plumulites. These genera are undoubtedly related to one another, but their systematic position has long been a matter of dispute. Although regarded by some authors as Mollusca (Polyplacophora), Cystidea, Annelida, or Trilobita, they have usually been referred to the Cirripedia; and several writers have looked on them as the ancestors of the stalked barnacles of later times. This view, which is based largely on a comparison with the Chalk form Stramentum (Loricula), is shown by Withers to be untenable, since that genus is now known to be an aberrant type representing a specialised side-line of development from the scalpelliform barnacles, and further, none of the Palæozoic genera can be proved to be Cirripedia, the earliest undoubted representative of that group being found in the Rhætic beds.

In the Machæridia the shell apparently covered the whole of the soft parts of the animal; it consists of either two or four columns of plates and could open along the whole of the sharp edge, and the plates along the thick margin show muscle-scars indicating the presence of a series of transverse muscles. The fact that the plates in some genera consist of crystalline calcite and show a reticulate structure suggests relationship with the Echinoderma, while the imbrication of the plates and the character of their ornamentation may indicate a connexion with the Cystidea. In his preface to the volume, Dr. F. A. Bather shows that he is inclined to accept this view of the affinities of the Machæridia, and suggests that the Heterostelea and Machæridia are among the earliest offshoots of the echinoderm stem and differ from all other classes of echinoderms in not having had pentamerism and the other echinoderm features impressed on them during an ancestral period of fixation.

Although bearing the modest title of "Catalogue," this work is really of the nature of a monograph and deals in a thorough manner with all the species known. The eight plates are excellently reproduced in collotype from photographs by H. G. Herring.

The Wonder and the Glory of the Stars. By Dr. George Forbes. Pp. 221 + 16 plates. (London: Ernest Benn, Ltd., 1926.) 8*s.* 6*d.* net.

We have much enjoyed reading Prof. Forbes's book, which consists largely of a selection of his numerous lectures delivered during the last twenty-two years and of related essays. The title is a true indication of the author's wish to convey something of his own enthusiasm for the wonders of the night sky accessible to all who care to look for them. Prof. Forbes has long been associated with astronomy, and he has watched its widening horizon from the early days of stellar spectroscopy and astronomical photography. A personal touch is conveyed to the reader by occasional reminiscences of men and events, including an account of a night spent by the author in 1871 at the Vatican Observatory with Secchi and his spectroscope, and impressions of meetings of the Royal Astronomical Society in 1926 which enter into the theme of the last chapter entitled "Fairy Tales by Astronomers."

As already indicated, the book lays no claim to being an elementary text-book of astronomy, but comprises a series of self-contained, yet interdependent articles, the popular nature of which is fully indicated by most of the titles—"Surprise Visitors among the

Stars," "Tornadoes in the Sun," "Stars and their Wireless Messages," etc. By this method of treatment, the reader who scans the pages from cover to cover in an evening or two must necessarily encounter some unavoidable repetition of salient facts. On the other hand, a few points of general interest have been omitted. No mention is made, for example, of the *cyclical* change of the shape of the sun's corona. The description of Cepheid variables might well have contained a few sentences concerning their use in the determination of stellar distances. Again, in the chapter on "Greenwich Observatory" a brief reference is due to the instrument which produced the original of Plate VI., as being typical of another branch of routine work carried on for more than fifty years. It may be added that the type is scarcely large enough for a popular work. There are very few misprints, but the index is defective in a few places. The illustrations are a pleasing feature and include several of the most recent astronomical photographs, the reproduction of which is above the average standard for books of this kind.

A Manual of Elementary Zoology. By Dr. L. A. Borradaile. (Oxford Medical Publications.) Fifth edition. Pp. xvi + 670 + 16 plates. (London: Oxford University Press, 1926.) 16*s.* net.

DR. BORRADAILE'S "Manual" is well known to all teachers of zoology, and, to judge from the frequency with which new editions appear, it must also be well appreciated by students. In these circumstances praise is superfluous and interest centres on the changes which the new edition shows. The most important of these are in the accounts of the movement of Amœba and of the relation of individuality to metabolic gradient, while the introductory chapter, the chapter on reproduction and sex, and that on the animal in the world, have been rewritten—and much improved.

A good deal of new matter has crept into the book since its first appearance, with the inevitable result that the medical student meets in it much that does not concern him, while the pure zoologist finds some rather serious omissions and some cases of too extreme condensation. There is no mention, for example, of Helix, Peripatus, or Ciona, and the reviewer's experience of the chapters on evolution and embryology is that they are too compressed to be of great value to the student. No two authors, however, would solve the problem of what to omit in the same way. On the whole, Dr. Borradaile's choice is a wise one; he maintains a balance between morphology and philosophy which makes his book a scholarly treatise, and one that can be unreservedly recommended.

Elements of Photogravure, Photo Printing from Copper Plates: Screen Photogravure simply explained, with full Working Instructions and an Explanatory Chapter on Modern Rotary Gravure Printing. By Colin N. Bennett. (Lockwood's Manuals.) Pp. viii + 129. (London: Crosby Lockwood and Son, 1926.) 5*s.* net.

MR. BENNETT describes in clear and simple language every step of the process of the making of photogravure prints by the screen plate process, leaving the original dust-grain process with little more than a bare mention as out-of-date. He begins with the getting of the necessary apparatus and materials; and estimates the prime cost to one who has the usual photographic necessities at from 10*l.* to 15*l.* This includes a copper-plate printing press. The book appears to provide an answer to every question that a photographer, whether amateur or professional, might wish to ask during his first attempts at the process, even as to where the various items may be purchased. In order to render the volume more complete, the final chapter is devoted to the "Elements of Rotary Gravure," and on the last page Mr. Bennett says that he "does not hesitate to name rotary gravure as the best all-round solution of two and three colour photo-printing." Flat plate gravure is not well adapted for the superposition of two or more impressions, because the damping of the paper renders registration difficult on account of its expansion thereby, and because the capacity of the paper to pick up copper plate ink is much diminished after its first pull through the press.

Biology. By O. H. Latter. ("Science for All" Series.) Pp. vii + 197. (London: John Murray, 1926.) 3*s.* 6*d.*

THIS book may be confidently recommended wherever biology is taught as a subject of general education. Mr. Latter's long experience of biological teaching is an assurance that from the wide field of possible topics his choice will be a wise one, and his book is, in fact, a notable success. Its chapters are linked by the principles of the dependence of living things on one another, and their adaptations to their surroundings. Since it is assumed that time will not be available for general practical work, each chapter ends with a suggestion of suitable demonstrations, which need no special equipment beyond a few microscopes. Two features of the book will make it particularly helpful to its readers—its clear diagrams and Mr. Latter's practice of giving the Latin or Greek derivation of all technical words. He thereby removes, as nearly as possible, one of the chief difficulties of a young biologist—that of mastering the terms in which the science is described.

Grundzüge der mathematischen Erdkunde. Von Prof. Dr. Georg Wegemann. (Sammlung Borntraeger, Band 9.) Pp. 184. (Berlin: Gebrüder Borntraeger, 1926.) 6·60 gold marks.

PROF. WEGEMANN'S book is a compendium of astronomical and geodetic knowledge. It is mainly descriptive, with abundant numerical data; formulæ are quoted but not proved. Time measurement, including many systems not prevalent in modern Europe, the form and motions of the earth, astronomical errors of observation, and the nature of the principal perturbations of the moon's motion, are a few of the varied topics treated.

An Introduction to the Calculus. By Clement V. Durell and R. M. Wright. (Cambridge Mathematical Series.) Pp. vii + 91 + xi. (London: G. Bell and Sons, Ltd., 1926.) 2*s.* 6*d.*

THIS is a reprint, with slight modifications, of the section on calculus in Part 2 of the authors' "Elementary Algebra." The course meets the requirements of the School Certificate Examination conducted by the Oxford and Cambridge Joint Board.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Kerr Effect in Wireless Transmission.

MR. HOLLINGWORTH's observations (NATURE, Sept. 18, p. 409) on the polarisation of long wireless waves by day and by night are of great interest in connexion with the attempts which have been made to explain the diurnal variation of atmospheric influences on wireless transmission.

According to the original theory of diurnal variation proposed by Dr. Eccles (*Proc. Roy. Soc.*, A, vol. 87, p. 79, 1912), atmospheric deviation of wireless waves is produced during the day by ionic refraction in a somewhat diffuse layer in the middle atmosphere, while at night true reflection of all wave-lengths takes place from the sharp boundary of the Heaviside layer in the upper atmosphere. According to this theory, the difference between the 'reflection coefficients' of the day and night layers is due to the difference in the degree of variation of ionic content of the under boundaries of the layers

More recently (NATURE, March 7, 1925; *Electrician*, April 3, 1925) a somewhat different theory has been found useful in linking the mass of evidence relating to geophysical influences on wireless transmission which has accumulated during the last few years. According to this view, the increase of signal strength at night, which is noticeable particularly on the shorter waves, is attributed not to an increase in ionic gradient but to a general lifting of the layer after sunset. The reduction in the collisional 'friction' of the electrons in the layer, due to the increased height and lower pressure, makes deviation with reduced absorption possible. In this connexion it seems clear that the difference between reflection and refraction is determined by the ratio of the thickness of the transitional layer to the wave-length, and, since a transitional layer of several kilometres is contemplated both by day and by night, we may generalise roughly and say that long wireless waves are deviated by reflection and short waves by refraction. The gradient of conductivity (which is determined not only by the gradient of ionic content, but also by the gradient of τ, the time between two collisions of an electron with the gas molecules) is sufficiently high to deviate long waves within a wave-length, while the shorter waves are deviated by ionic refraction brought about by a diminution of the refractive index. Experimental evidence is steadily accumulating which shows that in the latter case ionic refraction without absorption is only brought about, as Sir Joseph Larmor first predicted on theoretical grounds, when the frequency of the waves is higher than the frequency of the electron collisions with gas molecules.

In linking up these ideas with the magneto-ionic theory, in which the effect of the earth's magnetic field on the motion of the electrons is taken into account, a Kerr effect was predicted (*Proc. Camb. Phil. Soc*, vol. 22, Part 5, p. 675, 1925) for long waves when reflected by the ionised layer at night. Mr. Hollingworth's observations on long waves seem to show that such an effect is appreciable. Considered in conjunction with Dr Smith-Rose and Mr. Barfield's observations with the Adcock system, they also constitute another confirmation of Mr. T. L. Eckersley's theory of the nature of directional errors.

A consideration of the magneto-ionic formulæ for the conductivity and dielectric constant of ionised gas shows that, in cases of reflection, there is a certain critical height in the atmosphere above which the conductivity in the direction of the earth's lines of magnetic force is appreciably different from that in a direction at right angles. This is the height at which the frequency of the electron collisions with gas molecules is equal to the angular frequency with which the electrons normally spiral round the lines of magnetic force. Taking the earth's field as 0·5 gauss, the critical value of τ is found to be equal to 10^{-7}. Estimates of both mean free paths and air pressures at different heights in the atmosphere, as given by different writers, vary somewhat, but from the available data we may, using the above value of τ, put the critical height somewhere about 70 km. to 80 km. When the waves are deviated below this height, practically no abnormal polarisation is produced, but when deviated above, both Kerr and Faraday effects will be produced according to the wave-length. The fact that the Kerr effect is found at night and not by day indicates that the ionised layer passes from or below this critical region to a height appreciably above it at sunset Current determinations of the height of the layer for these wave-lengths by day and by night support this conclusion.

E. V. APPLETON.

Wheatstone Laboratory,
King's College, London,
September 21.

Early Egypt and the Caucasus.

As the careful summary of the meeting on this subject at Oxford (NATURE, September 25, p. 463) stops short before my reply to the difficulties there raised, I trust that I may be allowed to complete the report. We must consider the reasons for retaining the view of the dependence of the Fayum on the Nile flow, which has been held by engineers, geologists, and historians during the last fifty years—much of history depends on the conclusions.

The essential question is to choose between the received view (*a*) that the Fayum lake gradually rose by the rise of Nile level up to 205 or 220 feet over the present lake, and was suddenly dried up by restricting the inflow, under the Ptolemies; or the new view (*b*) that there was a high lake in the early human period, which was gradually dried down to the present size. The complete drying up would not take more than twenty-five years.

For the view (*a*) there are six reasons. Physically there is (1) an open channel from the Nile, the mud in which is at least as low as the Nile was at 5000 B.C., and it is unlikely that this would become blocked when a large mass of water was flowing to and fro every year. (2) It would be impossible to maintain a lake at high level unless fed by the Nile; the adjacent deep basin of Wady Rayan has not had any historical lake, because there is no Nile inflow. Historically we see (3) there are an early cooking-pot, fire, and flints *in situ* at 170 feet level, while the water in Greek times must have been up to over 200 feet, by a site being called the "crocodile island," so the lake level was rising and not falling. (4) There is no trace of human work anywhere below the Nile level of its own age, which points to the lake covering the ground up to Nile level. (5) There are four structures of stone, all at the same level, which cannot be reasonably explained except as quays of late origin, and these are at 215 feet level, showing the late lake to have been far above the early flint work. (6) Direct evidence is that of Herodotus; he states that the water flowed for half the year out of the lake to the Nile, and he names the different amount of tax on fisheries during the inflow and outflow. These reasons for the old view (*a*) seem to outweigh the interpretation of traces of the lake levels, after 2000 years of denudation which are adduced for the new view (*b*).

The geologists made objections, which were unfortunately irrelevant, as to the relation of Badarian to Solutrean culture; for it would be useless to expect that different branches from one culture, travelling 3000 miles apart under very different conditions, should retain the same details.

Permit me to add a parallel to the view of there having been an Asiatic centre of distribution for the Solutrean, Badarian, and some western neolithic culture. In the thirteenth century there were European settlers in Greenland, who were later exterminated by advancing cold, and savage Eskimos, much as Solutreans were exterminated in Europe. In the seventeenth century the same race settled in Greenland again and in New England. An American archæologist in future might say that no resemblance could be seen between these invasions, the clothing of the first age was different from that of the second, the architecture and arms of the second age were unknown in the first. Yet we know, from fuller detail, that they were of one race and one culture. Differences do not count in such a question; resemblances are the trustworthy facts.

There were five independent subjects noticed at the above meeting, each of which has to be judged on its own evidence, and the settlement of one subject will not prove or disprove any of the others, though they are closely connected in results.

FLINDERS PETRIE.

Variability of Species.

THE writers have, on one hand, been examining the variability of thirty-five species of Lepidoptera, chiefly common British moths, and, on the other hand, studying the variation to be expected theoretically in a population exhibiting inheritance wholly on Mendelian lines, with the corresponding appropriate mutation frequencies, under the influence of natural selection. The conclusions at which they have respectively arrived show a sufficiently striking agreement to suggest a theory which may be generally applicable to the natural variability of wild species.

The actual variance exhibited is regarded as having been arrived at as an equilibrium condition between the action of mutations tending to increase variability, and of selections tending to diminish it. If in such an equilibrium the mutation rates, and also the selection rates, were the same for all species, then the variance would be proportional to the population of the species. We know of no reason for supposing that the mutation rates are different for species differing in abundance, but it is *a priori* probable that in abundant species individual survival is less fortuitous, and more selective, than in rare species; while it is easily demonstrable that in species in which a higher proportion of the total variance is ascribable to genetic causes, the effective selection will be more intense than in species in which the variance is to a larger extent ascribable to environmental variations. On these grounds we should expect the more abundant species to be, in fact, the more variable, though to an extent which can only be ascertained by observations.

Charles Darwin ("Origin of Species," Chap. ii.), in studying the causes of variability, attempted a statistical investigation of material relating to a large number of different species of plants. He was, perhaps unfortunately, dissuaded from publishing his actual tabulations, but gained the concurrence of Hooker to the general conclusions that "wide ranging, much diffused, and common species vary most." Darwin was concerned to show that it was not merely that wide ranging forms give rise to local varieties in reaction to different inorganic and organic environments, but also that, "in any limited country, the species which are most common, that is, abound most in individuals, and the species which are most widely diffused within their own country (and this is a different consideration from wide range, and to a certain extent from commonness), oftenest give rise to varieties sufficiently well marked to have been recorded in botanical works."

The accompanying observations concern not "well marked varieties," but individual variation in a continuously variable character, namely, depth of pigment of the ground colour of the forewing, the variability found being that exhibited in each case in a single locality. As is shown in Fig. 1, the average variance of the abundant species is almost double of that of those species which are comparatively uncommon; the values for males and females are shown by the lower and upper lines, the agreement of which gives some indication of the statistical trustworthiness of the results.

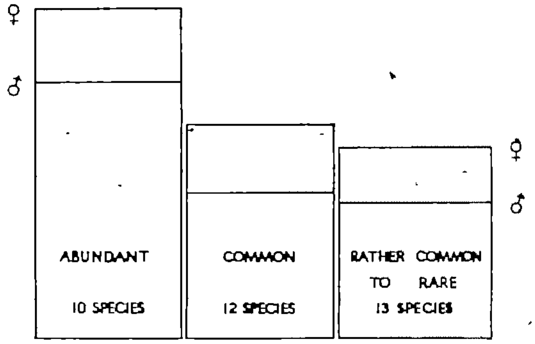


FIG. 1.

The data thus supply a complete confirmation of the conclusion arrived at on purely theoretical grounds; moreover, the fact that Darwin's observation with respect to "well marked variations" should be equally applicable to continuous variation would be unintelligible if, as is sometimes assumed, continuous variation had some origin distinct from the familiar Mendelian mutations.

Finally, the female moth is distinctly the more variable, the difference being nearly constant at about 38 per cent. for all degrees of abundance, this fact supplies a confirmation of theoretical anticipations of an unlooked-for kind. It has been argued (*e.g.* G. Dahlberg, "Twin Births, etc.," p. 231) that the sex with the greater number of sex chromosomes should therefore show the greater variability; a closer examination shows that this consequence will follow only if the dominant gene is, in the population concerned, generally less numerous than the recessive. (It should be noticed that this does not imply that the dominant genotype is generally the less numerous.) Our previous investigations (Fisher, 1922, *Proc. Roy. Soc. Edin.*, 42, 321) have, however, shown that in any character subject even to small selective influences the recessive gene will nearly always be the rarer. Consequently the heterogametic sex, which is the female in moths, should be the more variable, since a single recessive factor exercises its full effect in an XY chromosome pair, though in all other cases it requires also a recessive partner. Numerically, on the simplest assumptions, we should expect the variability due to the sex chromosome in the heterogametic sex to be increased by about 9 86 per cent., while that of the homogametic sex should be diminished by 27·47 per cent The difference is 51·5 per cent. of the smaller value, and on comparing this with our observed difference of 38 per cent it will be seen that either additional causes must be sought for the striking excess of female variation, or the greater part of the variation present must be ascribed to the sex chromosome, which is unlikely.

Whatever may be the explanation of this great apparent activity of the sex chromosome, the two main inferences from the statistical study of the effect of Mendelian factors under selection, (1) that variability in any one locality is greater for the more numerous species, (2) that it is greater in the heterogametic sex, have both been unmistakably verified in the body of material which we have examined.

R. A FISHER.

Rothamsted Exp. Station.

E. B. FORD.

Wadham College, Oxford.

The Atomicity of Electricity as a Quantum Theory Law.

IN the five-dimensional theory of the connexion between electromagnetism and gravitation first proposed by Th. Kaluza (*Sitzungsberichte d. Berl. Akad.*, 1921, S. 766; see also O. Klein, *Zs. fur Phys.*, 37, 875, 1926), the equations of motion of an electrified particle may be shown to be the equations of geodetics belonging to the following line element:

$$d\sigma=\sqrt{(dx^0+\beta\phi_i dx^i)^2+g_{ik}dx^i dx^k}, \qquad (1)$$

where x^1, x^2, x^3, x^4 are the co-ordinates of ordinary space time with the line element $g_{ik}dx^i dx^k$, while x^0 is a fifth co-ordinate, and the ϕ_i are the four co-variant components of the electromagnetic potential vector. If the constant β is given the value

$$\beta=\sqrt{2\kappa}, \qquad (2)$$

κ being the Einstein gravitational constant, the 14 field equations of the Einstein theory may, moreover, be simply expressed by means of the curvature tensor belonging to this line element.

Let now $d\tau$ be the differential of proper time belonging to a particle of mass m and charge e; then the Lagrange function L for the geodetics representing the motion of the particle may be given the form

$$L=\tfrac{1}{2}m\left(\frac{d\sigma}{d\tau}\right)^2. \qquad (3)$$

Defining momenta in the ordinary way by putting

$$p_i=\frac{\partial L}{\partial(dx^i/d\tau)} \qquad (i=0,\ 1,\ 2,\ 3,\ 4), \qquad (4)$$

p_0 is seen to be constant along a geodetic, since x^0 does not appear in L. In addition to the equation expressing this constancy, the system belonging to (3) contains four equations which indeed become identical with the equations of motion of the particle if we put

$$p_0=\frac{e}{\beta c}. \qquad (5)$$

With this choice of p_0 the momenta p_1, p_2, p_3, p_4 are further seen to agree with the ordinary definition of the momenta of an electrified particle.

Now the charge e, so far as our knowledge goes, is always a whole multiple of the electronic charge, so that we may write

$$p_0=\frac{Ne}{\beta c}, \qquad (6)$$

e being the electronic charge and N a whole number, positive or negative. This formula suggests that the atomicity of electricity may be interpreted as a quantum theory law. In fact, if the five-dimensional space is assumed to be closed in the direction of x^0 with a period l, and if we apply the formalism of quantum mechanics to our geodetics, we shall expect p_0 to be governed by the following rule:

$$p_0=N\frac{h}{l}, \qquad (7)$$

N being now a quantum number, which may be positive or negative according to the sense of motion in the direction of the fifth dimension, and h the constant of Planck. Comparing (7) with (6), and making use of the value (2) of β, we get for the period l:

$$l=\frac{hc\sqrt{2\kappa}}{e}=0\cdot8\times10^{-30}\text{ cm.} \qquad (8)$$

The small value of this length together with the periodicity in the fifth dimension may perhaps be taken as a support of the theory of Kaluza in the sense that they may explain the non-appearance of the fifth dimension in ordinary experiments as the result of averaging over the fifth dimension.

In a former paper (*Zs. fur Phys.*, *l c.*) the writer has shown that the differential equation underlying the new quantum mechanics of Schrodinger can be derived from a wave equation of a five-dimensional space, in which h does not appear originally, but is introduced in connexion with a periodicity in x^0. Although incomplete, this result, together with the considerations given here, suggests that the origin of Planck's quantum may be sought just in this periodicity in the fifth dimension

OSKAR KLEIN.

Copenhagen, September 3.

The Rôle of the Cerebellum in the Co-ordination of Animal Movement.

THE intracerebellar nuclei, forming, as they do, important stations on the course of the cerebellar reflex arcs, naturally invite inquiry as to the kind of influence they exert on the muscles. Our observations have been made on the cat, decerebrated in deep anæsthesia according to Sherrington's original technique, the plane of transection of the neuraxis passing just in front of the superior colliculus and in front of the infundibulum, thus leaving intact the *nucleus ruber* Horizontal slices were then removed from the cerebellum on one or both sides, so as to expose for stimulation the dorsal surfaces of the nuclei Measures were taken to arrest the bleeding and to maintain the proper temperature. The approximate position of the nucleus in question having been determined by measurements, the section of cerebellum in this neighbourhood was then carefully explored with minimal currents applied by a unipolar electrode The following is a brief résumé of our results obtained by stimulation of the several nuclei.

Faradisation of the outer side of the *nucleus dentatus*.—This yielded repeated flexions at the elbow of the ipsilateral foreleg, when the limb was already somewhat flexed owing to the cerebellar removal; the limb was also abducted. Results of this kind were obtained by Horsley and Clarke The contralateral foreleg, previously in slight extension, showed adduction with palmar flexion of paw. The hindlegs already extended became more rigid in extensor tone.

At times the ipsilateral foreleg passed from flexion into extension on stimulation of the dentate nucleus; or if originally extended the effect of stimulation was to diminish the tonus. Similarly the hindlegs sometimes showed an inhibition of their tonic rigidity. The tail has been seen to point opposite to the stimulation, whilst the body was curved with the concavity contralateral.

Faradisation of the *nucleus emboliformis*.—This elicited in the ipsilateral foreleg, when previously slightly flexed, more marked flexion at elbow and paw together with adduction. The contralateral foreleg already rigidly extended showed diminished tonus. The ipsilateral hindleg showed inhibition of extensor tonus, the contralateral hindleg increased extensor tonus. The ipsilateral foreleg when originally extended showed inhibition of tonus. The tail was elevated and rotated rapidly. The eyeballs were rotated on the visual axes, the upper parts turning towards the stimulation.

Faradisation of the *nucleus fastigii*.—Manifestations consisted in strong flexion of both forelegs, already somewhat flexed in consequence of the cerebellar ablation; the toes were spread apart. The ipsilateral hindleg was flexed, the toes being separated.

Obviously, from these results, stimulation of the nuclei may yield either an increase or a diminution of tonus, the outcome apparently depending on the functional state, whether of activity or depression, of the infracerebellar centres. It is known that certain regions of the cerebellar cortex yield on stimulation inhibition of muscular tone, and, since these regions are linked with the internal nuclei, the inhibition elicitable from these latter becomes intelligible; thus support is furnished for a doctrine of cerebellar function recently enunciated by one of us, namely, that control of postural tone by the cerebellum may be either in the direction of augmentation or of inhibition (*Physiol. Rev.*, 6, 124, 1926).

FREDERICK R. MILLER.
N. B. LAUGHTON.

Department of Physiology,
University of Western Ontario,
London, Canada, August 23.

The Action of Silica on Electrolytes.

IN a letter to NATURE (January 2, p. 17, 1926), Dr. Joseph suggests that I have modified my point of view. I am rather more confirmed in it. There are really two points at issue between Dr. Joseph and myself. (1) Dr. Joseph holds the view that our usual conception of ionic equilibrium in heterogeneous systems is sufficient to account for the liberation of acids when hydrated silica reacts with electrolytes (*J.C.S.*, 1923, 123, 2022; 1925, 127, 2813). We consider the reaction to be an example of an equilibrium between ions in the double layer and those in solution. As stated in my previous letters to NATURE, we believe that the surface primarily adsorbs anions. (2) Consequently the adsorption of acid by hydrated silica is also to be expected.

I shall take up the second point first. Dr. Joseph denies the existence of what we call 'primary' adsorption. This adsorption is to be calculated after taking into account the diluting effect of water of hydration (*Phil. Mag.*, vi. 44, 1922, p. 337). From the data given in my letter in NATURE of January 31, 1925, it would appear that the water of hydration cannot account for a diminution in concentration of about 90 per cent. The amount of primary adsorption is small and is found to be of the order of 10^{-4} gram moles of hydrochloric acid per gram mole of silicon dioxide. The failure of Dr. Joseph to confirm our results is to be ascribed to his having used 1 gram of silica and 100 c.c. of solution.

The smallness of the amount of adsorption is not against our point of view, as the adsorption of other anions is likely to be less than that of hydroxyl ions. We have observed that the total amount of acids that can be liberated from these samples of silica by repeated washing with saturated solution of potassium chloride is 6×10^{-4} gram equivalents of acid per gram mole of silica (*Quarterly J. Indian Chem. Soc.*, vol. 2, 1925, 211).

We shall now deal with the first point. In his second paper (*loc. cit.*), Dr. Joseph observes that calcium silicate is more insoluble than the corresponding barium salt. Dr. Joseph also states that solubility relationships explain the observations regarding the interaction between silica and neutral electrolytes. On this basis it is to be expected that under identical conditions calcium should, in contact with silica, liberate hydrogen ions at a higher concentration than barium chloride. On the other hand, from theoretical considerations of the effect of these cations on the electric charge of the surface of hydrated silica, barium should have a greater effect than calcium, and consequently barium should liberate hydrogen ions at a greater concentration. This is what we have observed, and I think the observation cannot be explained from Dr. Joseph's point of view based on considerations of solubility as usually applied to such reactions.

We have also observed that at higher concentrations individual differences between different cations decrease. Here also solubility relationships fail even if we consider the formation of some sort of solid solution. Besides silica there are other systems, *e.g.* manganese oxides, which behave similarly.

J. N. MUKHERJEE.

Physical Chemical Laboratory,
University College of Science,
92 Upper Circular Road, Calcutta.

The British Patent Office.

IT is to be hoped that the arguments in the leading article in NATURE of September 18, for reforms in the patent system which would increase the chance of an issued patent being valid, will have effect.

It is undoubted that the value of a patent would be increased if the British Patent Office were given greater powers by the enlargement of the field of the investigation made as to novelty and by allowing the Patent Office to pronounce on the question of quantum of subject matter. The Patent Office examiners in Germany, for example, have this power, so why not those in England? It is common experience that the investigation as to novelty now made by the Patent Office examiners is, within the limited powers granted to them, more efficiently carried out than in any other country. One difficulty in the way of allowing the Patent Office to give a definite decision on validity is not so great as it appears. It is very doubtful whether 'prior user' alone is often the determining factor in deciding the invalidity of a patent. In most cases the relevant process or article has been described also in a patent specification or in text books or periodicals of the art. It is to be noted that in Holland, where the powers of the Patent Office examiners are great and their attitude towards claims strict, the validity of a patent is guaranteed after five years' freedom from successful attack.

It would help to inspire confidence in the worth of a patent, even under the present system, if the examiners in the Patent Office were to be more strict in their requirements as to the clear and precise definition of an invention and the distinguishing of it from the prior art. At present a patent agent can usually form a correct opinion from reading a specification as to its scope, but the ordinary manufacturer, however 'skilled in the art' he may be, must frequently find himself at a loss. It requires no fresh legislative powers for the Patent Office to require an applicant to state unequivocally what is the monopoly claimed in terms which, whilst appealing rather to a craftsman than a lawyer, would yet be precise enough to satisfy the latter.

This defect is probably due to the attitude of 'leave-it-to-the-Courts' which is a relic of the days before the Act of 1902 came into force, and would tend to disappear if it were established that the greatest possible assurance of the validity of a granted patent were to be striven for, and that only in the very last resort should patent matters come before the Court.

ERNEST E. TOWLER.

Patent Department,
Standard Telephones and Cables, Ltd.

Apocryphal Medical Science.

OUR attention has been directed to a book called "Microbe Hunters" recently published by Messrs. Harcourt, Bruce and Company, New York, and alleged to have been written by one Paul de Kruif—a gentleman whose name is quite unknown to us. The work evidently aims at being a kind of popular history or rather romance regarding medical discovery, and mentions us among others. We should like an opportunity to say, for the information of readers of NATURE, that the author's statements about ourselves and our researches are almost entirely apocryphal; that they are not supported by reference to the original literature; that they are largely imaginative or spurious; and that his knowledge of the subjects with which we have been concerned is obviously incomplete.

We have been legally advised that some of his assertions regarding ourselves are libellous according to British laws; but in America we have no means of protection except a public denial of the truth of his allegations, and we therefore trust that we may be allowed to publish such a denial, as emphatically as we may, in the columns of NATURE.

Dr. Cuthbert Christy's signature does not appear on this letter, as he is in Africa; before sailing, however, he left us the following statement: "With regard to Chapter IX. of Paul de Kruif's book 'Microbe Hunters' I beg to emphatically state that it contains statements which are totally erroneous, misleading and some of them libellous. As an example I will quote paragraph 2, page 264, which reads: 'The third member' (namely, myself) 'became disgusted with the ignorance and failures of his two colleagues and went off prospecting for rubber. . . .' This paragraph is absolutely untrue and libellous. It suffices to say that I have always given credit to Castellani for his discovery of the trypanosome as the etiological agent of Sleeping Sickness—see for instance my letter to the *Morning Post*, August 22, 1923. As regards my abandoning my colleagues and going off prospecting for rubber, this is entirely libellous. I never abandoned my colleagues and, as a matter of fact, I did not get interested in rubber until 1906, which was three years after the labours of the First Sleeping Sickness Commission were completed."

ALDO CASTELLANI.
GEORGE C. LOW.
DAVID NABARRO.
RONALD ROSS.

Kammerer's Alytes.

As I have been both misquoted and misrepresented by Prof. MacBride in a recent letter to NATURE (August 21, p. 264), I may be permitted to say a word in my own defence. My remarks on Kammerer's Alytes at the British Association were to the effect that the sections sent by Dr. Kammerer to America showed only asperities, not distinctive glands characteristic of the nuptial pads of other Salientia. The glands in his sections of the controls were the same size as those in his experimentals. Asperities may be formed on different parts of the body in one or both sexes of different species of frogs, and in some cases are apparently not correlated with a sex hormone. In the case of Kammerer's results, the question concerned the inheritance of spines, not of complete pads. Prof. MacBride seems to believe there has been some confusion in my mind on this subject.

In regard to the only specimen in existence of Kammerer's experimentals exhibiting merely a "clumsy attempt at 'faked' restoration," made "after its return to Vienna," we have Kammerer's own word that the blackened areas were present in the specimen when it went to England (Przibram, 1926, NATURE, August 7, p. 210), and moreover these areas are the only "nuptial pads" which show up in the photograph made in Cambridge (Kammerer, 1924, "The Inheritance of Acquired Characteristics," New York, Fig. 9) or in the one made in Vienna (Kammerer, 1919, *Arch. f. Entwicklungsmech.* 45, plates x-xi). Further, these blackened areas deceived two able biologists in Vienna who examined the specimen in my presence.

The question of Proteus is, of course, entirely irrelevant. The young Proteus possesses eyes, and the mere fact that certain individuals due to an irregularity of development, whether or not casually connected with an abnormal environment, should have continued the development of these structures, has no bearing on either the question of the inheritance of acquired characters or of Kammerer's experiments with Alytes.

G. K. NOBLE.

The American Museum
of Natural History,
New York, N.Y.

Variation of Penetrating Radiation on the Jungfrau.

OUR new researches on the penetrating radiation in the region of the Jungfrau have now reached a partial conclusion. As is well-known, the existence of this radiation was proved by balloon observations in the years 1909–1914, and, in particular, their extraordinary hardness, which pointed to a cosmic source, was then established by Kolhörster. Afterwards, Nernst in 1921 suggested that their origin lies in recently formed matter. Our researches in 1923–1924 did, in fact, give indications of a sidereal periodicity of intensity of the radiation. These variations can now be closely followed with our more sensitive instruments. It appears that the radiation reaches maximum intensity when certain celestial regions culminate, for example, the Milky Way, and specially the regions of Andromeda and of Hercules. This is explicable as a consequence of the minimum length of the path of rays from these regions through our atmosphere at culmination. The measurements were made at different stations on the Jungfrau up to heights of 14,000 feet, and on the Monch peak at 13,500 feet above sea-level. Glacier ice was in general used as screening material.

W. KOLHÖRSTER.
G. VON SALIS.

September 14.

Function and Design.[1]

By Prof. J. B. Leathes, F.R.S.

Among natural sciences physiology takes a place which in one respect is different from that taken by any other. It studies the phenomena of life, but more particularly the ways in which these phenomena are related to the maintenance of life. Anatomy and morphology are concerned with the forms of living organisms and their structure; biological chemistry, as distinct from physiology, with the composition of the material in which the phenomena of life are exhibited. The province of physiology, in studying the functions of these forms and of this material, is to ascertain the contributions that they make to the organisation of the living mechanism, and learn how they minister to the maintenance of its life. Function implies ministration; structure for physiology implies adaptation to function, what, in a word, may be termed design.

Ultimate analysis of the phenomena with which physiology deals leads to the fundamental distinction between matter in which life is manifested and matter in which it is not. Life is exhibited only in aqueous systems, containing unstable, perishable combinations of carbon with hydrogen, nitrogen, sulphur, phosphorus and oxygen, in the presence of certain inorganic ions, those which are present in the sea, the native environment originally of all forms of life. The inalienable property that such matter exhibits when alive, and that matter which is not alive does not, is that these unstable organic combinations are for ever reforming themselves out of simpler combinations that do not exhibit this property, and do so at a rate which averages at least not less than that at which they break down. This power of self-reformation, spontaneous regeneration, operates not only when living organisms, cells or communities of cells are growing or reproducing their kind; the very maintenance of living existence requires by definition that it should persist. In the absence of water, the living process may sometimes apparently be suspended for a time, as it may be if the surrounding watery medium is immobilised by cold; it is a question whether this is anything more than a retardation to a rate of change that is imperceptible by the ordinary methods of observation, and a question how long such suspended animation is possible where it is possible at all.

Chemical analogies for this power of spontaneous regeneration, if such exist, can only exist in part; in the present state of our comprehension of it, certainly, it is hazardous to try to trace them. The attempt so commonly made to trace one between the growth of living matter and the growth of crystals in a saturated solution, it is safe to say, is in so many respects on the wrong lines that it is merely misleading.

Let us for a moment consider what this spontaneous regeneration implies. Of the various chemical components of protoplasm, proteins are generally considered the most important, often the only important, ones. The elucidation of the chemical principles upon which the structure of proteins rests, which took place about the beginning of this century, was, like the neurone hypothesis of the structure of the nervous system, an advance the magnitude of which only those, perhaps, can appreciate who began the study of physiology well back in an earlier one. For a time it seemed in each case that the problem was solved and all that was to follow was simple. Those were great days.

The best-known varieties of proteins, when detached and uprooted from the place where they grew, consist of chains of about a hundred, sometimes nearly two hundred, links. Each link is an amino acid coupled by its acid group to the amino group of one neighbour and by its amino group to the acid group of its other neighbour, a molecule of water being lost at each linkage. There are not more than about twenty different amino acids, so that some of them must occur several times in the chain; in some kinds of protein one amino acid may occupy thirty or forty of the hundred places in the chain. In any such isolated protein it is probable that the order as well as the proportion in which each amino acid occurs in the molecule is fixed, and it is this specific order and proportion that accounts for the specific character and properties of the protein. What could be simpler? Only yesterday all was so obscure.

It is not recorded that in the rush of this advance any one stopped to reflect what number of formations such a protein might still possibly have. Supposing it were a chain of only fifty links, a very simple case; if all the links were different, the number of possible permutations is denoted by the innocent-looking symbol $\underline{|50}$. If, instead of all being different, one kind of link recurred ten times, the number would be reduced to $\underline{|50} / \underline{|10}$. If, in addition, there were four that recurred four times and ten that recurred twice, it would be further reduced to

$$\underline{|50} / \underline{|10} \times (\underline{|4})^4 \times (\underline{|2})^{10}.$$

It would now consist of a chain of only fifty links, of which there were only nineteen different kinds, and the number of different arrangements of its parts would be about 10^{48}. Astronomy deals with big figures. Light, it is said, takes 300,000 years to travel from one end of the Milky Way to the other; this distance expressed in Ångström units, 10,000,000 of which go to a millimetre, would be less than 10^{32}. So far are we from knowing the structure of protein molecules! So far are we from knowing what variations in disposition of the parts in such a molecule may not occur without our being within a measurable distance of detecting them! For if the number of possible varieties of a protein the molecular weight of which is known, and known to be exceptionally small, which contains the several amino acids in a known proportion, is so great as this, the number that is possible when that proportion may be changed is practically incalculable, each change in proportion being capable of a number of new arrangements that could be calculated, as was done for our hypothetical case.

Now it is possible that the analogy of crystal formation may be applied to the reproduction of the characteristic order in which the linkings occur, and that the parts out of which a new chain is to be formed may be collected and brought into position alongside of the corresponding parts of an existing chain by forces that are similar to those that determine the latticed relations of atôms in a crystal. But something more than this is required to account for the linking up of these links by the loss of water, and still more for the fashioning of the links themselves. We have to suppose that it is by selective emphasis of certain otherwise unemphasised but possible arrangements of atoms or groups of atoms, evidence for the occurrence of which under similar conditions in the absence of life is generally not obtainable. Specific catalysed syntheses must cooperate with the forces that merely sort out and place in proper order the assembled parts, and must fashion for them the particular links that they need at each step. Specific catalytic agents playing an important part in cell chemistry are familiar in the enzymes found in digestive secretions and also locked away within the cells themselves.

---

[1] From the presidential address to Section I (Physiology) of the British Association delivered at Oxford on August 5.

In the chemical make-up of protoplasm, proteins, the most abundant component, are not the only ones that are necessary. Pre-eminent among the others are the nucleic acids. When we consider what has been learnt of the behaviour and of the chemical composition of the nuclear chromosomes, and that according to Steudel's reckoning the nucleic acids form 40 per cent. of the solid components of these chromosomes, into which are packed from the beginning all that pre-ordains, if not our fate and fortunes, at least our bodily characteristics down to the colour of our eyelashes, it becomes a question whether the virtues of nucleic acids may not rival those of amino acid chains in their vital importance. From Steudel's figures it can be reckoned that there are about half a million molecules of nucleic acid in a single sperm cell of the species with which he was working.

In addition to nucleic acids there are also strange compounds of higher fatty acids containing suspiciously significant groups, identical in their general character with those found also in nucleic acid, namely, phosphoric acid, organic bases and sugar; and besides these there are the mysterious sterols. All of these are frankly insoluble in water, and yet have in some part of their composition features that make them not indifferent to water or even to the molecules and ions that exist in true solution, in the liquid state, within the cell. The physical condition of these insoluble substances in the aqueous system of the cell is still little understood. All that can be said with certainty is that they must modify its homogeneity even more than the long floating chains of amino acids, however much these may be linked together one with another. If the characteristic behaviour of living matter is rightly regarded as due to the order that it introduces into the movements and spatial relationships of foreign molecules in its vicinity, then these insoluble components may well be expected to play a leading rôle by forming films and surfaces that permeate its texture and delimit its parts.

If this analysis is approved and the distinctive property of living matter, the power of self-regeneration, depends upon the power of limiting the movements and directing and controlling the spatial relations of surrounding molecules so as to modify their chemical behaviour, it is the exercise of this same power that leads to the formation of substances such as starch, glycogen and fats; and in so far as such substances contribute to the regeneration of the living matter, the power of forming them contributes to its survival. Where energy is necessary for such synthetic rearrangements of adjacent matter, it may be derived from the radiant energy of the sun or from the combination of oxygen with adjacent organic matter.

This faculty of regeneration implies the power of introducing order into the chaotic movements of adjacent matter in conformity with patterns that it possesses. It is a faculty resident in material that is capable of incalculable variation. The number of permutations of its parts that are possible without affecting the results of such analysis as is practicable defies calculation. Some of these permutations confer synthetic powers which others do not. When they appear, are they not what biologists call, for short, mutations? But when they appear, if they retain the power of self-regeneration, and if they minister to its maintenance, they will *ipso facto* survive. For whatever promotes persistence of this power must itself survive.

A disposition of matter in molecules or aggregates, unstable and incalculably variable, that has and retains the power of determining the disposition of matter not yet so disposed, in such a way as to conform to its own disposition or to patterns which help it to exercise this power, is all that must be premised for the whole of evolution to follow. Variations that do not or cease to contribute to the retention of this power do not survive. The condition of survival is ministration to self-regeneration, that is, to the maintenance of life.

Before the days of vertebrates, in pre-Silurian time, an unstable variation occurred in certain types in the disposition of atoms and organic combinations of atoms that was mainly protein in character, a protein to the making of which little short of 200 amino acid links must contribute. Coupled to this protein, which probably is not the same in all species of animals in which it is found, is another group containing iron that is probably always the same. This group is of remarkable nature, and is closely related to one that occurs in the far older substance chlorophyll. This complex substance hæmoglobin had the power of attaching to itself two atoms of oxygen for each atom of iron that it contained in such a way that it could be readily detached and made available for effecting oxidations. Such was the service that this variation rendered that it is safe to say that without it there could be no vertebrate creation. It is this service that has made it possible for it to survive to this day, when in the human species alone it is being produced at the rate of about 10,000 tons a day. The story of the service of chlorophyll would, of course, be more remarkable than this.

Natural selection applies to the survival of the chemical forms of living matter as it does to complex living organisms. These forms, infinitely protean in their variety, survive and persist in so far and so long as they minister to its self-regeneration. It is the principle of survival by service. Function alone gives permanence to structure.

Why is it that what may be termed official physiology takes so little cognisance of the doctrine of evolution?

These branches of biological study appear to follow courses so exactly parallel that they never meet.

The doctrine of evolution digs down into the foundations of scientific philosophy. If a physiologist addressing physiologists ventures to say anything on this subject of supreme appeal to all biologists, it must be in exaltation of the work of those who have approached it from the morphological side, and it may be in hopeful anticipation of the ultimate share in the elucidation of some of its problems to be borne by physiology.

On the part that function plays in the determination of structure it is to be supposed that physiology will ultimately, at any rate, have something more to say. May I submit to the consideration of physiologists certain points in the physiological development of the machinery of the body where, unless I am mistaken, it is possible to detect the operation of function in determining the design of the machine?

The properties and behaviour of cells result from the properties of the material composing them. When a muscle cell contracts this is, in general terms, a reversible rearrangement of its parts in response to some alteration in the distribution of forces within or about it due to a disturbance from without. Such reversible reaction to adequate disturbance is a property common in the material of which living cells are composed.

In addition to this reversible type of reaction there are irreversible reactions, characteristic of other kinds of cells, and it is what we call connective-tissue cells that I would consider here. There are several kinds of connective-tissue cells, but they are alike in that they produce and discharge into their vicinity material of a characteristic composition; in some of the commonest this material is chemically collagen, the substance out of which gelatine can be obtained. In course of time these cells come to be embedded in the material which they deposit about themselves and so form one kind of connective tissue. Cells capable of behaving in this way are found, however, which have not yet exercised their faculty; these fibroblasts are then undifferentiated wandering cells that have found no abiding place in the community in which they have their birth. What it is that makes them settle down and start producing the material in which they come to be embedded has never yet been determined. But the most striking structures to which they give rise are the tendons and aponeuroses that make the muscles fast to the bones, and the ligaments that bind the bones to one another. The material that they deposit is composed of inextensible fibres that lie, in the case of tendons at any rate, so exactly and exclusively in the line of the resultant of the tension set up in the muscle to which they attach themselves, that it is difficult to believe that the disturbance which starts them producing their characteristic secretion is anything else than the pull exerted on them by the muscle fibres to which they are attached; the recurring external disturbances that produce reversible states of tension in the muscle, indirectly producing in them an irreversible reaction, which consists in the discharge of material that by its inextensibility can transmit the tension along the line of the force that provokes its deposition.

In their simplest form, cells of this kind deposit the wavy fibres in areolar tissue which, when straightened out under the action of a displacing force, set a limit by their inextensibility to the dislocation of the part first affected, and so distribute the action of the displacing force over surrounding areas. It is interesting to note that the origin of cells of this kind has been traced to the mesothelium cells that line tissue spaces and serous cavities, the clefts that make the gliding displacements of parts over one another possible. The deposition of fibrous material seems here, as in the tendons and ligaments, to be the result of reaction to the recurring disturbances set up by displacements, such, for example, as those of the lungs, the alimentary tract, the heart and pulsating vessels, and the deposition occurs in the line of strains set up by the displacing forces. The service rendered by this behaviour of the cells is that the fibres which they deposit, in virtue of their inextensibility, limit the extent of displacement at any one point by distributing it to surrounding parts.

The other component of areolar tissue, the elastic fibres, is similarly produced by other cells. These fibres take a straight course between their attachments; displacements in the line of their deposition are rendered possible by their stretching, and are recovered from by their elasticity.

The contribution made by such cells to the fabric of the body appears to result from the recurring operation of disturbances, to which they react by depositing fibres along the lines of disturbance.

More striking are the properties of cells upon which the formation of the skeleton depends. The cells that make bone not only secrete fibrous collagen, but they also encrust the fibres with insoluble lime salts, and it has long been subject of comment that the rigid bone that results always comes to lie in the line of prevailing strains and stresses. The analysis of the structure, for example, of the head and neck of the human femur, by Wolff and others who have followed him, shows how strictly this is true. Calculations prove that no particle of bone lies anywhere but where the strains dictate. We can predict with certainty, it seems, that it will be found that bone cells are composed of material that in reacting to physical forces directs, in constant relation to the line of action of those forces, the deposition of the substances which make up this connective tissue. Bone can only arise where strains and stresses set up this reaction, and the greater the strain or stress the denser the deposit. When a bone is fractured many bone cells are dislodged, and in the abundance of nutriment that ruptured vessels supply, these cells, released from their imprisonment, multiply. At first the force of gravity and the twitching of muscles acting on the soft semi-fluid tissues between the broken ends of the bone supply stimuli that are indeterminate in direction, and such reaction as occurs results only in the formation of loosely ordered calcareous fibres; but even this soft callus gives some degree of rigidity, sufficient to restrict the strains gradually to more and more clearly defined lines along which in proportion a stronger reaction can take place.

Once it is established that bone corpuscles react to strain and stress by discharging collagen, the intimate spatial disposition of which, as well as of the lime salts with which it comes to be encrusted, is determined by the directing forces to which it is exposed; and once it is recognised that the law of spontaneous regeneration requires that this reaction will persist in proportion to the prevalence of these forces, not only must the gradual replacement of callus by appropriate permanent bone necessarily follow, bone in which no particle persists except it be in the line of constantly recurring stress and strain, but it will also necessarily follow that the position of every spicule of bone in the skeleton, cancellous or compact, is the expression of a physiological reaction to the forces of gravity and muscular tension.

The evolution of the machinery of the connective tissues seems to be not entirely the result of natural selection and the survival of individuals in which this machinery chanced to be of appropriate design. The appearance in early vertebrates of the material that is characteristic of the bone corpuscle seems to have ensured that skeletons would take a shape determined by the direction of the forces to which these corpuscles were exposed, and that the formation of this skeleton is as much a reaction to recurring stimuli as are the reflexes, composite movements and postures characteristic for the species.

This conception of the way in which the vertebrate connective tissues take their shape transfers a large share of the development of the bodily form back into the nervous system, in which the machinery is stored that directs and determines the habitual movements and postures that in reaction to external disturbances are specific. A physiological account of the evolution of the nervous system, one certainly that is based on the chemical constitution and chemical behaviour of its component parts, must seem almost infinitely remote from practical investigation. But the work of Pavlov has made one thing clear: that by a physiological reaction in it, machinery may come into existence which did not exist before. The repeated occurrence of a disturbance at times that are uniformly related to the normal operation of existing machinery results in the acquirement of a new reaction which must require machinery that is new. It is rendered probable, if not proved, that this new machinery is situated in what may be called the growing point of the central nervous system, the cortex of the cerebral hemispheres, the part where all is not 'cut and dry,' where cells retain more of the properties of the developing neuroblasts, the properties that enable them to grow out through the embryonic tissues along courses that make it certain that the maturing organism will behave in a manner true to type. In the formation of a conditioned reflex, two events are made to occur in the cerebral cortex at times which are uniformly related to one another; one of these events, from the constitution of the nervous system, necessarily results in a certain activity of some muscle or gland, the other has been hitherto in no way related to such a result; after many repetitions of the association of these events, it is found that that one which previously had never resulted in this particular activity, comes to have this result as certainly as the other.

But if and when it is possible to trace the origin of structures to functional reactions of cells, and to reactions that depend upon the chemical properties of the cell substance; and if and when this is possible not only in the connective tissues, but also in the nervous system, the functions of which have so controlling an influence on the operation of every part of the body; until it becomes clear that the results of changes in such influence reappear in succeeding generations, the study of functions can have no bearing upon the ultimate problem of biology, the evolutional history of life upon the earth. Pavlov communicated to the International Congress of Physiology in 1923 some results of experiments that he had done upon this subject which, when confirmed, should 'electrify the atmosphere.' Conditioned reflexes that are established only after many—eighty or a hundred—repetitions of the associated stimulus, in each succeeding generation require fewer and fewer repetitions, and in the fourth may be established after only four. In April of this year he wrote to say that owing to other work he had not been able to give the necessary time to confirmation of these results. We are content to wait.

In the great question whether characteristics developed in the life of an individual have any influence on descendants, experimental evidence must come slowly. In what is called parallel induction a step has been taken which is probably of greater importance than is generally conceded. External influences that affect the bodily characteristics of an organism affect also the germplasm in such a way that these characteristics appear in the first, and even, in a less degree, in the second generation born after the external influences have ceased to operate. While such experiments furnish evidence only of a temporary change in the properties of the germplasm, one that may be put down to the lodgment in it of unassimilated foreign matter that is gradually eliminated, the fact that the eternal germplasm has been shown to be subject to temporal influences must not be belittled. A true mutation is not eternal. Our descendants may be able to dispense with hæmoglobin. The hereditary melanism that in certain moths, it is said, can be induced by food infected with manganese, is, perhaps, something more than such parallel induction.

Physiological inquiry is a stream that has many sources; its waters gather from quarters far removed from one another. A marvellous meeting took place in the early years of this century when the forgotten experiments of Mendel came to the surface again, and found corroboration in the cytological studies that from about the same time had pursued their slow obstructed way above ground in the endeavour to elucidate the changes in the nucleus of maturing germ cells. In a resting germ cell the chromosomes form an even number, characteristic for the species; they consist of half that number of pairs of homologues, one of each pair descended from the paternal element in the last zygosis, the other from the maternal. At one of the cell divisions by which the germ cell gives rise to the mature gamete, with half the characteristic number of chromosomes, there occurs a segregation of the two members of each pair so that they pass into different gametes—the exact cytological equivalent of Mendelian segregation of allelomorphic pairs of characters. To-day the study of genetics and of the 'topographical anatomy of the chromosomes,' with its 'groupings' and 'crossings over,' seems to require chemical assistance. It may be that in the lifetime of some of us those confluent streams of thought and experiment are to be joined by yet another that rises in the vast, remote and, as it must appear to some, muddy swamps of physiological chemistry; and it then, forgetting its 'foiled, circuitous wanderings,' will form with them a 'majestic river, brimming and bright and large.'

Francis Bacon and Scientific Method.[1]

By Dr. C. D. BROAD.

II.

THE natural history, selected, arranged, and recorded by the rules described in the previous article, forms the basis on which scientific knowledge must be built. Bacon's next task was to construct a logical instrument by which a knowledge of general laws can be erected on this basis. Plainly the kind of reasoning which is needed is inductive. But Bacon objected both to the order and the form of reasoning which he found in current inductive arguments. Those who use them jump directly from particular facts to extremely sweeping generalisations, and they then deduce propositions of medium generality from these generalisations by means of syllogistic reasoning. Now Bacon's view is that there should be a very gradual ascent from particulars through principles of slowly increasing generality to the widest generalisations. Conversely, there should be a very gradual descent from the widest generalisations through principles of slowly decreasing generality to new particular facts. In the ascending scale each stage covers all the facts below it and extends very slightly beyond them. We then deduce observable, but not hitherto observed, consequences from the hypothesis and see whether they are true. If they are found to be so we can accept the hypothesis and go on to generalise it a little further. Thus the descending scale serves to test the stages in the ascending scale.

Bacon's objection to the form of reasoning employed in current induction was that it made no use of negative instances. It simply argued in the form: "All *observed* S's have been P, therefore *all* S's will be P." Now Bacon's view is that the cause of a given effect cannot be discovered by direct and positive means. It can be discovered only by gradually eliminating alternative possible causes until we are left with a single survivor, which can then be accepted with confidence as *the* cause. In order to discover the cause of a given kind of phenomenon, three sets of tables were to be formed, namely: (1) cases where this phenomenon is present; (2) cases where it is absent; (3) cases where it varies in degree. Now Bacon takes it as axiomatic that what he calls the 'formal cause' of a phenomenon is such that (1) it cannot be absent when the phenomenon is present; (2) it cannot be present when the phenomenon is absent; and (3) it cannot be constant when the phenomenon varies, or conversely. He knows then that the cause must be present in all the cases in the first table. He need not consider, therefore, any factor which is absent from any of these cases. Again, he need not consider any factor that is present in the cases in the second table, for the cause must be absent from all of them. Lastly, he can reject any factor which is constant throughout the cases in the third table. By this method of rejection, and by it alone, Bacon thought it possible to discover with certainty the causes of given effects.

This is Bacon's method in the barest outline. What kind of fact did he hope to discover by it? He tells us that the ultimate aim of theoretical science is to discover 'the forms (or formal causes) of simple natures,' and that the ultimate aim of applied science is to use this knowledge to 'induce on bodies the form of any nature that we may desire it to have.' He draws a sharp distinction between the 'formal cause,' on one hand, and the 'material' and 'efficient' cause, on the other. He assigns the study of material and efficient cause to 'Physics,' and their practical use to 'Mechanics'; whilst he assigns the study of formal causes to 'Metaphysics,' and their practical employment to what he calls 'Natural Magic.' But he recognises that he is here using 'Metaphysics' in an unusual sense. The meaning of all this is the following. By a 'simple nature' Bacon means some perceptible generic physical property, such as colour, temperature, etc. By the 'form' or 'formal cause' of a simple nature he means that which this property is in things themselves apart from their relation to sensitive organisms. Thus, violent and irregular molecular motion would be the 'form' of the 'simple nature' called 'temperature.' Again, periodic variation of electro-magnetic intensity would be the 'form' of the 'simple nature' called 'colour'; and so on. So the Metaphysics of Forms is what we should call Microscopic Theoretical Physics. The propositions of 'Physics,' in Bacon's sense of the word, are what we should call 'empirical laws,' *e.g.* 'if amber be rubbed with flannel it becomes electrified.' Here the 'material cause' is amber and flannel, whilst the 'efficient cause' is the process of rubbing the two together.

Now of course we may know of various practical methods of inducing heat or electricity on bodies when we know nothing of the form of heat or the form of electricity. But Bacon sees that so long as we have merely this rule-of-thumb kind of knowledge our practical control over Nature will be very limited. If, on the other hand, we know the form of a given nature we know that *any* means of inducing this form will induce this nature, and that nothing else will do so. Thus by knowledge of forms, and by that alone, we may be able to produce profound modifications at will in the properties of bodies. This is what Bacon means by 'Natural Magic'; and the syntheses of new substances in organic chemistry would be an example of what he had in mind.

Bacon holds that there is a part of physics and mechanics which is closely connected with metaphysics and natural magic, and constitutes the transition from the former to the latter. This he calls the study of the 'Latent Structure' and the 'Latent Processes' of bodies. He recognises that bodies have an inner microscopic structure too small for our unaided senses to perceive, and that many of their perceptible characteristics depend upon this. He also recognises that what we call the efficient causes of given effects are only isolated outstanding features in processes which are continuous and in the main imperceptible. If we are to understand and control Nature we must turn our attention from the gross structure and changes of bodies to their minute components and processes. Bacon particularly insists that, whilst both of these subjects have been neglected, the latter has been more neglected than the former; and yet the dynamical aspect of Nature is even more important than its statical aspect.

---

[1] Continued from p. 488.

It will be interesting at this point to consider Bacon's views about mathematics, for they exhibit his peculiar weakness and strength in a clear light. It is evident that Bacon was no mathematician. He has no theory of mathematical reasoning; he seems to be contemptuous of pure mathematics; and he was evidently unacquainted with the progress which was being made by both pure and applied mathematics in his time. It is noteworthy that in his remarks about Plato, with whom he is not altogether unsympathetic, he never thinks of Plato and his school as mathematicians but always as theologians and moralists. Yet Bacon does repeatedly say that physics cannot progress far without mathematics; and some of his strictures on the excessive worship of mathematics in science are the negative side of an important positive demand. Thus he complains that optics and astronomy have fallen wholly into the hands of mathematicians. When this complaint is investigated it is found to mean that Bacon wants something more than mere geometrical optics and mere descriptions of the courses of the heavenly bodies. He wants a *physical* optics and a *physical* astronomy, which shall deal with the *nature* of light and the *substance* of the stars and planets. His own attempts to supply this want are of very little value, but the demand is a sound one.

Although Bacon held that the proper course for scientific reasoning to take is a gradual ascent from particulars to general laws and a gradual descent from these general laws to new particulars, he was prepared to admit as a subsidiary process the direct passage from one particular to other partly analogous particulars. This he calls *Instructed Experience* (*Experientia Litterata*). He distinguishes various forms of this, of which the following are the most interesting: (1) Varying an old experiment, either by applying it to different but partly analogous materials, or by applying different but partly analogous processes to the old materials, or by varying the quantities or intensities of the factors in the old experiment. (2) Repeating the original process on the product of the previous experiment, as in redistillation. Bacon is careful to point out that we must never assume that an increase in any factor will produce a corresponding increase in the effect, or that the repetition of a process upon its product will increase the effect. (3) Extending a process from Nature to art, from one art to another, or from one part of an art to another part of it. Bacon says that new and useful processes are most likely to be discovered when one or a few men learn to compare the processes of a number of different mechanical arts. (4) Inverting one or more of the factors in an experiment; *e.g.* substituting great cold for great heat. (5) Making one factor gradually more or less intense until the characteristic effect just ceases to take place. (6) Coupling together two cause-factors, each of which has already been tried separately. Here again Bacon carefully points out that we have no right to assume that, because a in the absence of b gives α, and b in the absence of a gives β, therefore ab will give $\alpha\beta$. We may conclude this point of Bacon's doctrine with two highly characteristic quotations: "Though a successful experiment be more agreeable, an unsuccessful one is often no less instructive"; and "Experiments of Light" (*i.e.* those which throw light on the laws of Nature) "are more to be sought after than Experiments of Fruit" (*i.e.* those which lead to results that are of immediate practical use).

I will conclude by mentioning the seven cases in which the senses have to be aided and the kind of help which Bacon suggests. (1) If the object be very distant it must be joined to something which is perceptible at a distance, *e.g.* something that gives a flash or a noise. (2) If it be enclosed in an opaque envelope it must be judged by processes at the surface (*e.g.* feeling the pulse) or by what comes out from it (*e.g.* examination of urine). (3) It may be unable to affect the senses because of its intrinsic nature (*e.g.* colourless gases), or (4) because of its minuteness. The latter difficulty can be avoided by causing it to produce some effect of sensible magnitude (*e.g.* using an air-thermometer to indicate small changes of temperature). (5) Motion may be too slow or too swift to be perceived. In the former case it can be magnified by pointers and similar devices. Bacon does not know how to deal with the latter case. (6) The intensity may be too great for the senses to bear. In this case Bacon recommends the use of reflectors or semi-opaque screens. (7) The senses may be very rapidly exhausted. This happens only with taste and smell. Bacon suggests no remedy for this; but he says that where our senses fail us altogether we may use those of animals (*e.g.* dogs for scent).

Much of the merit of Bacon consists in minute detail, and is lost in a rapid sketch like the present. I think we may sum up his strength and weakness as follows. He was not a great scientist, either practically or theoretically. But he saw many of the essential factors in successful scientific procedure with great clearness, and stated them with admirable force. His method is admittedly incomplete; and no method could accomplish all that he expected of it. The nearest approach to a complete method would be a synthesis of the methods of Bacon and Descartes. But we must go far before we shall find another such combination of wide generalisation, strong common sense, balanced enthusiasm, and pointed eloquence as we find in Bacon.

The Tropical Cyclone.

By E. V. NEWNHAM.

THE cyclone season of the northern tropics is drawing to a close. The accounts of widespread damage to property and loss of life, both in the Gulf of Mexico and in the Far East, that have appeared recently in the newspapers, show that the storms that have already occurred will make this season a memorable one. It is not intended here to deal with these recent events, but rather to present the salient facts about the tropical cyclones of both hemispheres, and to indicate the extent to which these phenomena are understood at the present time.

Like all meteorological phenomena, tropical cyclones show great individual variations from the general type; nevertheless, their general characteristics are sharply defined. In size they occupy an intermediate position between the two other kinds of atmospheric vortex that give rise to winds of hurricane strength, namely, the large cyclonic depression of temperate and high latitudes and the small but excessively violent tornado of the American and Australian type. In all three vortices the pressure of the air is greatly reduced towards the centre, but it is only in the case of the tornado that the pressure becomes too low to be recorded by the ordinary barometer.

The typical tropical cyclone consists of a nearly circular symmetrical whirl, clockwise in the southern hemisphere, counter-clockwise in the northern hemisphere, with a diameter varying from 100 to 600 miles, about a central 'eye,' where the air is nearly calm. The wind is strongest along the margin of the 'eye,' which averages about 14 miles in diameter, and in this region often greatly exceeds a hundred miles an hour. Within the 'eye' the weather is usually fair, but in the zone of strong winds torrential rains occur. The movements of the clouds are in general centrifugal, particularly as regards the higher clouds. The place of origin is in general over the hotter parts of the ocean between latitudes 8° and 12° on both sides of the equator, generally near the equatorial margin of the trade winds bordering the doldrums, or belt of equatorial calms and light winds, but in the case of the storms in the Bay of Bengal and the Arabian Sea, in the region of variable winds and squalls that occur at the transitions between the north-east monsoon of the winter and the south-west monsoon of the summer.

Tropical cyclones form in three zones:

(1) The south-western part of the North Atlantic, around the West Indies.

(2) From the Arabian Sea eastwards so far as the China Seas and western part of the North Pacific.

(3) From around Madagascar eastwards to the Paumotu Islands.

There is, as a rule, one definite season extending over several months and reaching a maximum a little before the autumn equinox, when the ocean is generally at its warmest. Individual seasons differ greatly as regards the number and intensity of the storms that occur, and a connexion has been claimed by some writers between the character of the season and the number and size of the spots on the sun, but a clear relationship for the whole area affected by cyclones has not been established so far.

Cyclones move slowly along paths which also show great variation, but a dominant tendency towards motion along a certain type of curved path, sometimes described as parabolic or hyperbolic, is apparent in all parts of the world where a large mass of land is not so situated as to prevent the storm from passing through its normal life-history.[1] The motion during the first few days is compounded of an east to west drift, and a slight poleward drift, but somewhere between latitudes 20° and 30° (north or south) the motion becomes directly poleward and then inclines towards the east, becoming north-easterly on leaving the northern tropics and south-easterly on leaving the southern tropics. It should be noted that within the tropics the movement is clearly not in accordance with the prevailing winds of the region through which the storm is passing, and is more often than not almost directly opposed to those winds,[2] but on leaving the tropics, when the storm begins to lose its tropical characteristics and take on those of the ordinary temperate 'depression,' the motion, in the case of the cyclones of the North Atlantic and the China Seas, appears as a rule to be that of the prevailing winds, between about latitudes 30° and 50° N.

To return to the important subject of their place and time of origin: whatever the process may be whereby a cyclone begins to form in a region of light and variable winds, there can be little doubt that their whirling motion is due to the deflective force of the earth's rotation. Now this force varies as the sine of the latitude, and is therefore inappreciable for some degrees north and south of the equator; this fact explains why cyclones seldom originate within 8° of the equator. The reason why the time of maximum frequency is normally just before the autumn equinox appears to be that one of the necessary conditions for the formation of a cyclone is a discontinuity between distinct wind systems, and this will be found at a suitable distance from the equator when the equatorial belt of calms (the doldrums) is nearly at its farthest from the equator, *i.e.* not long after the summer solstice, the maximum being retarded somewhat because the greatest warmth of the ocean is normally attained about two months after the solstice. In the case of the Indian cyclones there is a double maximum, one in early summer and the other in autumn; in this case, the controlling factor is clearly the presence or absence of the necessary discontinuity of wind, the warmth of the sea appearing to play little part in fixing the cyclone season.

The above general description of tropical cyclones is based mainly upon a recent memoir of the British Meteorological Office,[3] which is in turn based upon all available contributions to the literature of the subject up to 1920. In the introduction to this work, Sir Napier Shaw attempts to explain the life-history of a tropical cyclone from its birth, as a result of the convection in suitable circumstances of hot moist air, to its death, when, having been transformed into a cyclonic depression of temperate latitudes, it is surrounded by cold dry air on reaching the polar regions. The convectional stage is developed in a very ingenious manner; a number of small convectional 'bubbles' are assumed to unite into a single large 'bubble'; air is withdrawn over a certain area and is 'evicted' in the upper atmosphere; the system quickly acquires the properties of a fully developed cyclone and begins to drift towards the west. In a theoretical section, Dr. H. Jeffreys, regards a combination of the two principal theories so far advanced to explain the origin of cyclones—the 'millpond eddy' and the

---

[1] The storms of the Bay of Bengal and Arabian Sea appear to behave normally in this respect, but the great land mass to the north does not allow them to survive long enough to follow more than the first third or half of the typical path.

[2] So far as I am aware, this point has not been emphasised hitherto. Its truth rests upon the accuracy of the charts of prevailing wind published in "Bartholomew's Physical Atlas," vol. 3, plate 14, which are due mainly to Koppen.

[3] "Hurricanes and Tropical Revolving Storms." By Mrs. E. V. Newnham. Meteorological Office Memoir, No. 19, 1922.

'convectional' theories—as necessary for a complete explanation.

Since 1920 several further contributions have been made to the literature of tropical cyclones. One deals with the region around the West Indies.[4] Redrawing the tracks of all known cyclones in this area since 1886, Mitchell found that no storm originated over the eastern two-thirds of the Caribbean Sea; many storms originated, however, south of the Cape Verde Islands, and some over the western third of the Caribbean Sea. The deciding factor in this case, as for the Indian cyclones, appears to be the presence or absence of a discontinuity between conflicting winds; such a discontinuity is absent over the eastern two-thirds of the Caribbean Sea. Another interesting fact pointed out by Mitchell is that the cyclone of this area 'recurves' (*i.e.* turns directly polewards) as soon as a trough of low pressure arrives to the north, irrespective of the longitude and time of year.

Another recent valuable publication deals statistically with the tropical cyclones of Australia, without, however, contributing much that is new to the theory of the storms.[5] The last paper to which I shall refer is concerned with the dynamics of the formation of cyclones.[6] Capt. Brunt follows Shaw in regarding simple thermal convection of moist air as the initial stage, the energy for the subsequent violent winds being supplied by the latent heat of condensation of the water vapour that is precipitated in the rising column of air before those winds arise. He lays stress on the importance of explaining how the removal of air from the centre of a developing storm is brought about, and presumes that it is effected by the discharge of the column of rising air into strong upper winds.

The verification or refutation of this and of the various alternative theories of the origin of cyclones that have been brought forward, which space does not permit me to describe, awaits a more complete knowledge of the temperature, humidity, and wind at all levels in the regions of formation of cyclones, which are unfortunately in most cases just where observations of any kind are most difficult to obtain.

---

[4] "West Indian Hurricanes and other Tropical Cyclones of the North Atlantic Ocean." By C. L. Mitchell. *Monthly Weather Review*. Supplement No. 24, 1924

[5] "Australian Hurricanes and Related Storms" By S Visher and D Hodge, 1925

[6] "The Origin of Tropical Revolving Storms." By D. Brunt, London Meteorological Office. *Marine Observer*, 1924.

The Reported Conversion of Hydrogen into Helium.

THE current (September) issue of the *Berichte* of the German Chemical Society contains a paper by Profs. F. Paneth and K. Peters on "The Transformation of Hydrogen into Helium," in which they describe in outline how they have succeeded in detecting the presence of very minute amounts of helium, of the order of one hundred millionth of a cubic centimetre, derived from hydrogen which had been absorbed by finely divided palladium at the ordinary temperature.

Theory indicating that this conversion would involve the liberation of much energy ($6\cdot4 \times 10^{11}$ cal. from 4 gram-atoms of hydrogen), the author's primary task was to find out if the change would take place without introducing energy from outside, *e.g.* in the presence of a catalyst; and in order to be able to detect very small quantities of helium they elaborated the spectroscopic method in such a way that the limiting amount detectable was 10^{-8}-10^{-9} c.c., or 10^{-12}-10^{-13} gm. Easily liquefiable gas was removed with liquid air and charcoal; oxygen was added and the hydrogen burnt on the surface of the catalyst; water-vapour and excess oxygen were removed with charcoal, and the residual gas was passed into a glass capillary-tube of 0·1 mm. section, which was surrounded with electrode-wires and placed before the slit of the spectroscope. Every precaution was taken to exclude atmospheric helium; the portion of the apparatus that was heated was surrounded with a vacuum-mantle and immersed in water. The presence of neon lines afforded a most valuable criterion of the presence of atmospheric gases; neon was never completely excluded, but the amount present was so small that it did not invalidate the author's main conclusion.

The method is so delicate that the liberation of helium from a mixture of thorium B and thorium C was easily detected, while it is sufficiently sensitive to determine the presence of helium in a few cubic centimetres of natural gas. By its means a natural gas containing 0·19 per cent. by volume of helium was discovered in Germany, and steps have been taken to exploit it commercially. The Canadian natural gas from which helium is extracted contains 0·33 per cent. by volume.

Attempts were made to effect the transformation by submitting hydrogen to the action of a silent electric discharge in an ozone apparatus, and by passing a prolonged and powerful discharge through it in a Geissler-tube fitted with aluminium electrodes; but no success was achieved. Nor was the attempt to produce helium by bombarding certain salts with cathode rays, as suggested by Lord Rayleigh, any more fertile, so that recourse was had to passing fairly large amounts of hydrogen—up to one litre—through heated palladium, in the hope that at the moment of exit a fraction of the protons and electrons would combine to form the helium nucleus. In this case the indications were favourable, but the result was inconclusive owing to the presence of atmospheric neon, and the absence of any proportionality between the strength of the helium lines and the amount of hydrogen that was used.

Finely-divided palladium, either as sponge, 'black,' or palladinised asbestos, was then used to absorb hydrogen at room temperature, and after different intervals of time the hydrogen was combined with oxygen, as previously described. The residual gas obtained after a 12-hours' contact between palladium and hydrogen exhibited four or five lines of the helium spectrum and only a single neon-line; there was also a distinct proportionality between the amount of helium observed and the duration of the time of contact. The activity of the different palladium preparations employed varied considerably; it invariably diminished with repeated use, but both the power of absorbing hydrogen and of effecting the transformation were restored by heating in hydrogen or oxygen, in a mixture of these gases, or in a vacuum. No helium production was observed with palladium preparations that did not absorb hydrogen, although preparations were occasionally obtained that absorbed hydrogen well but gave little of no helium, especially if the hydrogen had been absorbed at a high temperature.

The above results indicated that palladium preparations that have long remained unused at room temperature should contain a little helium (not of atmospheric origin). Examination of a number of such specimens showed that helium was present in all of them, and in particular a specimen of palladinised asbestos, which had been purchased from Kahlbaum two years previously, was found to be relatively very rich, 1 gm. of it containing 10^{-6} c.c. of practically pure helium. After this specimen had been heated to expel the helium, and treated with oxygen for twelve hours, no fresh helium was detected, but at the end of five hours in contact with hydrogen a considerable amount of helium was found. This experiment was performed three times with the same result. The palladium, however, gradually lost its activity; at the beginning it produced helium at the rate of 10^{-8}-10^{-7} c.c. per day; after twenty treatments it became inactive. Its activity was restored, although not to the original degree, in the manner described above. Finely divided platinum is less active than palladium, and the action of pyrophoric nickel is weaker still.

The authors discuss fully the possible sources of error in their experiments, such as the ingress of atmospheric helium, the adsorptive capacity of glass for helium, the conceivable preferential adsorption of helium by palladium, or by asbestos, and the possibility of helium being formed as a radio-active disintegration product of palladium; all of which they consider to be excluded. The hydrogen and oxygen used by them contained less than 0·001 per cent. of air. They were not able to detect any trace of the energy liberated during the transformation, and they point out that the amount set free from the conversion of such small quantities of hydrogen—about 0·28 calorie—would be extremely difficult to detect, and particularly so if thermal changes due to absorption or formation of compounds also take place. They incline to the view that the liberated energy is more likely to appear as radiation, *e.g.* as γ or Millikan-rays, than as heat.

News and Views.

ONE of the subjects discussed at the recent World Power Conference at Basle was the exchange of electrical energy between countries. An interesting example of this interchange of energy occurs between Denmark and Sweden. Submarine cables crossing the Sund Straits transmit power at 25,000 volts and 50,000 volts respectively. When the water supply in Sweden is abundant they carry the excess hydro-electric power to Denmark, and when Sweden suffers from water shortage they convey thermally generated power in the reverse direction. It was pointed out that some countries, Switzerland for example, have great water power resources but yet are very unwilling to export electric power, and set up high tariffs. One of the reasons for their action would appear to be that, in the opinion of some Swiss engineers, Switzerland is destined to become one of the important centres for carrying out electrometallurgical and electrochemical processes on a large scale. In their opinion, the sale of electrical energy abroad helps the establishment of those industries outside their own frontiers and so is not in the national interest. Another objection is that the export of electricity in bulk to foreign countries will gradually subordinate Switzerland to these countries; the foreign capital introduced being conceivably a source of danger. Mr. Niesz of Baden held that these objections have no real foundation. The majority of the engineers present agreed that it is desirable that the authorities in different countries should place no obstacle in the way of a free interchange of electrical energy provided that economic conditions are favourable.

MR. ALAN COBHAM alighted on the Thames opposite the Houses of Parliament on October 1, thus completing his latest flying achievement. In recognition of his services to aviation the King has conferred upon Mr. Cobham the honour of knighthood (K.B.E.). His three long-distance flights are a notable advertisement for commercial aviation. The De Havilland-50 aeroplane, with Armstrong-Siddely "Puma" engine and interchangeable floats and wheels, was designed for flying in countries with undeveloped transport services, where lake, river, or sea offer natural alighting places. An aeroplane of this type was flown to Rangoon and back. The same aeroplane fitted with the more powerful "Jaguar" engine was flown to the Cape and back. Finally, the same aeroplane and engine, after overhaul and fitting of forged "Y-metal" aluminium pistons, was flown to Melbourne and back, floats being fitted as far as Port Darwin, wheels for trans-Australian flying. The structural alterations required for the heavier engine, if any, are not known, but the following are some of the main characteristics:

D.H.-50.	Puma Engine.	Jaguar (Radial) Engine.
Span, 13 m.	6 cyl. (water cooled).	14 cyl (air cooled).
Surface, 41 m².	180 kw	290 kw.
Total wgt, 1770 kgm.	1400 r p.m.	1700 r p m
Speed, 180 km./hr.	300 kgm wgt	360 kgm. wgt.

The last of the three flights was equivalent to flying 800 km. every other day from June 30 to October 1, a high feat of personal skill and endurance, and an equally remarkable record of aeroplane and engine performance.

THE specificity of quinine in curing or relieving the symptoms of malaria has long been known. At the present time, the chief drawback to its use is its cost, due in part to the few areas in which the bark yielding the highest proportion of this alkaloid can be cultivated and in part to the restriction of output. Other drugs have therefore been tried in the treatment of this disease; the other crystalline alkaloids present in the more common variety of bark, quinidine, cinchonine, and possibly cinchonidine, have been shown by Fletcher to be nearly as efficacious as quinine itself (see *Brit. Med. Journ.*, 1926, vol. i. p. 154), and their use therefore should result in a considerable reduction in the cost of treatment. On the other hand, no synthetically prepared compound has so far been found to be of value, but this statement may soon be no longer true if the report from Germany which appeared in the *Times* of September 25 is confirmed. The new drug is called 'Plasmochin,' and has been tested both experimentally in birds and animals and also clinically of endemic malaria and in cases of general paralysis of the insane who have been submitted to the malarial treatment. This treatment consists in infecting the patient with one form of the malarial parasite, and after a week or two curing him with quinine; great improvement of the original symptoms has resulted in many cases. The drug appears to be non-toxic, but caution is expressed as to whether it will replace quinine completely in the treatment of malaria. It has, however, been found to destroy the crescent forms of the 'malignant' tertian parasite within five to seven days. It is possible that it may form a useful adjunct to treatment with quinine or the other cinchona alkaloids.

Mr. G. N. Humphreys, of the Uganda Survey Department, has recently led two expeditions to Ruwenzori; he has climbed most of the chief peaks, and made an extensive examination of the range. His first expedition in February of this year was hampered by bad weather, but he climbed Mount Speke and the peak Vittorio Emanuele, and an unnamed peak; and the expedition achieved the first crossing of the range from east to west; it used a pass near Mount Gessi, and discovered three new lakes, of which the largest is two miles long. The second expedition in July had better weather, and the party climbed both the peaks Margherita and Alexandra on Mount Stanley, some of the higher peaks on Mount Baker, and Mount Luigi di Savoia. The expeditions made some natural history collections. A preliminary account of the journeys was given by Mr. Humphreys in a lecture to the Uganda Literary and Scientific Society on August 27 last.

The British Aquarists' Association has just held its first exhibition in the British Sea Anglers' rooms in Fetter Lane, London, E.C. 4. Judging by the exhibits alone, one would gather that the primary object of the Association is the study of the elegant and comfortable management of freshwater vertebrates, and the provision of expert advice to its members on the construction and maintenance of aquaria. A glance through the *Amateur Aquarist and Reptilian Review*, the official organ of the Association, however, shows that it has much wider biological interests in the structure, habits and life-histories of aquatic organisms generally. In a first exhibition, it was natural that the goldfish family and the quainter and more ornamental water vertebrates should predominate, and we were surprised to find four healthy specimens of such a rarity as Proteus in one aquarium. The exhibition gave special attention to the problem of the respiratory balance. The mechanical method was represented by a recurrent siphon fountain of simple make, an aerating cylinder in which a pump is used to develop air-pressure sufficient for twelve hours' aeration, and a fish aquarium with a sluice under the perforated floor which flushes away the accumulated débris without disturbing the water above. Biologists who prefer the plant-animal balance would be interested to find that such a large variety of aquatic plants from all over the world can now be purchased from dealers in London. The experience of the Association should prove of value to biologists intending to do experimental work with living aquatic animals.

The work of the Building Research Station of the Industrial Research Department is described in a ten-page pamphlet issued by H.M. Stationery Office. Originally housed in temporary buildings at Acton, this station has now been transferred to permanent quarters at Garston, near Watford, which change admits of considerably increased activities. The highly technical problems involved in modern building are often insufficiently appreciated. These problems refer not only to the purely engineering, constructional, and accessories features contained in most large buildings but also embrace developments in the use of, and a scientific knowledge of, the materials which are popularly associated with ordinary building. To elucidate these matters, the co-operation of the chemist, physicist, architect, and engineer is necessary. As is pointed out, quite apart from the general claims of this industry to a share in the efforts of the scientific worker, the country is involved in huge sums spent upon housing, and it is in the national interest that every effort should be made to utilise science in the interests of real economy in construction. By arrangement with other institutions, the station carries out special researches in addition to the work within its own walls, and is prepared to deal with problems for private individuals at arranged fees. Included in the scope of its work is the collection and co-ordination of current results of investigation from other sources.

During the week-end September 24-27, the third conference of the Association of Special Libraries and Information Bureaux was held at Balliol College, Oxford. The immediate object of the Association is the preparation of a directory which, with suitable classification, will direct attention to the sources where special collections of books or other materials have been brought together, whether these be in public libraries or in private collections. This task is a large one, and it is being assisted by a grant of 2000*l.* from the Carnegie United Kingdom Trust. Information bureaux are now being rapidly founded in connexion with many industrial and commercial enterprises, and several of the papers and discussions at the conference dealt with these developments. Papers dealing with the collection of technical information and its utilisation by research associations for the benefit of manufacturers in different branches of industry were also read. The Association is keeping in close touch with foreign sources of information, and is securing liaison with similar developments abroad. At the conference, Dr. de Vos Van Steenjiwk gave an account of the work of the new International Institute of Intellectual Co-operation at Paris. The Association, in preparing the directory and acting as a clearing-house for sources of information, is rapidly placing itself in a unique position to offer valuable service, which will doubtless attract a large membership from professional and business circles. Further information on the Association's work can be obtained from its office at 38 Bloomsbury Square, W.C.1.

DR. D. G. HOGARTH in "The Twilight of History," a lecture delivered as the eighth Earl Grey Memorial Lecture at Armstrong College, Newcastle, in February last, and now published by the Oxford University Press, suggests a new orientation in approach to the problems of the obscure period between the downfall of the second Late Minoan kingdom in Crete and the rise of Hellenism. He does not regard the decadence in art which is to be observed in this period as necessarily implying a set-back in civilisation. While he would agree with the late Sir William Ridgeway in the view that Minos was not 'Minoan' at all, and did not participate in the civilisation named after him, he would not concur in calling him the 'destroyer.' Neither the Achæan nor the Dorian invasion, on his view, was catastrophic. He argues that pre-eminence in artistic products is an accompaniment of an aristocratic regime based upon a subject population of inferior culture, whereas the decadence in artistic motives which follows Late Minoan II., being accompanied by improved technique, for example in pottery, points to the substitution of the artisan for the artist, and a wider diffusion of culture among the people at large. The wider distribution of Minoan products indicates a period of expansion rather than dispersal and the development of an export trade which brought the Greek world into contact with the fertilising influence of the Oriental. Dr. Hogarth concurs in the view that the break up of the Mycenæan Empire was due to the Dorians, but so far from regarding this as the beginning of a 'Dark Age,' he looks upon the isolated communities under hereditary nobles which they founded as the precedent condition of the evolution of the Greek city state. A brief summary does less than justice to Dr. Hogarth's sanity of outlook and his sense of proportion. A careful study of his stimulating lecture might perhaps serve to curb some of the wilder flights of enthusiasm which, apparently, fail to surmount a wall erected somewhere about 776 B.C.

IN connexion with the opening of the reorganised public exhibition galleries of the Imperial Institute, Mr. Arthur M. Samuel, Parliamentary Secretary of the Department of Overseas Trade, addressed a well-attended meeting of head teachers of schools in the London area, held in the great hall of the University of London on the evening of September 28. The Hon. W. G. A. Ormsby-Gore, Under-Secretary for the Colonies, and the Duchess of Atholl, Parliamentary Secretary to the Board of Education, also addressed the teachers. The galleries were opened to the public on the following day. The present system of arrangement, which has been introduced by the new director of the Institute, Lieut.-General Sir William Furse, has as its main object the development of the educational value of the collections, which are planned to illustrate as completely as possible the economic and physical geography of the overseas countries of the Empire. The plan of arrangement which has been adopted for the courts is in keeping with modern ideas in regard to the teaching of geography. Maps and models in relief illustrate the topography and configuration of the country, the distribution of rainfall and other important features. Wherever possible or appropriate, space is devoted to exhibits illustrating the ethnology of the country, and the visitor then passes to a series of show cases in which are displayed selected natural products and manufactures of the country, particular attention being given to new products and developing industries. Complete series of samples for inspection by commercial men and others are to be arranged in special sample rooms. Exhibits illustrating the opportunities for sport are also a feature in certain courts. Full use has been made of the experience gained at the British Empire Exhibition in developing effective means of display, a notable example being the installation of a striking series of finely executed dioramas which portray scenery and natural features, industries, and sport. The scheme has not yet reached its full development in all the courts, but it is clear that the reorganised galleries should prove of great value for teaching purposes and at the same time offer a most attractive display to the general public.

THE *Empire Cotton Growing Review*, vol. 3, No. 3, July 1926, continues to publish interesting accounts of the possibilities of cotton-growing in various tropical dependencies overseas. Mr. G. F. Keatinge, revisiting South Africa in 1925, finds that the production of 1000 bales in 1919, is now 10,000, but would have been more but that many farmers have been discouraged as the result of drought in 1924, excessive rain in 1925, and insect pests at all times. Where, however, cotton is grown continuously on the same land for a series of years, a slow accumulation of pests is to be expected. Cotton prospects in Papua and in New Guinea are discussed by Mr. G. Evans. This number of the journal contains the second part of an article of more general interest to agriculturists, in which Messrs. F. L. Engledow and G. Udny Yule discuss the principles and practice of yield trials. This discussion, which deals with the many difficulties of such yield trials in a critical and yet practical spirit, will be of very general value; the authors state that the form of their paper is the result of their experience in training six generations of 'cotton men' at the School of Agriculture, Cambridge. The Empire Cotton Growing Corporation has also published separately a very full report by Col. C. N. French upon cotton-growing in Nigeria, which is a very interesting discussion of the problems of cultivation, transport, and marketing which arise in a territory where cotton is grown by native farmers.

The report is a striking tribute to the work of the Director of Agriculture, Mr. Faulkner, and his staff.

WE have received a copy of No. 2 of *Continental Metallurgical and Chemical Engineering*, a publication in English, issued by the Dr. Joachim Stern Verlag in Berlin. This periodical is devoted to metallurgical and chemical subjects, and the number received, which is that for September, contains the first part of an article on the cutting and turning of metals, describing important experiments now in progress in the Technische Hochschule of Berlin with the object of determining the forces in action at the cutting edge of the tool and the mechanism of the cutting process. Another subject which is treated in detail is the extraction of radium, vanadium, and uranium from carnotite, whilst the manufacture of ruby glass and the production of synthetic camphor are also topics which receive notice. The review of current literature is, in this number, confined to chemical and metallurgical papers from French and German periodicals. On the commercial aspect, the most interesting article is one describing the movement for the formation of a continental iron and steel syndicate, containing an account of the steps which have been taken in this direction in various European countries, mainly with the object of countering the efforts of the great American steel-marketing organisations. The new periodical is associated with the *Metallborse*.

THE issue of the *Physikalische Zeitschrift* for July 15 contains a portrait of the late Prof. Otto Lummer and an account of his life and work from the pen of Prof. E. Riecke. Otto Lummer was born in Gera on July 17, 1860, studied mathematics and physics at the Universities of Tübingen and Berlin, obtained the degree of doctor at the latter in 1884 and acted as assistant to Helmholtz at the University until 1887, when he followed his chief to the newly established Reichsanstalt at Charlottenburg. He lectured at Berlin from 1901 until 1904, when he became professor of physics at the University of Breslau. He died suddenly on July 5, 1925. Throughout his life he was a skilled experimenter and an attractive lecturer. The work for which he is best known was done while at the Reichsanstalt—the invention of the Lummer-Brodhun photometer in 1889 and the Lummer plate in 1902, the accurate measurement of the ratio of the specific heats of gases with Pringsheim in 1887–1898, and the measurement of the emission spectrum of a black body also with Pringsheim in 1899–1900, which furnished Planck with the starting-point for the quantum theory. His work while at Breslau was concerned mainly with photometry and its industrial applications.

THE annual report of the Field Museum of Natural History, Chicago, for 1925 contains, as usual, much to make museum workers in Great Britain think. Take, for example, the expeditions during the year: there were three making archæological collections—in Mesopotamia, Egypt, and Peru; two making ethnological collections—in the neighbouring states and in Madagascar; three dealt with various branches of botany—in Peru, Chile, and British Guiana; one sought for fossil vertebrates in Argentina; the Roosevelts led a general zoological expedition through the high lands of central Asia; and four other zoological expeditions worked in Central Africa, Southern Georgia, Saskatchewan and Alberta, and British Columbia. Out of the 21 collectors thus engaged eight were members of the ordinary scientific staff, very nearly one-third of the whole. What one ponders over is how the staff manages to deal with the mass of material that is pouring in. That it does deal with some of it in a highly successful manner is clear from the photogravure plates of various exhibits, such as the man-eating lions of Tsavo and the reproduction of a flowering cactus from British Guiana. These plates, it should be mentioned, are all produced in the museum, and are but one example of its unusual activities. Many solutions of our problem suggest themselves, but one seems certain: the museum must employ many highly-skilled technical assistants. We should like to see a complete establishment list, with the rates of pay.

THE Royal Meteorological Society has lately issued the first three numbers of a new series of publications, entitled *Memoirs*, in which it is intended to include the more technical papers printed by the Society. Such papers have hitherto appeared in the *Quarterly Journal* of the Society, which is circulated to all the fellows, but with the recent growth in the mathematical and technical developments of meteorology, this course has been judged less suitable than the new plan now adopted. The *Quarterly Journal* is intended to make a wide general appeal to those interested in meteorology, and will continue to include a large number of the papers submitted to the Society, together with other meteorological notes and articles: but the more technical and difficult papers, which, for reasons of economy, will be sent only to those fellows who indicate their special interest in these papers and express a desire to receive them, will be noticed in the *Quarterly Journal* only by title or in abstract. The Society, like most other publishing scientific societies, finds the financial difficulties due to increased cost of printing enhanced by the growth in the number of papers presented to it, and this new departure is rendered possible only by the aid of a share of the recently increased Government grant for scientific publications, administered by the Royal Society.

ORDERS of the Committee of Privy Council have been issued by which Dr. Charles J. Martin, Director of the Lister Institute and professor of experimental pathology in the University of London, and Sir Frederick G. Hopkins, professor of bio-chemistry in the University of Cambridge, are appointed members of the Medical Research Council into the vacancies caused respectively by the death of Lieutenant-General Sir William B. Leishman and by the retirement of Prof. T. R. Elliott.

MR. W R. THOMSON, formerly a member of the staff of the Royal Agricultural College, Cirencester, has been appointed by Messrs. Fertilisers Sales, Ltd., Adelaide House, King William Street, London, E.C 4, to be director of propaganda for calcium cyanamide in Ceylon.

THE Chemical Society is publishing a series of photographs of eminent chemists, reproduced by a photo-lithographic process. So far eight are available: Bunsen, Emil Fischer, Hofmann, Mendeléeff, Pasteur, Sir William Perkin, Ramsay, and Roscoe. The portraits should be admirable and inspiring decorations for chemical and other laboratories.

FROM the fifty-sixth annual report of the Newport (Mon.) Public Libraries, Museum, and Art Gallery, for 1925–26, we learn that a new building for the Museum and Art Gallery is as urgently needed and as far off as ever. Meanwhile valuable objects of art and science, which should find a home in Newport, are directed elsewhere, and the educational activities of the Museum are hampered for want of a lecture room

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A medical practitioner as bacteriologist for the City of Salford—The Medical Officer of Health, 143 Regent Road, Salford (October 11). An assistant lecturer in the principles of teaching (logic, psychology and ethics) at the Glasgow Training Centre of the National Committee for the Training of Teachers—Director of Studies, Training Centre, Jordanhill, Glasgow (October 16). An assistant pathologist at the Royal Free Hospital and London School of Medicine for Women—The Secretary, R.F.H., Gray's Inn Road, W.C.1, or The Warden and Secretary, London School of Medicine for Women, Hunter Street, W.C.1 (October 18). A professor of mathematics, a reader in physics and a reader in chemistry at Raffles College, Singapore—The Board of Education or the Scottish Education Dept., Whitehall, S.W.1 (October 22). A lecturer and demonstrator in chemistry and a lecturer in pharmacy in the University of Sydney, New South Wales—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (October 30). An Editor for "Science Abstracts" having a knowledge of physics, electrical engineering and foreign languages—The Secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2 (November 8). An assistant curator in zoology in the Bristol Museum and Art Gallery—The Director (November 15). A State mining engineer to the Western Australian Government—The Agent-General for Western Australia, 115 Strand, W.C.2 (November 30). The "J. C. White" lectureship in bacteriology in the Queen's University, Belfast—The Secretary (December 1). A teacher of biology at Gordon College, Khartoum—The Sudan Government Offices, Wellington House, Buckingham Gate, S.W.1 (marked "Teacher of Biology"). A warden of the Ellis Llwyd Jones Hall of Residence for Women Students, Victoria University of Manchester—The Registrar of the University. A lecturer in mathematics at the Chelsea Polytechnic—The Secretary, Chelsea Polytechnic, Manresa Road, S.W 3.

Our Astronomical Column.

THE METEORIC PHENOMENA OF SEPTEMBER 6.—Mr. W. F. Denning writes that, with reference to the meteoric phenomena observed on Monday, Sept. 6, though there were probably two different meteors seen at about $20^h\ 45^m$ G.M.T., the various observations are not sufficiently definite to determine the real paths with certainty except in one case. This refers to the great fireball which was directed from the north-east and passed over Yorkshire from the North Sea to disappear finally over Matlock, Derbyshire. Its height was from 60 to 28 miles, path about 133 miles, and velocity 15 miles per second. The radiant point was near ε Persei over the north-east horizon at the time of the fireball's appearance.

Statements have appeared in the newspapers that a London photographer released a number of gas balloons earlier in the same evening. Those were so arranged as to acquire altitudes of about 5000 feet and to explode finally with great noise and light. The originator of the scheme alleges that he sent the balloons up as an 'amusement' and 'experiment,' and claims that the supposed meteors and curious flashes observed on the same evening were the products of his experiment. This claim cannot apply to the Yorkshire fireball at least, which gave a dazzling illumination, occasioned loud detonations, and caused buildings to vibrate as during an earthquake. A small gas bag could scarcely induce results of this character.

DESIGN OF A 25-FOOT REFLECTOR.—There is no finality in telescope design, and Mr. F. G. Pease, of Mt. Wilson Observatory, pronounces that the making of a 25-foot mirror is quite within the bounds of possibility, and gives a design for such an instrument and its dome in *Publ. Astr. Soc. Pacific* for August. He makes the focal length only 3 3 times the aperture, so that the dome has only twice the span of that of the Hooker telescope. The estimated cost is 12 million dollars. Various materials are suggested for the mirror: glass, pyrex, obsidian, stainless steel; Mr. Pease is not without hope that an alloy may be found with a low coefficient of expansion like invar, but superior in reflective power.

The proposed instrument would carry a 70-foot interferometer. Mr. Pease considers that the climate of Mt. Wilson would permit of the effective use of such an instrument on nearly as many nights as the 100-inch Hooker telescope.

CATANIA OBSERVATORY.—This observatory undertook the photography of the zone +46° to +55° of the Astrographic Catalogue. The printing of its results is much in arrears, owing to shortage of funds since the War and frequent changes of directors (A. Riccò died in 1919 and B. Viaro in 1922), but the appearance of Vol. 2, Part 2 will be welcomed. This extends from declination +47° to +49°, and from R.A. 3^h to 6^h. There are 48 pages of catalogue, with an average of about 120 stars on each, going down to mag. 12·2 (photographic). The information given is fuller than in most astrographic catalogues, R A. and decl. being given for all stars (to $0{\cdot}01^{sec}$ and $0{\cdot}1''$), also meridian positions and spectral types for all stars for which they are available. There is difference of opinion as to the advisability of thus increasing the size and cost of the work, but there can be no question that it makes the catalogue much more convenient for reference.

The *Annuario* of the Observatory for 1926 contains drawings of sunspots and prominences by G. Favaro, and of Mars (opposition of 1924) by M. Maggini. The latter show an unusual number of small round markings, both bright and dark; some of the former may be clouds. A bright bridge crosses Syrtis Major, a feature that others have noticed at times.

Research Items.

ANALYSIS OF PREHISTORIC BRONZE.—Mr. A. Leslie Armstrong publishes, in *Man* for September, a number of analyses of bronze implements and founder's metal made by Prof. Desch in connexion with the work of the Bronze Age Implements Committee of the British Association. A palstave found at Windsor in 1864, formerly in the Hull Museum and now in the Ashmolean Museum, Oxford, was one of the most interesting of the objects examined. Its metal had an abnormal appearance, and on analysis it proved to contain so much oxygen and sulphur that the metal was "hopelessly brittle" and could only be regarded as a founder's failure. The figures were copper 78·79, tin 16·49, nickel 0·49, lead 0·09, sulphur 0·68, total 96·54. Three implements from a hoard found at Westcroft, Shelf, near Halifax, were also brittle owing to excess of sulphur, the analysis of one revealing 1·50 of sulphur, copper 86·32, tin 12·14. The Everthorpe Hoard of thirteen socketed celts, a gouge, and three lumps of metal, now in the Hull Museum, was also examined, and revealed the surprising fact that the metal was practically pure copper, a condition unusual in English objects. The celts are unfinished foundry specimens and the analyses of three samples were practically identical, showing 98 to 99 per cent. of copper. A socketed celt, however, from the same hoard showed the remarkable result of copper 66·88, tin 10·54, and lead 22·36. Such an amount of lead is probably unique.

THE 'A' CEMETERY AT KISH, MESOPOTAMIA.—The Field Museum, Chicago, has undertaken the publication of the technical description of the pottery, metal, and stone implements, and other details of the more material side of the archæological discoveries of the Field Museum-Oxford University Expedition to Kish. The first part, Vol. 1, now issued is by Mr. E. Mackay, the excavator, and deals with the finds in the 'A' cemetery, close to, and south of, the Ingharra series of mounds. This site was partially excavated between January and March 1924, when thirty-eight graves were opened. The finds presented many points of particular interest. On the site, which awaits further excavation, was a large building of plano-convex bricks, which had afterwards been enlarged, and after a considerable lapse of time the addition was repaired. The burials are dated at about 3000 B.C., when the buildings had fallen into a state of decay. The skeletal remains show that though the legs were bent, the bodies were not interred in the 'crouched' position and there is no indication of a rule of orientation. The pottery includes new and important types, the most striking being the handled form which is unique in Mesopotamia or elsewhere found in nearly every grave. It is made in three pieces skilfully joined, the chief peculiarity being the handle, which is hollow, and has the face and breasts of a female in clay applied to it. It is clearly in origin a spout, as in some cases the cavity of the handle communicates with the interior of the jar, and in no case is the handle actually secured to the rim. Nearly every grave was supplied with a pottery brazier made in two pieces. Nothing quite like them has been found excepting the Hittite 'champagne cups' of Bronze Age date, and a vessel from the prehistoric burials of southern India conjecturally dated 2500 B.C. Copper implements were numerous, especially knives and daggers. They were beaten out of thin sheet metal and as they seem too light in weight for actual use, were probably made for funerary purposes. Curious implements of sickle shape of which the use is difficult to determine may, it is suggested, have been used as strigils. The designs on the seals, as usual, throw light on the general culture of the period. The fauna represented suggests a semi-arid climate such as that of South Africa, and it is interesting to note that an antelope apparently was domesticable.

FOREST ECOLOGY IN SWEDEN.—The Swedish Institute of Experimental Forestry in 1923 acquired two forest areas in Västerbotten, northern Sweden, for scientific studies. Kulbäcksliden is about four square miles in area, and Svartberget is slightly smaller. In "Excursion Handbook" No. 11 of the Institute, the geology and vegetation of these forest areas are described by Messrs. O. Tamm and C. Malmström, with maps of the soil and vegetation formations. Over the greater part of the areas the plant communities have suffered no interference by human agency. The predominant tree is the Scots pine, but there is a considerable proportion of spruce. From an investigation of fossil pollen in peat bogs M. Malmstrom believes that pine and birch used to prevail, while spruce was absent or rare, and did not become an important forest tree until perhaps four thousand years ago. Spruce pollen increases rapidly in amount in later peat deposits, suggesting a rapid invasion of this tree. At the same time elm and lime disappeared. Spruce seedlings have an advantage over pine and birch in needing very little light. Thus as competition and crowding increases, the spruce is best able to hold its own. On the other hand, spruce has less resisting power than pine against forest fires, so that after a fire the pine again has a chance until eventually crowded out once more by spruce.

KAPOK.—The *Bulletin of the Imperial Institute*, vol. 24, No. 1, 1926, has an article, with bibliography, upon the prospects of the production of this fibre within the British Empire. The tree producing kapok, *Eriodendron anfractuosum*, belongs to the natural family Bombacaceæ and occurs in many tropical parts of the British Empire, but practically the entire commercial supply of the fibre is obtained from Java. On a relatively small scale it has been cultivated with success in Ceylon. The hairs in kapok are attached to the inner wall of the capsule and not to the seed itself, so that the separation from the seed is much more easy than in the case of cotton. The hair cells are full of air and very light, and as they are unpermeable to moisture they are used throughout the world for the manufacture of life belts and similar appliances, but the chief use of kapok at present is for stuffing cushions, mattresses, etc. Hitherto great difficulty has been experienced in spinning kapok, owing to the smooth, slippery surface of the fibre, when this difficulty is overcome the yarn may not be strong enough for some purposes, but in the production of good non-conducting fabrics and in other directions kapok may find an extensive field of employment. The seed is rich in oil, and in the Dutch East Indies forms an important source of revenue. Cultivation of the kapok tree seems to offer few difficulties in a suitable climate, and propagation, either from seed or cuttings, is a simple matter.

FUNGI.—The Ministry of Agriculture and Fisheries has published 25 coloured plates, of a few (sixteen) of the edible British fungi and also of nine of the more dangerous poisonous species (London: H.M.S.O.). This handbook replaces a former edition, now out of print; names and description have been brought up-to-date, and seven new plates inserted, four of more common species in place of rare species now omitted, three as more representative illustrations of the same species than the figures in the former handbook. The illustrations are clear and the description as non-technical as possible, but it is doubtful whether it is advisable for any but the competent mycologist to range so widely in his diet of fungi. The handbook is very cheap at 3*s.* in S/Cloth Boards or 2*s.* 6*d.* Quarter Boards. In the *Annals of the Royal Botanic Gardens, Peradeniya*, vol. 10, part 1, T. Petch continues his "Additions to the Ceylon Fungi," whilst the *Kew Bulletin*, No. 7, 1926, contains an account of the Fusaria of Jamaica, by C. G. Hansford. Dr. Paul A. Murphy and Robert M'Kay have a paper upon the downy mildew of onions (*Peronospora Schleideni*, Unger) in the *Scientific Proceedings of the Royal Dublin Society*, vol. 18 (N.S.) No. 22, 1926. Perennating mycelium in the bulbs seems to be the main method by which this disease hibernates in Ireland. In the *Transactions of the Royal Scottish Arboricultural Society* Dr. Malcolm Wilson, with collaborators, publishes brief notes upon *Rhizosphæra Kalkhoffii* Bubák, as a cause of defoliation in conifers, and upon *Rhabdocline Pseudotsugæ* Syd., a new disease of the Douglas fir in Scotland.

BLOCK LAVA AND ROPY LAVA.—It is well known that there are two contrasted types of lava flows known as *aa* or block lava and *pahoehoe* or ropy lava. The rough surfaces of the former are moderately crystalline, whereas the latter is covered with a smoother layer of glass which varies in vesicularity from a continuous solid to a froth. A flow frequently starts as *pahoehoe*, especially where the rate of flow is not too high to permit skins of chilled glass to form over the surface, while further on *aa* is formed. This may occur where there is an increase of slope giving turbulent conditions, or when the underlying lava stream has begun to crystallise so that it can no longer advance in a completely liquid state At Mauna Loa most of the *pahoehoe* is formed during the declining phases of activity; crusts then form over the lava, which flows slowly in tunnels and advances by pushing out bright toes along the front of the stream. These in turn rapidly crust over, and the conditions are very different from the raging torrents with which the flank eruptions often begin. Experiments carried out by O. H. Emerson, and recorded in the *Am. Journ. Sci.* for August, together with many pertinent field observations, converge in showing that *aa* lava is essentially due to crystallisation of the mass while it is flowing. It is concluded that the controlling factors in determining the final appearance of a lava flow are mainly mechanical, such as the thickness and viscosity of the flow, its degree of crystallisation at any given time, and its velocity. It has been thought that *aa* is formed by containing and releasing more gas than *pahoehoe*, for the bursting of vesicles often contributes to the roughness of a lava surface Dr. Jaggar, however, is quoted to prove that there is no evidence as to which of the two forms, if either, gives off the greater quantity of gases.

ARCHÆAN ROCKS OF SOUTHERN INDIA.—In his presidential address to the Geological Section of the Indian Science Congress of 1924, now published in the *Records of the Mysore Geol. Dept.*, 23, 37, 1926, Dr. W. F. Smeeth discusses the sequence and origin of the gneisses and associated rocks of Mysore. He adheres to his view that the chloritic and hornblendic rocks of the Dharwar group are the oldest of the complex, and that the gneisses, charnockites and granites are successive intrusions of later dates. Nevertheless, no sign has been detected of any old land surface or basement rock on which the oldest Dharwars could have been laid down or erupted. This failure has led to the hypotheses that the original underlying floor, together with the base of the Dharwars themselves, have been re-fused, or that they have foundered into the depths after having been stoped away by a magma rising from deeper sources. The upper or chloritic division of the Dharwars shows as a whole more folding and shearing than the lower or hornblendic division, and the contact relations indicate that the latter are, for the most part, intrusive towards the former. Confirmatory evidence is found in the structural relations of the banded quartz-ironstones that are developed among the chloritic schists. Acid intrusions which have been thought to be offshoots from the later Champion Gneiss are stated to be more abundant in the upper division than in the lower, and this discrepancy is met by the suggestion that some of them are associated with a period of granite intrusion still earlier than that of the Champion Gneiss, and also earlier than the intrusion of the hornblendic series.

BRAZILIAN METEOROLOGY.—The observations taken at the Central Observatory at Rio de Janeiro in 1921 are tabulated in full in the *Boletin Meteorologico* published by the Ministry of Agriculture. They are followed by a summary of the observations taken at some 80 other stations, and rainfall data at 25 other stations. In an appendix there are added the data obtained from various private observatories, owned mainly by railway and mining companies. The volume contains detailed rainfall maps, so far as statistics permit, for every month in the year. The lack of data in the far interior is noticeable in these maps, which show only five stations in the basin of the Amazon and its main tributaries. On the coast, however, the stations are numerous.

RECURRING MAGNETIC DISTURBANCES.—Largely through the work of Maunder and Chree, the '27-day recurrence tendency' is one of the most firmly established facts of terrestrial magnetism: the phrase denotes the tendency for a day following or preceding, at an interval which is an integral multiple of 27 days, a day of marked magnetic disturbance or calm, to share the same characteristic in diminished measure. The tendency is attributed to the association of magnetic disturbance with corpuscular emissions from particular disturbed regions of the solar surface: if on a given day such a region is suitably disposed towards the earth, so that its emissions impinge on the earth, then 27 days later, in consequence of the solar rotation, it will recur to approximately the same aspect relative to the earth, and if still active there will be recurrence of terrestrial magnetic activity at this interval; it is known that particular solar regions often remain disturbed for the duration of more than one solar rotation-period. The same hypothesis applies, *mutatis mutandis*, to days of magnetic calm, which are naturally associated with notably calm regions on the sun's surface. In *Terrestrial Magnetism*, June 1926, W. J. Peters and C. C. Ennis use the Ebro observations of 1910–1924 to prove that earth currents exhibit the same recurrence-tendency. This was to be anticipated, since it is almost certain that these currents are induced in the earth by the variations in the earth's magnetic field (themselves originating in electric currents situated in the atmosphere); it is satisfactory, however, to have this anticipation confirmed.

THE ACOUSTICS OF BUILDINGS.—As the result of experiments which have been carried out at the National Physical Laboratory, Teddington, during the last two or three years, architects can now be told what will be the acoustical properties of any hall designed by them, before it is erected. The apparatus used in the predetermination of these properties is described by Dr. A. H. Davis and Mr. N. Fleming in the September issue of the *Journal of Scientific Instruments*. For the effects of floor, ceiling, side walls, and galleries, a small model in hard wood is made, the end walls being omitted. A spark from an electric machine is made to pass between two electrodes placed in the model at the point at which in the hall the sounds are produced, and, after a short interval, a second spark is made at a point in the model which corresponds to a point behind the source of sound in the hall. The position of the sound wave due to the first spark is shown by the shadow it casts on a photographic plate placed in the model at a point corresponding to one behind the back wall of the hall. By changing the interval between the two sparks, the sound waves before and after reflection are followed.

THE CATALYTIC DISSOCIATION OF CARBON MONOXIDE.—The reversibility of the reaction $CO_2 + C = 2CO$ was demonstrated by Deville in 1863, and although numerous experiments on the thermal decomposition of carbon monoxide, alone or in the presence of catalysts, have been carried out since that time, the existence of this equilibrium at comparatively low temperatures has but recently been observed. The minimum temperatures at which various catalysts cause the decomposition of pure carbon monoxide were determined by J. Cleminson and H. V. A. Briscoe in a series of experiments described in the August issue of the *Journal of the Chemical Society*. The pure gas was heated in a durosil vessel, connected with a mercury manometer, in the presence of the catalysts, the diminution in volume serving to measure the extent of decomposition. The temperatures at which the decomposition began were 300°, 290°, and 250° for carbon, magnesia, and alumina respectively.

FUMIGATION WITH HYDROCYANIC ACID.—Fumigation with hydrocyanic acid gas is the subject of *Science Bulletin*, No. 46, published by the Department of Agriculture of the Union of South Africa, which details the work of B. J. Smit and T. J. Naude on the distribution of the gas in a tented enclosure. In order to find the conditions for the most efficient fumigation, samples of the gas from different parts of a treated brick-chamber were drawn through potash solution and the hydrocyanic acid concentrations estimated. When the pot method is used, it is found that, under the influence of the heat of reaction between the hot sulphuric acid and the sodium cyanide, the gas rises to the top of the chamber and descends along the walls to the floor, the dose being in excess of the theoretical for the first few minutes. In fumigations with liquid hydrocyanic acid, the distribution of the gas depends on the nature and area of the surface on which the liquid is poured, but when the evaporation is aided by heat the results resemble those obtained by the pot method.

EKA-CÆSIUM.—Various attempts have recently been made to isolate eka-cæsium, the hitherto missing element 87. Assuming that MsTh$_2$, an actinium isotope, might undergo dual disintegration, and emit a small number of α-particles in addition to its normal β-ray disintegration, O. Hahn recently attempted to detect the missing element. He concluded that eka-cæsium, provided it has a half-value period of not less than a few hours, does not result from the disintegration of MsTh$_2$. Using the scintillation method, G. Hevesy has also investigated the problem of the missing element by counting the α-particles emitted by RdTh during its growth from MsTh$_2$. His results indicate that the fraction of MsTh$_2$ atoms which disintegrate under emission of α-particles is certainly less than 1/200,000. In a recent paper (*Phys. Zeit.* 27, p. 531, August 15, 1926), O. Hahn and O. Erbacher have carried the investigation a stage further. They used strong MsTh$_2$ preparations, of strength equivalent to 24-32 mgm. radium, which they freed completely from isotopes of radium, lead, and bismuth in the presence of iron, after which cæsium nitrate was added, and the MsTh$_2$ quantitatively separated from it. The cæsium was then precipitated, carefully washed and dried, and transferred to an electroscope. The measurement of its activity was commenced about thirty minutes after separation of the MsTh$_2$. The residual activities were probably due to traces of MsTh$_2$, and were so small that the authors conclude that if eka-cæsium is produced from MsTh$_2$ and has a half-period within the limits of a few minutes and ten years, the branching ratio is not greater than one in ten millions. By the observations of the β- and γ-activities of their purified MsTh$_2$ preparations during a period of 50 hours, four accurate decay curves of MsTh$_2$ were obtained, and these yield a mean value of 6·13 hours for the half-period of MsTh$_2$ ($\lambda = 0{\cdot}113$ hour^{-1}). This result agrees fairly well with the earlier determinations, but indicates that the value $T = 5{\cdot}95$ hours obtained by W. P. Widdowson and A. S. Russell is distinctly low.

AN ARABIC TREATISE ON ALCHEMY.—Additional information on the "somewhat shadowy figure" of Abu 'l- Qāsim al- 'Irāqī, an Arabic alchemist of the 13th century, whose work "Al- Muktasab" (Arabic text and English translation, Paris 1923) was published by Mr. E. J. Holmyard, and was reviewed in NATURE (Aug. 30, 1924, p. 307), is now available in the July number of *Isis*. Mr. Holmyard here gives translations of parts of other works of Abu 'l- Qāsim, in which (as in the first treatise) the influence of Alexandrian writers is very clear. In a list of secret names ("Decknamen") of materials, many are those "used by the Greeks." Among the names of mercury is "liquid gold" (which Mr. Holmyard does not comment upon). The Greek name is "liquid silver" (χυτὸς ἄργυρος in Aristotle, the earliest mention), but Ktesias mentions an Indian "liquid gold" (ὑγρὸς χρυσός). The elixir is called *al-tiryāq* (θηριακή, a nostrum invented by Andromachus of Crete, physician to Nero, which Sprengel says "was later applied without distinction to all the kinds of diseases"). Supposedly Greek names, which are obviously greatly disfigured, are left by Mr. Holmyard without comment. Among these are ***halinus*** for hæmatite (? *al īmus*, αἱματίτης); ***isqūnās***, purified sulphur (? from φεῦγον, the sulphur being sublimed); ***mughlīs***, salt of urine (probably made up from ὄμιχμα and ἅλς); ***faluxabalis***, white lead (perhaps containing λιθάργυρος; the name Ἀφροσέληνον suggested by Mr. Holmyard seems improbable); ***harfalis***, copper scales (Ruhland, *Lex.* 29, says *alfatida* is "cuprum ustum"); ***badis***, trona (Ruhland, 100, ***barach panis*** is "nitrum salis"), ***raus***, sulphur, etc.

Jubilee of the Mineralogical Society.

THE opening of the Jubilee Celebration of the Mineralogical Society on Tuesday, September 21, was preceded by a very successful week's excursion to Cornwall under the leadership of Mr. Arthur Russell, which was attended by about eighteen members and guests.

On Tuesday, September 21, an informal gathering in the Mineral Gallery of the British Museum (Natural History), South Kensington, was followed by a visit to the Imperial College of Science, where was shown a series of exhibits in the Geological Department, and Prof. H. C. H Carpenter exhibited and gave an account of the large crystals of aluminium and other metals that he has succeeded in making.

The afternoon began with a most interesting visit to the Royal Institution, where Sir William Bragg and his assistants showed models of crystals and the results obtained by the X-ray analysis of minerals Sir William Bragg also took his guests over the Institution and showed the historic laboratories of Faraday, and the apparatus employed by him and by other famous investigators. Later in the afternoon, at the Jermyn Street Museum, Sir John Flett and the Museum curators exhibited the mineral and other collections, the library, and map-room, and entertained the visitors at tea.

The formal reception took place in the evening of Tuesday at a conversazione held by kind permission in the rooms of the Geological Society at Burlington House. Here Mr. Campbell Smith had arranged an interesting collection of apparatus and specimens. The latter included a beautiful set of gold nuggets, got together by one of the oldest members of the Mineralogical Society, Prof. Liversidge. The apparatus, consisting of goniometers, refractometers, etc., all of British workmanship, was mostly of recent design, but part was old and of historic interest from its association with earlier workers. After the formal reception the President delivered a short address dealing with the history of the Society, its relations with other kindred societies, and the main lines of work which it has accomplished and published.

The exhibits at the Geological Society's rooms were on view during the following day, September 22, and were visited and examined by many who had had too little opportunity on the previous evening. By kind permission of the Provost of University College, parties were also able to visit at 134 Gower Street the beautiful collection of Vesuvian rocks and minerals formed by the late Dr. H. J. Johnston-Lavis, and bequeathed by him to the University of London. In the afternoon the party was received at the Imperial Institute by Sir William Furse and Sir Richard Redmayne, who gave an account of the collections, and the intention of those in charge to make the Institute a new educational instrument with the definite aim of illustrating the products and characteristics of the various parts of the British Empire. The party then proceeded to the British Museum (Natural History), where they were received by the Trustees, the Assistant Secretary, and the Keepers of Mineralogy and Geology, and were shown some of the chief features of the Mineralogical Collections. Afterwards the party were photographed and entertained at tea provided by the Government.

The London part of the celebration closed with a dinner at the Connaught Rooms, at which about seventy were present, the chief speakers being Dr. Harry von Eckermann (Sweden), Prof. Paul Niggli (Switzerland), Prof. F. Wigglesworth Clarke (U.S.A.), Prof. J. L. H. Borgström (Finland), Prof. F. Rinne (Germany), and Dr. H. Ungemach (France), for the foreigners, and Sir Henry Miers, Sir Thomas Holland, Sir John Flett, and the President of the Mineralogical Society, for the hosts.

Letters were communicated, bearing messages of congratulation from many foreign societies which had been unable to send representatives to the gathering, among the most interesting being those from Prof. Victor Goldschmidt of Heidelberg, from Prof. Paul Groth, Prof. A. Lacroix, Prof. E. S. Dana, the veteran Gustav Tschermak, Dr. H. Michel, Prof. J. Morozewicz, Prof. F. J Becke, Prof. F. Zambonini, and the Mineralogical Societies of Vienna, Russia, Hungary, and America. Addresses were read and presented from the Geological Societies of Poland and Cornwall, and it was resolved to send telegrams of greeting to Prof. Tschermak, Prof. Dana, Prof. Goldschmidt, and Prof. Groth representing the oldest of the honorary members of the Society, and to Mr. B. Kitto, Prof. A. Liversidge, Dr. R. Pearce, and Mr. C. J. Woodward, veteran ordinary members of the Society, the last being one of the two survivors of the Crystallological Society.

On the following morning about a dozen left Euston for the north of England with Prof. A. Hutchinson of Cambridge, to study the Shap and Carrock Fell areas, the Alston district, and other famous mineral localities. The excursion closed at Cambridge on Friday, October 1, with visits to the Mineral Laboratories of the University and of Dr. A. E. H. Tutton.

The President of the Mineralogical Society, Prof. W. W. Watts, in his presidential address, extended a very warm welcome on behalf of the council and members of the Society to those who had come from far-distant parts of Europe and America to join in the celebration. He pointed out that the Society was not the first of its kind in Great Britain, but had been preceded in 1799 by a body who formed "The British Mineralogical Society," and continued active for seven years when they rejoined the Askesian Society, a selected number of which formed the nucleus from which the Geological Society grew. The minute book of that old Mineralogical Society is still preserved in the Science Library, and by the kind permission of Sir Henry Lyons was exhibited at the conversazione.

In the same year as the Mineralogical Society was founded, a more academic body, at first called the Crystallometric Association and afterwards the Crystallological Society, was formed, but it amalgamated with the Mineralogical Society in 1883, bringing with it such men as Maskelyne and Lewis, Fletcher and Miers, who afterwards served as presidents. As a result of this happy combination, the Mineralogical Society was free to publish crystallographic as well as its other purely mineralogical work.

The Society was fortunate in securing Henry Clifton Sorby as its first president and keeping the "Father of Petrology" in the chair for three years. His influence on the Society was very great, both in the optical and microscopic work which he founded, and in adding the advancement of the knowledge of petrology as one of the objects of the Society.

Sorby was followed by a line of presidents each of whom rendered conspicuous service to the science and to its Society; Heddle, with his long list of works on Scottish mineralogy; Bonney, with his series of papers on rocks and rock-forming minerals; Hudleston, of wide travel and critical instinct; Scott, with his broad chemical knowledge and his service to the finances of the Society; Fletcher, who not only wrote a series of masterly papers on meteorites but also revolutionised crystal-optics by his conception of the optical indicatrix; Maskelyne and Lewis, professors of mineralogy at Oxford and Cambridge respectively, famous for their crystallographic work,—to mention only some of those who are no longer with us.

The work of these men reflects that of the Society. Always there have been pure mineralogical papers dealing with mineral types or mineral groups, topographic papers concerning areas at home and abroad famous for their unique or abundant minerals, and petrographic papers dealing with the naturally occurring associations of minerals. These have depended upon chemical analysis, measurement of crystals, and determinations of optical characters as revealed by the microscope and other optical instruments.

In addition to this there have been a number of papers devoted to the mathematical aspects of crystallography, to the expression of internal structure by outward form, to the physiology of mineral growth, repair, and destruction, to the minerals used as gems or for other economic purposes, their associations and genesis, and of later years to the atomic and molecular structure of crystals as revealed by X-ray analysis.

The organ of the Society, the *Mineralogical Magazine*, has appeared regularly throughout the life of the Society and, in addition to original communications read at the meetings, has contained abstracts and reviews, and lists of new mineral names. During the last few years (since 1920) the Society has published sections of mineralogical abstracts. These give concise accounts of mineralogical papers and works published elsewhere, and have been of the greatest service to all workers in mineralogy, crystallography, and petrology. Indeed, the Society has never been more active than at present, and there is every promise of a brilliant and useful future.

Classification of Amœbæ.[1]

THE purpose of the memoir before us is to set forth a description of 39 new species and 11 new genera of Amœbæ and to propose a classification of Amœbæ. That a revision of the systematics of Amœbæ is desirable is unquestioned. The author has endeavoured to obtain a secure basis for his revision by prolonged observation of the various species, several of which have been raised in cultures from a single example. Variations within the species such as have been frequently assumed and even asserted to occur by some writers were not found, and the author states that most free-living amœbæ can be recognised specifically at least as readily as ciliates or beetles. No special difficulty is met with in classifying about three-fourths of all the known species of Amœbæ, but the remainder are small species the morphology of which has not been studied with sufficient care for the purpose. The supposed shapelessness of Amœbæ has led to previous attempts to classify species wholly with respect to nuclear characters, but the author states that such a systematic basis is no more defensible here than it would be in other protozoa. The genus Protamœba has been defined as lacking nucleus and vacuoles; the author suggests that the enucleate daughters which occasionally arise during fission of an amœba have provided the basis for this genus, the validity of which he therefore doubts, and Gloidium has scarcely a better standing.

Prof. Schaeffer differentiates pseudopodia into determinate and indeterminate. The former grow to a more or less definitely limited size and are then withdrawn; they are generally conical and composed of clear protoplasm only, and they are usually extended only on an advancing part of an amœba. Indeterminate pseudopodia are not restricted as to size; they direct locomotion and may grow large enough to form the entire amœba. They are more or less cylindrical and filled with granular protoplasm.

In putting the question "How many good species of Amœbæ are now known?" the author states that it is not yet possible to give a definite answer. The large, free-living species hitherto described amount to about 85; the parasitic and culturable species are about 70, and with the new species described in the present paper the total number approaches 200. A natural system of classification of the amœbæ must be based on the larger species, and it is with these the author chiefly deals. The changes of form exhibited by an amœba are characteristic and provide the basis for a natural classification. He regards Trimastigamœba, a minute amœba which can take on a flagellate condition, as the most primitive genus.

Prof Schaeffer describes the different conditions—natural and cultural—under which he has observed his material. He states that no species has yet been found to live and reproduce in both fresh and salt water, though one species can be transferred from sea water to fresh water without apparent injury, and will live about ten days, but reproduction was not observed. More species of amœbæ and more individuals are to be found in tidal pools rich in diatoms than under any other conditions.

The author discusses problems of nomenclature and considers that 'Amœba' must go and be replaced by 'Chaos,' and that the Amœba first called 'der kleine Proteus' (Roesel, 1755) is the same as *Proteus diffluens* Muller and the correct name is *Chaos diffluens*. On submitting this conclusion to about a score of representative American zoologists, the majority expressed their general agreement, but the author wisely remarks that it might be desirable to bring the case before the International Commission for consideration and decision.

The main part of the volume is devoted to careful descriptions of the species, and these are supported by excellent lithographed figures. The memoir forms a most important contribution to the systematic study of Amœbæ.

---

[1] "Taxonomy of the Amebas, with Descriptions of Thirty-nine new Marine and Freshwater Species." By Asa Arthur Schaeffer. Papers from the Department of Marine Biology of the Carnegie Institution of Washington. 115 pp 12 plates. Washington, 1926.

Ventilation in Factories.

THE importance of a proper system of heating and ventilation in factories for the comfort and health of the workers need not be emphasised. Considerable difference of opinion as to the correct system probably exists amongst engineers, so that a scientific examination of various common methods should prove of value in selecting that one which the workers find most satisfactory. Dr. H. M. Vernon and T. Bedford[1] have recently made a physiological study of the ventilation and heating in certain factories.

---

[1] Medical Research Council: Industrial Fatigue Research Board. Report No. 35: A Physiological Study of the Ventilation and Heating in certain Factories. By H. M. Vernon and T. Bedford; assisted by C. G. Warner. Pp iv+82. (London: H.M. Stationery Office, 1926) 3s. net.

Continuous records of air velocity and air temperature were taken by means of the hot-wire anemometer and the thermopile respectively. Vane anemometers to determine the directions of the air currents were also used, as well as the katathermometer for direct estimations of the cooling power of the air. The following may be considered the criteria by which a heating and ventilating system should be judged. The room should feel comfortably warm and fresh, yet be without draughts, the temperature at head level should be cooler than that at the level of the feet, and the incidence of sickness and ill-health should be a minimum.

The ideal temperature appears to be about 60° F.-63° F. The cooling power should be 7·0 in winter and about 6·0 in the hot weather, the difference being due to the acclimatisation of the body to the different seasons. These cooling powers can be attained with air velocities of 30 ft. per min. in winter and 50 ft.-100 ft. per min. in summer. The room feels 'too warm' when the temperature rises 4° F. and the cooling power falls one unit, and 'too cold' under the reverse conditions.

An important index of the actual temperature conditions is the temperature gradient from the floor level to the region of the head or higher. It is greatest when the heating system is placed above the heads of the workers: in fact, such a system is roundly condemned as leading to cold feet and hot heads and their accompanying discomforts, and should only be used in conjunction with a heating system at a lower level, when it is desired to avoid down draughts from skylights. The lowest gradient was found when the heating system was placed *under* the floor, and when at floor level it was nearly as satisfactory. The temperature used should not be too high, else the air currents induced become too rapid. It is important that these should be directed upwards, since expired air travels upwards, being lighter than room air, and hence with a down draught there is danger of the workers having to breathe each other's expired air, with the attendant risks of possible infection.

The system of ventilation which gave least draughts and yet most freshness to the air was one of natural ventilation by means of windows, with fan exhaustion in addition if necessary; the outlets for the latter should be situated 7 ft.-8 ft. above the floor. If a plenum system is installed, it should deliver the warm air near the floor from small inlets, and not from inlets situated above the heads of the workers; the latter leads to discomfort and is wasteful of energy. A plenum system delivering *cool* air above head level in conjunction with floor warming gives the most satisfactory type of heating when natural ventilation cannot be utilised.

The efficiency of any given system can be determined from the cooling power and its velocity and temperature components, together with a knowledge of the available window area and the extent to which it is utilised. The latter should be considered relative to the floor area and not to the cubic capacity of the room, since the ventilation is slightly better in a higher room than in a lower one with the same window and floor area.

Evidence is adduced in the report to show that the incidence of sickness is less in workrooms with a good ventilation and a satisfactory mean temperature. The report should, indeed, be studied by all who take part in the designing of modern factories.

International Agreements affecting Port Sanitary Work.

SIR GEORGE BUCHANAN gave a valuable address upon the above subject at the conference of Port Sanitary Authorities during the recent London congress of the Royal Sanitary Institute. He had recently attended on behalf of the British Government the fourth International Sanitary Conference at Paris, at which seventy nations were represented; and he considered that some good results had been achieved. The conference was held with the object of revising and bringing up-to-date the International Sanitary Convention, 1912, under which the various signatory governments agreed upon mutual action and common standards for dealing with the diseases liable to be carried on ships, including cholera, plague, typhus, smallpox, and yellow fever. The conference laid down some new lines of international action which are of great importance to British port sanitary authorities, on whom rests the daily burden of protecting their ports, as well as the rest of the country, from the risks from the importation of these diseases.

The deficiencies of the 1912 International Sanitary Conference have been obvious for many years. To take one example: a ship was only held to be 'infected' with plague when human cases of the disease had occurred during the voyage; but the most dangerous ship of all, with swarms of rats among which plague is prevalent, was not so classified and therefore came under no regulations.

In the new Convention an effort is made to increase the measures whereby countries may obtain all possible intelligence regarding the prevalence of certain infectious diseases. It gives further encouragement to the existing system of interchange of information regarding the incidence of infectious diseases by requiring the signatory governments to reply to any inquiries addressed to them, from the Office Internationale d'Hygiene Publique, for information on any subject affecting the risks of transmission of infectious disease from one country to another. Thus the Office Internationale will discharge the duty of acting as a kind of clearing house for information; and it is authorised to make agreements which will avoid duplication of effort.

In reference to plague, the establishment of new definitions by which a ship with plague-infected rats becomes an 'infected' ship, and a ship with an unusual mortality among rats, a 'suspected' ship, was readily agreed to, as was also the authorisation of measures to prevent rats reaching the shore directly or through merchandise. In ports designated as sufficiently equipped to undertake effective rat destruction, systematic measures will be required to be undertaken once in six months, and a certificate that this has been done, specifying methods and results, will carry the ship on to the next half-yearly period The inspection officer is authorised to exempt from systematic measures when circumstances permit, and to issue an exemption certificate, which is also valid for six months.

In case of other diseases the measures required by the new Convention have been made to conform to our latest knowledge and experience; and all those applicable to the ship, passengers, and crew have been made strictly reasonable, the aim being to make them more efficacious and, where possible, less burdensome. Seeing how much of the world's immunity from pestilence is due to the measures outlined above, and to the spade work of the port sanitary authorities and their officials, the public has reason to be grateful to the representatives of the seventy nations for the valuable work they have accomplished.

The Measurement of Ocean Currents.[1]

THE application of Bjerknes' circulation theory to the movement of water masses in the oceans has provided a method of increasing utility for the study of ocean currents. If the temperature and salinity of the ocean are given for several known depths at several positions, the difference in velocity of the current at the surface and the various depths can be computed and mapped. It is frequently possible to make observations down to a depth where it may be assumed that no appreciable current exists.

In 1914 a survey in the neighbourhood of the River St. Lawrence was carried out for the Canadian Government by Dr. Johann Hjort and the data obtained were worked up by Prof. Sandström, whose explanation of the theory and its application in hydrography has hitherto been the only work of the kind in the English language. It is not without interest that this neighbourhood is stated to be the first to be charted by a vessel employed solely for that purpose, and that this survey was conducted by Captain Cook immediately previous to his expedition of discovery to the South Seas and the Pacific, which resulted in the addition of Australia to the British Empire.

The U.S. Coast Guard in *Bulletin* No. 14 has published a full account of Bjerknes' theory and the method of its application by Lieut.-Commander E. H. Smith, who is in charge of the scientific work carried out by the Atlantic Ice Patrol, a service inaugurated after the loss of the *Titanic* to warn vessels passing south of Newfoundland of the position of the larger icebergs, of which the Patrol follows the drift. The account is based on a series of lectures by Prof. Helland-Hansen at Bergen, and the examples by which the practical application of the theory is illustrated are taken from observations by the Ice Patrol. It is of particular interest that "the currents calculated from the observational data collected in 1922 off the Grand Banks agree very closely with the drifts of the icebergs of that same year and region." Here the method shows every prospect of being of definite and immediate economic value.

The *Bulletin* contains two handy tables from Hesselberg and Sverdrup's formulæ, to allow for the effect of pressure at different depths upon the specific volume at atmospheric pressure, a correction which becomes necessary where considerable depths are investigated, as in this area. Taking this into account, the method of calculation employed, involving the calculation of the dynamic depth, is in the opinion of the writer not so simple as that employed by Sandström—both methods yielding the same final result.

It is noteworthy that the big German scientific expedition arranged by the late Prof. Merz, which is at present engaged in a very complete investigation of the physical conditions of the South Atlantic, has planned its route in such a way as to make full use of the application of this theory in determining the currents and consequent exchange of the water masses.

It is not unreasonable to hope that this method may provide the means of investigating fluctuations in the north-going current of warm Atlantic water which bathes the western coast of Great Britain and affects our climate and sea fisheries. H. W. H.

---

[1] "A Practical Method for Determining Ocean Currents," by Edward H Smith, Lieut.-Commander U.S. Coast Guard. *Coast Guard Bulletin*, No. 14. Washington, 1926.

University and Educational Intelligence.

CAMBRIDGE.—Prof. A. C. Seward, in his address on resigning the office of Vice-Chancellor, announced the offer of 150,000 dollars from the Trustees of the Laura Spelman Rockefeller Memorial for the establishment of a chair of political science. The new Vice-Chancellor is the master of Sidney Sussex College, the Rev. G. A. Weekes. The late Disney professor of archæology, Sir William Ridgeway, bequeathed to the University his collections of Stone, Bronze, and Iron Ages, including his series of barbaric currency coins, his collection of barbaric jewellery and of articles of ancient pottery.

J. D. Cockcroft, St. John's College, and J. A. Ratcliff, Sidney Sussex College, have been elected to the Clerk Maxwell Scholarship.

LEEDS.—Mr. E. L. E. Wheatcroft has been appointed to the newly created chair of electrical engineering. Mr. Wheatcroft read mathematics and engineering at Cambridge. His practical training was gained in the works of the British Thomson Houston Company and, later, with the General Electric Company in America. He has had an extensive experience in certain phases of heavy electrical engineering (particularly in regard to problems relating to the generation and transmission of power), and has carried out a considerable volume of research work.

In making this appointment the University has in mind the desirability of developing the Department of Electrical Engineering. Compared with some parts of the country, Yorkshire has followed a progressive policy in the distribution of electrical power, and it is felt that this policy should be reflected in the attention paid within the University to the study of the scientific principles of electrical engineering.

LIVERPOOL.—By the will of Mr. Samuel Turner, who died on July 18, the residue of his property is bequeathed to the University "to be applied as the University authorities in their discretion may think fit for the furtherance and advancement of medical research into the diseases of phthisis and cancer, and any kindred diseases." The bequest will apparently amount to approximately 30,000*l*. but will not be available until after the death of Mr. Turner's widow.

LONDON.—The following free public science lectures are announced:—"The Philosophic Significance of Spiritual Values," Prof. G. Dawes Hicks (at University College, October 1); "Is Mind governed by Laws?" Prof. C. Spearman (at University College, October 12); "The Motivating of Conduct," P. Hopkins (at University College, November 4); "Extreme Cold," Prof. W. H. Keesom (at Imperial College of Science, October 13); "The Interaction of Pure Scientific Research and Electrical Engineering Practice," Prof. J. A. Fleming (at Institution of Electrical Engineers, eight, beginning October 20); "Some Applications of Modern Science, Prof. E. V. Appleton and others (at King's College, seven, beginning October 7); "The Place of Mind in an Organic Theory of Nature," Prof. C. Lloyd Morgan (at King's College, three, beginning October 19); "Evil Spirits in Babylonian Religion," C. J. Gadd (at King's College, October 25); "Early Arabian Tribes," S. Smith (at King's College, December 10); Swiney Lectures on geology, Prof. W. T. Gordon (at King's College, twelve, beginning November 5); "The Present position of the Logic of Induction," Dr. C. D. Broad (at King's College, December 1).

Contemporary Birthdays.

October 10, 1871.	Earl of Crawford and Balcarres, K.T., F.R.S.
October 10, 1838.	Prof. W. Carmichael M'Intosh, F.R.S.
October 10, 1861.	Dr. Fridthof Nansen, G.C.V.O.
October 11, 1875.	Dr. Arthur William Hill, C.M.G., F.R.S.
October 11, 1864.	Sir Henry George Lyons, F.R.S.
October 12, 1868.	Prof. John T. Hewitt, F.R.S.

The EARL OF CRAWFORD AND BALCARRES was educated at Eton and Magdalen College, Oxford. Sometime president of the Board of Agriculture and Fisheries, he has been, since 1923, Chancellor of the University of Manchester. Lord Crawford is a trustee of the British Museum, the National Gallery, and National Portrait Gallery

Prof. W. C. M'INTOSH, emeritus professor of natural history in the University of St. Andrews, is about to celebrate his eighty-eighth birthday We extend our most cordial congratulations. A fellow of the Linnean Society for sixty-three years, he will, next year, attain jubilee fellowship of the Royal Society. Born at St. Andrews, and educated at its University, his interests have ever centred and been in alliance with those of the ancient northern city. To record his long series of memoirs in zoology would absorb much letterpress. A pioneer of research in fishery problems, he was the first to found a marine biological station in Great Britain. Prof. M'Intosh was awarded a Royal medal of the Royal Society in 1899.

Dr. FRIDTHOF NANSEN, the distinguished Arctic explorer and naturalist, was born at Store Fröen, near Christiania (Oslo), at whose University he was educated, and where, since 1908, he has been professor of oceanography. In 1893 he left in the *Fram* to conduct his famous Arctic expedition. The narrative of this great polar adventure is recorded in "Farthest North" (1897). Dr. Nansen was Minister for Norway, at London, from 1906 until 1908.

Dr. HILL was educated at Marlborough and King's College, Cambridge. University lecturer in botany at Cambridge from 1905 until 1907, he was afterwards, until 1922, assistant-director of the Royal Botanic Gardens, Kew, succeeding then to the directorship on the retirement of Sir David Prain.

Sir H. G. LYONS, Colonel R.E. (retired), is a Londoner. Educated at Wellington College, he passed into the Royal Engineers. Director-General of the Geological Survey of Egypt and allied departments from 1896 until 1909, he has been, since 1920, Director and Secretary of the Science Museum, South Kensington. He is Hon. D.Sc., Oxford and Dublin. A past president of the Royal Meteorological Society, he was awarded its Symons gold medal in 1922 for services to meteorological science, in particular, investigations into the climatology of Egypt and the Sudan. His studies relative to the changes in the level of the Nile and Victoria Nyanza are well known Sir Henry is chairman of the National Committee for Geodesy and Geophysics (International Research Council).

Prof. HEWITT, emeritus professor of chemistry in the University of London (East London College), was born at Windsor. His studies were conducted at the Royal College of Science, the University of Cambridge, and at Heidelberg.

Official Publications Received.

Transactions and Proceedings of the New Zealand Institute. Vol. 56 (New Series), July 12th. Pp. xxii+860+111 plates. (Wellington, N.Z.: W. A. G. Skinner.)

Wigan and District Mining and Technical College. Calendar, Seventieth Session 1926–1927. Pp. xvi+146. (Wigan.)

The London Schools' Guild of Arts and Crafts. Exhibition at the London Day Training College, Southampton Row, W.C.1, on Wednesday, Thursday, Friday and Saturday, September 22nd to 25th, 1926. Pp. 20+xxiii. (London.) 3d.

The North of Scotland College of Agriculture. Calendar, Session 1926–27. Pp. viii+124. (Aberdeen.)

Bernice P. Bishop Museum. Bulletin 24: The Geology of Lanai. By Chester K. Wentworth. Pp. 72+7 plates. Bulletin 25: Revised List of Hawaiian Pteridophyta. By Carl Christensen. Pp. 30. Bulletin 26: Fishes of Hawaii, Johnston Island and Wake Island. By Henry W. Fowler and Stanley C. Ball. (Tanager Expedition Publication No. 2.) Pp. 31. Bulletin 27: Marine Zoology of Tropical Central Pacific. By Charles Howard Edmondson, W. K. Fisher, Hubert Lyman Clark, A. L. Treadwell and Joseph Augustine Cushman. (Tanager Expedition Publication No. 1.) Pp. ii+148+11 plates. Bulletin 28: Report of the Director for 1925. By Herbert E. Gregory. Pp. 42. (Honolulu, Hawaii.)

East Anglian Institute of Agriculture (Essex Agricultural Committee). Calendar, 1926–1927. Pp. 60+xxxii. (Chelmsford.)

Department of Scientific and Industrial Research. The Building Research Station. Pp. iv+10. (London: H.M. Stationery Office.)

The Physical Society of London. Proceedings, Vol. 38, Part 5, August 15. Pp. xix+337-404. (London: Fleetway Press, Ltd.) 6s. net.

Medical Research Council. Sixth Annual Report of the Industrial Fatigue Research Board to 31st December 1925 (including Analysis of Published Work). Pp. iv+126. (London: H.M. Stationery Office.) 3s. net.

Methods and Problems of Medical Education. (Fifth Series.) Pp. iii+225. (New York City: The Rockefeller Foundation.)

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1926–1927. Pp. 93. (Edinburgh.)

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 11: Nutrients required for Growth Production with Indian Food-stuffs. By F. J. Warth and Izaz Ahmad. Pp. 211-238. (Calcutta: Government of India Central Publication Branch.) 3 annas; 4*d*.

Journal and Proceedings of the Sydney Technical College Chemical Society for 1923–1924. Edited by the Publications Committee. Vol. 2. Pp. 65+7 plates. (Sydney, N.S.W.: Alfred James Kent.)

The Indian Forest Records. Silviculture Series, Vol. 12, Part 9: Notes on Artificial Regeneration in North India. By S. H. Howard. Pp. v+37+10 plates. (Calcutta: Government of India Central Publication Branch.) 1.6 rupees; 2*s*. 4*d*.

Federated Malay States. Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1925. By B. J. Eaton. Pp. ii+12. (Kuala Lumpur, F.M.S.: Government Press.)

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 4, No. 2. The Eastern North Atlantic. By Björn Helland-Hansen and Fridtjof Nansen. Pp. 76+71 plates. (Oslo: A. W. Brøggers Boktrykkeri A/S.) 12 kr.

Birkbeck College (University of London). The Calendar for the Year 1926–27 (104th Session). Pp. 226. (London.)

Journal de la Société des Américanistes de Paris. Nouvelle série, Tome 18. Pp. xxvi+537. (Paris.)

Annual Report of the Meteorological Committee to the Air Council for the Year ended 31st March 1926. (M.O. 283.) Pp. 74. (London: H.M. Stationery Office.) 2s. net.

Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 23: Report of the Irish Radium Committee for the Year 1925. A Review of the Results of Radium Treatment over a Period of Ten Years (1916–1925), by Dr. Maurice R. J. Hayes; Report of One Year's Radium Work carried out in 1925, by Dr. Walter C. Stevenson. Pp. 299-327. (Dublin: Royal Dublin Society; London: Williams and Norgate, Ltd.) 2*s*. 6*d*.

Journal of the Royal Statistical Society. New Series, Vol. 89, Part 4, July. Pp. x+635-815+viii. (London.) 7*s*. 6*d*.

British Museum (Natural History). Picture Postcards. Set D9: Crystals, Series No. 1. 5 cards in colour. 1s. Set D10. Crystals, Series No. 2. 5 cards in colour. 1s. Set H3: Famous Naturalists, Series No. 2. 1 card in colour, 5 cards in monochrome. 1s. (London: British Museum (Natural History).)

Scottish Marine Biological Association. Annual Report 1925–26. Pp. 24. (Glasgow.)

County Council of the West Riding of Yorkshire: Education Committee. Report on the Examination for County Minor Scholarships, 1926. Pp. 31. (Wakefield: County Hall.)

Aeronautical Research Committee: Reports and Memoranda. No. 1006 (Ae. 212): Full-Scale and Model Measurements of Lift and Drag of Bristol Fighter with R.A.F. 32 Wings. By R. F. Anderson, L. H. Caygill and R. McKinnon Wood. (A. 4. a. Full-Scale Work—Aeroplanes General, 127.—T. 2160.) Pp. 5+7 plates. 6d. net. No. 1007 (Ae. 213): Full-Scale and Model Measurements of Lift and Drag of Bristol Fighter with Handley Page Slotted Wings. By E. T. Jones and L. H. Caygill. (A. 2. a. Calculations and Model Experiments, 107; A. 2. b. Full-Scale Experiments, 37.—T. 2195.) Pp. 9+14 plates. 9d. net. No. 1009 (Ae. 215): Experiments on the Flow behind a Rotating Cylinder in the Water Channel. By E. F. Relf and T. Lavender. (A. 1. b. Photographic Work, etc., 10.—T. 2066 and a.) Pp. 2+6 plates. 9d. net. (London: H.M. Stationery Office.)

Sierra Leone. Annual Report of the Survey Department for the Year 1925. Pp. 6+1 map. (Freetown, Sierra Leone: Government Printing Office.)

Madras Fisheries Department. Administration Report for the Year 1924-25. By Dr. B. Sundara Raj. (Report No. 1 of 1926, Madras Fisheries Bulletin, Vol. 20.) Pp. iii+78+7 plates. (Madras: Government Press.) 14 annas.

Official Checklist of the Birds of Australia. Second edition. Compiled by Checklist Committee, Royal Australasian Ornithologists' Union. With Appendix: Scientific Names, Notes and Pronunciation, by H. Wolstenholme. Pp. x+212. (Melbourne: H. J. Green.) 12s. 6d.

Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. Justificação das Normaes de Chuva da Rêde Pluviometrica Brasileira. Por F. R. Magarinos Torres. Pp. 63. (Rio de Janeiro.)

Colony of the Gambia. The Annual Report of the Department of Agriculture for the Year 1925. Pp. 52. (London: The Crown Agents for the Colonies.) 5s.

The Scientific Proceedings of the Royal Dublin Society. Vol. 18, N.S., Nos. 17-28. 17: The Estimation of Organic Matter in Water by Means of Potassium Bichromate and Sulphuric Acid, by Dr. W. E. Adeney and Miss B. B. Dawson; 18: On the Rate of Carbohydrate Transport in the Greater Yam, *Dioscorea alata*, Linn., by Dr. T. G. Mason and C. J. Lewin; 19: The Constitution of Dicyanodiamide, with a Note on the Formation of a Mercury Derivative, by James Bell; 20: On the Rate and Mechanism of the Aeration of Water under Open-air Conditions, by Dr. W. E. Adeney; 21: The Pentosan Theory of Cold-resistance applied to Conifers, by Prof. Joseph Doyle and Phyllis Clinch; 22: The Downy Mildew of Onions (*Peronospora schleideni*), with particular reference to the Hibernation of the Parasite, by Dr. Paul A. Murphy; 23: A Simple Method of Temperature Control for use with Refractometers and Polarimeters, by Michael T. Casey; 24: The Dehydration Rates of Conifer Leaves in relation to Plant Distribution, by Prof. Joseph Doyle and Phyllis Clinch; 25. Photo-electric Measurements of Illumination in relation to Plant Distribution, Part 1., by Dr. W. R. G. Atkins and Dr. H. H. Poole; 26: Report of the Irish Radium Committee for the Year 1925; A Review of the Results of Radium Treatment over a Period of Ten Years (1916–1925), by Dr. Maurice R. J. Hayes; Report of One Year's Radium Work carried out in 1925, by Dr. Walter C. Stevenson; 27: Studies on Peat. Part 1: The Thermal Decomposition of Peat under reduced Pressure, by Dr. Joseph Reilly and Gerald Pyne; 28: Velocity of Formation of 3-5 Dimethylpyrazole-4-Diazonium Chloride, by Dr. Joseph Reilly and Honorah M. Bastable. Pp. 199-349. (Dublin: Royal Dublin Society; London: Williams and Norgate, Ltd.) 12s.

Rendiconto delle Sessioni della R. Accademia delle Scienze dell' Istituto di Bologna. Classe di Scienze fisiche. Nuova serie, Vol. 29 (1924–25). Pp. 218+xxx. (Bologna.)

Supplement to the Journal of the Indian Mathematical Society, Vol. 16. Report of the Fifth Conference of the Indian Mathematical Society held at Bangalore in April 1926. Pp. xviii+47. (Madras.)

Memoirs of the Geological Survey of India. Palaeontologia Indica. New Series, Vol. 8, Memoir No. 4: The Fossil Suidae of India. By Dr. Guy E. Pilgrim. Pp. iv+65+20 plates. (Calcutta: Government of India Central Publication Branch.) 11.12 rupees; 19s.

Regenwaarnemingen in Nederlandsch-Indië. Zes en veertigste Jaargang, 1924. Pp. ii+125. (Weltevreden: Landsdrukkerij.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 70: The Hibiscus Mealy Bug (*Phenacoccus hirsutus*, Green) in Egypt in 1925, with Notes on the Introduction of *Cryptolaemus montrouzieri*, Muls. By W. J. Hall. Pp. iv+15+4 plates. (Cairo: Government Publications Office.) 5 P.T.

Oxford University Press. General Catalogue, 1926. Pp. xii+475+186. (London: Oxford University Press.)

Catalogue 486: Books, Engravings, Drawings, Maps, etc., relating to South and Central America, and the Falkland Islands. Pp. 86. (London: Francis Edwards.)

Classified List of Second-hand Scientific Instruments, No. 88. Pp. vi+58. (London: Charles Baker.)

Catalogue No. 541: Surveying and Drawing Instruments and Appliances. Pp. 230. (London: C. F. Casella and Co. Ltd.)

List No. 169: Cambridge Electrometers and Photo-electric Cells. Pp. 12. (London: Cambridge Instrument Co., Ltd.)

Diary of Societies.

SATURDAY, October 9.

Biochemical Society (in Biochemical Laboratory, Cambridge), at 2.45.—Sir F. G. Hopkins: The Purine Enzymes of the Dalmatian Hound.—E. G. Morgan: The Distribution of Xanthine Oxidase.—H. F. Holden and R. Hill: Some Chemical Relationships of Hæmoglobin and its Derivatives.—O. Rosenheim and T. A. Webster: The Non-Specificity of Fearon's Pyrogallol Test for Vitamin A.—M. Perkins and W. Smith: How Bats prepare to Fly.—H. Chick, M. H. Roscoe, and J. L. Leigh-Clare: Distribution of Vitamin D in Nature.—T. Moore and S. G. Willimott: Notes on the Colour Reaction attributed to Vitamin A.—Demonstrations:—Dr. J. B. S. Haldane: The Effect of Carbon Monoxide on Animals without Hæmoglobin.—M. Perkins and W. Smith: Respiration of Bats.—H. L. Coombs and T. S. Hele: The Sulphur Metabolism of the Pig.—G. S. Eadie: The Relation between Velocity and Substrate Concentration with Barley Amylase and Starch.—Dr. R. K. Cannan: Echinochrome, the alleged Respiratory Pigment of certain Echinodermata.—P. Eggleton and M. Eggleton: Changes in Phosphates in Frog Muscle as the Result of Activity.

Hull Association of Engineers (at Municipal Technical College, Hull), at 7.15.—A. Spyer: Water Tube Boilers for Marine and Land Purposes.

MONDAY, October 11.

British Psychological Society (Education Section) (at London Day Training College), at 6.—W. S. Flack: Mental Tests as a Means of Classifying Secondary School Pupils in Mathematics.

Institution of Automobile Engineers (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—H. Kerr Thomas: The Debt of the Community to the Automobile (Presidential Address).

Institute of Metals (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—S. E. Flack: Chairman's Address.

Ceramic Society (at Central School of Science and Technology, Stoke-on-Trent), at 7.30.—Prof. H. B. Dixon: Ignition of Gases.

Institute of Brewing (London Section) (at Engineers' Club, Coventry Street).—W. S. Ward, W. J. Watkins, H. W. Harman, and others: Discussion on The Present Season's Malts.

TUESDAY, October 12.

Society for the Study of Inebriety (at Medical Society of London), at 4.—Dr. J. D. Rolleston: Alcoholism in Classical Antiquity.

Institution of Petroleum Technologists (at Royal Society of Arts), at 5.30.—A. Beeby Thompson: The Significance of Surface Oil Indications.

Institute of Marine Engineers, at 6.30.—W. G. Burn: Double Acting Oil Engines.

Institute of Metals (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—A. Spittle: Chairman's Address.

Royal Photographic Society (Kinematograph Group), at 7.—W. Day: The World's Oldest Films.

Quekett Microscopical Club, at 7.30.—Dr. J. R. Leeson: Microbes of Disease.

Institution of Automobile Engineers (Birmingham, Coventry, and Wolverhampton Centre) (at Queen's Hotel, Birmingham), at 8.—H. Kerr Thomas: The Debt of the Community to the Automobile (Presidential Address).

THURSDAY, October 14.

Institution of Automobile Engineers (Derby Graduates' Meeting) (at Derby), at 7.30.—Discussion on Spiral Bevels v. Worm Drive for Rear Axles.

Institute of Metals (London Local Section) (at 83 Pall Mall), at 7.30.—A. H. Mundey: Chairman's Address.

Institution of Mining and Metallurgy (at Geological Society).

FRIDAY, October 15.

Royal College of Surgeons of England, at 5.—Sir Arthur Keith: Demonstration of Specimens of Surgical and Anatomical Interest recently added to the Museum.

Royal Photographic Society (Pictorial Group), at 7.

Institute of Metals (Swansea Local Section) (at Swansea University College,), at 7.15.—Capt. L. Taverner: Chairman's Address.

Junior Institution of Engineers, at 7.30.—R. L. Sargeant: China from the Engineer's Point of View.

Diesel Engine Users' Association (at Caxton Hall).—H. J. Young: The Obligation of the Ironfounder to Diesel Engine Users.

SATURDAY, October 16.

British Psychological Society (at University College), at 3.—W. J. Messer: Conative Control.—R. J. Bartlett: Does the Psychogalvanic Phenomenon indicate Emotion?

PUBLIC LECTURES.

SATURDAY, October 9.

Horniman Museum (Forest Hill), at 3.30.—Mrs. Robert Aitken: Life in a Red Indian Family.

SUNDAY, October 10.

Guildhouse (Eccleston Square, S.W.1), at 3.30.—Dr. Bernard Hollander: Sound and Unsound Mind.

MONDAY, October 11.

University College, at 5.—Prof. G. Dawes Hicks: The Philosophic Significance of Spiritual Values.

TUESDAY, October 12.

University College, at 3.—Prof. E. A. Gardner: Characteristics of Greek Art.—At 5.30.—Prof. C. Spearman: Is Mind Governed by Laws?

Gresham College, at 6.—Sir Robert Armstrong-Jones: Physic. (Succeeding Lectures on October 13, 14 and 15.)

WEDNESDAY, October 13.

Royal Institute of Public Health, at 4.—Sir William Willcox: Intestinal Infection in Relation to Personal Health and Disease.

Imperial College of Science, at 5.—Prof. W. H. Keesom: Extreme Cold.

Fulham Central Public Library, at 8.—F. H. Edmunds: A Geological History of the London District.

THURSDAY, October 14.

Fulham Central Public Library, at 8.—M. A. Phillips: British Mammals.

SATURDAY, October 16.

Horniman Museum (Forest Hill), at 3.30.—Mrs. H. M. Dunn: Kashmir, the Country and its People.

SUNDAY, October 17.

Guildhouse (Eccleston Square, S.W.1), at 3.30.—Air Vice-Marshal Sir Sefton Brancker: The Scientific Problems of Commercial Aviation.

CONGRESSES.

October 13 to 23.

German Society for the Study of Diseases of Digestion and Metabolism (at Berlin).

October 25 to 28.

Italian Congress of Surgery (at Padua).

SATURDAY, OCTOBER 16, 1926.

CONTENTS.

PAGE
Books, Libraries and Languages 541
Propaganda and Philosophy. By J. C. H. . . 543
The Races of Mankind. By Prof. G. Elliot Smith, F.R.S. 545
The Influence of Science. By E. J. Holmyard . 547
Modern Industrial Chemistry 548
What is Mind? By R. J. Bartlett 549
Letters to the Editor:
  Spectrographic Junction between the X-ray Region and the Extreme Ultra-Violet.—Dr. A. Dauvillier 551
  Prof. Labbé's Production of "Allomorphs."—A. G. Lowndes 551
  'Pwdre Ser' (The Rot of the Stars).—Dr. H. A. Baylis 552
  Science and Psychical Research.—A. A. Campbell Swinton, F.R.S.; Harry Price; Sir Arthur Conan Doyle 553
  Distribution of Intensity in the Spectrum of γ-Rays.—Dr. D. Skobeltzyn 553
  Light-Organs in Littoral Cephalopoda.—G. C. Robson 554
  Electrostatic Moments of Molecules.—R. J. Clark 555
  Lengthened Chain Compounds of Sulphur.—Dr. G. M. Bennett 555
  Prof. Paul Kammerer.—Prof. Hans Przibram . 555
English Provincial Universities: Demand and Supply. 556
Fluctuations in the Abundance of a Species considered Mathematically. By Prof. Vito Volterra, For. Mem. R.S. 558
Obituary:
  Arthur Walton Rowe. By Prof. Henry E. Armstrong, F.R.S. 561
  Rev. F. D. Morice By J. W. 562
News and Views 562
Our Astronomical Column 566
Research Items 567
Forthcoming Books of Science 570
University and Educational Intelligence . . . 573
Contemporary Birthdays 574
Societies and Academies 574
Official Publications Received 575
Diary of Societies and Public Lectures . . . 576
Our Bookshelf . . . . Supp. 21

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Books, Libraries and Languages.

THE work of the third conference of the Association of Special Libraries and Information Bureaux (A.S.L.I.B.) held recently at Oxford had many points of contact with the world of science, and among the more interesting papers in this connexion was one read by Dr. J. E. de Vos van Steenwijk on the subject of international scientific bibliographies and information bureaux. The author is assistant-chief to the Section of Scientific Relations of the International Institute of Intellectual Co-operation, which acts as a permanent bureau to the International Commission of Intellectual Co-operation set up by the League of Nations. Both the Commission and the Institute are working on the compilation of analytical bibliographies of current scientific literature; physics was the first science to be taken up, economics is now being approached, and the biological sciences are to be considered next. In the last-named subject Dr. de Vos stated that in the United States the publication entitled *Biological Abstracts* expects to give yearly about 50,000 abstracts derived from 4000 to 5000 periodicals; and by this means it is hoped to save much unnecessary duplication or multiplication.

The second important task which the Institute has set itself is to inquire into the ability and readiness of libraries to act as information bureaux. It has issued a circular to some 2000 libraries in different countries with the object of finding out which of them contain collections on special sciences, and are able and willing to answer inquiries of a bibliographical nature. The use to which this information will be applied has not yet been decided, but it is suggested that the Institute might act as an international clearing-house for distributing the information collected. In Dr. de Vos' opinion, some central organisation, national or private, should be appointed in each country to collect information concerning the present position of its libraries and, in addition to ascertaining the locations of special collections, to find out where the necessary specialists are to be obtained.

The question whether an international organisation should undertake the production of bibliographies is one that merits consideration, and also one upon which opinion is likely to be divided. Since the International Catalogue of Scientific Literature ceased publication, no work of its kind has, so far as we know, been done, and many will want to know to what extent such work is needed. In this respect different sciences appear to have different requirements. In chemistry so many abstracts are produced by chemical societies throughout the civilised world that the necessity for another organisation appears to be negligible; in fact, the International Catalogue has scarcely been used at all by chemists. Chemistry, however, is exceptional; some other sciences are far less well served, and unless the societies concerned, or private bodies, intend to undertake the work of abstracting or of compiling bibliographies in a comprehensive way, there appears to be scope for an international effort of this kind.

Related to this subject of abstracts is that of the use of scientific and technical libraries. We greatly appreciate the action of those learned societies which open their doors to students and to others who are not members. For example, in 1919, as a result of a conference of chemical and allied societies, the Chemical Society extended the chemical equipment of its library and admitted as readers the members of the Association of British Chemical Manufacturers, the Biochemical Society, the Faraday Society, the Institute of Chemistry, the Society of Chemical Industry, the Society of Dyers and Colourists, and the Society of Public Analysts. The effect of this wise policy is partly shown in the number of books borrowed during the year. This has risen from 2905 in 1918 to 4950 in 1925. During the year 1925, there were 6994 attendances of readers in the Library of the Chemical Society, of which 4746 were made by fellows and 2248 by members of contributing societies.

There is, of course, a difficulty in opening the doors of a library too widely: there may not be seating accommodation for all who would come in. As time goes on, many scientific libraries find their shelves fully occupied and are at a loss to know how to provide room for the new volumes.

Some libraries contain many volumes they do not really need which would be much more appropriately placed in some other institution. The Association of Special Libraries will be doing good work if it takes this matter in hand and induces each library to exchange or dispose of such works as it does not need and thus make room for books or periodicals more directly connected with its own special subject.

It is by no means desirable that all the older scientific books should be destroyed on the ground that they are out-of-date, for many of these books are valuable historical evidence of the state of scientific knowledge and theory at the time they were written. Indeed, some of them contain original observations which have since been overlooked. But provided that it was assured that a certain number of copies of these works would be preserved, the remainder might cheerfully be removed.

The Association of Special Libraries is not, however, concerned alone with the use of books: its object is "to facilitate the co-ordination and systematic use of sources of information in science, industry, commerce, public affairs, etc." It was appropriate, therefore, that in a paper entitled "A National Intelligence Service," Mr. J. G. Pearce should raise the question as to what is the most efficient method by which scientific and technical workers throughout the country may receive early information about new discoveries and new developments in the subjects with which they are concerned.

A central institution of the kind would have classified index-cards, each bearing the full reference to a book or paper, with a summary of its contents. When it is remembered that some 24,000 periodicals which may contain scientific articles are published throughout the world, and that to this number pamphlets and books must be added, it will be seen that the number of index-cards required to be prepared every year would be very large, probably at least a quarter of a million. The work of selection and indexing must be done by experts in each subject, and then the cards must be written, typewritten, or printed. When an inquiry was received, the staff of the institution would look up the index-cards bearing upon the subject, and would send copies of these, obtained either by typing or by photography.

The Association proposes to make use of the special libraries and information bureaux which already exist in Great Britain. There are several hundreds of these, including the libraries of learned societies, universities, colleges, public libraries, libraries of research associations and libraries of manufacturers and business firms. The first step is the preparation of a Directory of Special Libraries in Great Britain and Ireland. The general editor for this Directory is Mr. G. F. Barwick, late keeper of printed books at the British Museum, whose name is a guarantee that the work will be well done. It is hoped to publish the directory in the summer of 1927. Such a directory will indicate the library or libraries where information on a given subject is likely to be found. Apart from this directory, the Association proposes to answer inquiries from its members as to the literature on a particular subject by giving the names of those libraries that are likely to be able to give the information required.

There are divergent opinions concerning the desirability and practicability of special scientific libraries undertaking the work of information bureaux. Libraries undertaking this work would require greatly enlarged staffs. Information-hunting is a long and arduous pursuit, and we are informed by two experts in this business that the average time required to answer a single inquiry is about two days. On the other hand, the expense should not be prohibitive, for, as Dr. de Vos remarked, an information service should be made to pay for itself: firms and individuals could afford to pay high fees if they were relieved from doing the work themselves. A second difficulty would be to find the personnel. Information work demands very special qualifications, both in regard to knowledge of books and other sources of information, of at least one science, and a natural *flair* for finding things out. Special training might solve this difficulty to some extent, and a real demand would probably create a supply. Large firms and institutions would, however, probably continue to employ their own information officers, so that the work of information bureaux set up in connexion with special libraries would consist mainly in serving the needs of individuals and small institutions. A further hindrance to the realisation of the scheme would be found in the inability of scientific libraries owned by learned societies to undertake work for outside firms and individuals; charters of incorporation would have to be carefully scanned before action was taken.

The language difficulty is a perennial one in the sphere of the dissemination of scientific knowledge, present methods being prodigiously wasteful in time, effort and money. Translators who possess the qualification of expert knowledge of science and language, including its idioms and technical terms, are exceedingly rare, and as a rule the work is badly remunerated. At the Oxford meeting, Mr. P. K. Turner, of the Research Department of Burndept Wireless, Ltd., spoke in no exaggerated terms of these difficulties, and his suggested solution—the adoption of an international auxiliary language—though old, is one that cannot be overlooked.

Following closely on the lines of the International Auxiliary Language Committee of the British Association, Mr. Turner considered the rival claims of a dead language, a modern national language, and an invented language, and came to the conclusion that Latin is too difficult for the purpose, a modern language would inevitably raise international jealousies, and that an invented language, easy to learn, precise, and capable of providing new words for new concepts, would be best. Of the artificial languages now current, only Esperanto, its offshoot Ido, and Interlingua (Latin without inflexions) are of serious importance, and of these Esperanto has undoubtedly made the greatest headway. We have recently read a scientific treatise on the elementary principles of radio-communication written in Interlingua, the language sponsored by Prof. G. Peano, of the University of Turin, and were much impressed by its ready intelligibility and its brevity; but probably any of the three languages named would serve, with or without modifications, for international abstracts and bibliographies.

The fact remains, however, that none of these invented languages has made any progress in the scientific world. Whenever they are suggested they seem to raise a perfect *furore* among partisans of the dead and national languages. We hold no brief for any one of these linguistic devices which, like shorthand, mathematical, chemical and musical notations, have been invented to serve a special purpose, but in view of the very great advantages that would follow the adoption of a suitable medium for international communications in science, we think that the subject should not be allowed to drop. If the world were ruled by reason (which it is not, and probably never will be) an international auxiliary language would have been adopted many years ago; it remains to be seen how far civilisation will succeed in promoting the dictates of reason against the opposition of instinctive tendencies and age-long prejudices.

Propaganda and Philosophy.

(1) *The Gist of Evolution.* By Prof. Horatio Hackett Newman. Pp. x+154. (New York: The Macmillan Co., 1926.) 6*s.* net.

(2) *Selected Articles on Evolution.* Compiled by Edith M. Phelps. (The Handbook Series.) Pp. liii+283. (New York: The H. W. Wilson Co.; London: Sir Isaac Pitman and Sons, Ltd., 1926.) 2.40 dollars.

(3) *Science as Revelation.* By John M. Watson. Pp. 303+7 plates. (New York: The Macmillan Co., 1925.) 10*s.* net.

(4) *God and Evolution.* By the Rev. W. R. Matthews. (Liverpool Diocesan Board of Divinity Publications.) Pp. ix+58. (London: Longmans, Green and Co., Ltd., 1926.) 3*s.* net.

SO far as one can see from current apologetic literature, England and America present rather a strong contrast. The religious problem across the Atlantic seems merely to be the limited one of evolution *versus* the book of Genesis, an issue which engaged the attention of Englishmen half a century ago, when Americans were getting over their disastrous civil war. The three volumes from America before us all deal more or less directly with the Fundamentalist controversy, the seriousness of which is not understood in England, where we are inclined to laugh at it. It is, however, no laughing matter. It is already being converted into a political issue; the "Bible Schools" where non-graduates are trained for the ministry are engaged in an industrious propaganda, and in some places no political candidate would stand a chance of election who did not profess 'Biblical' views, and no teacher in a public institution could retain his position if he favoured evolution.

(1) In his volume, Prof. H. H Newman, who

participated in the Scopes trial, contributes a brief and clear statement of modern biological doctrines, written for popular use and avoiding technical language so far as possible. The late Lord Acton somewhere tells a story of a great medical specialist unable to pronounce definitely upon a case brought to him. As a clear plain verdict was insisted on by the patient's friends, the great man replied: "I cannot tell you myself, but I can recommend you to fifty doctors who would." The fact is that ignorance can always be dogmatic, and this is where the conscientious man of science is at a disadvantage. "The chemist, the astronomer, the geologist, equally with the biologist and the physicist, feel the inadequacy of their present knowledge of their subjects," writes Prof. Newman. The Fundamentalist has no such searchings of heart, and his omniscience is a controversial asset. Still, we may hope that Prof. Newman's "Gist of Evolution" will be read and pondered by intelligent people in America. It is admirably lucid, its topics are well chosen, and it is neither heavy nor verbose.

(2) Miss E. M. Phelps's book is a compilation of carefully selected articles on evolution, expressions of opinion on both sides of the controversy being included. We cannot imagine anything more useful for one anxious to get a clear grasp of the issue. Although a number of these articles might be selected for attention, that of Prof. John Dewey strikes us as peculiarly valuable as a diagnosis of the situation. It appeared in the *New Republic* of April 2, 1924. He points out that whereas in times past there were two parties to a dispute of this kind, *i.e.* the theological and the scientific specialists, nowadays there is a third, the general public. The real issue now "concerns the growing influence of the general public in matters of thought and belief, and the comparative failure of schooling up to the present time to instil even the rudiments of the scientific attitude in vast numbers of persons, so as to enable them to distinguish between matters of mere opinion and argument and those of fact and ascertainment of fact. . . .

"The realities of the situation centre about what can be done to ally the forces which have democratised society with the mental and moral attitudes of science. The worst of the predicament is a tendency towards a vicious circle. The forces that compel some degree of general schooling also make for a loose, scrappy, and talkative education, and this education in turn re-enforces the bad features of the underlying forces."

(3) These remarks seem applicable to the third volume under review. Mr. J. M. Watson's "Science as Revelation" is a book of rather ambitious scope, attempting to put in clear, brief, and popular form the results of research in all the sciences from physics to psychology. There follow two chapters on ethics and philosophy, and then two more on the new religion, and the new revelation, of science. We are inclined to think that so far as religion and ethics are concerned, our author unduly simplifies the problems. The real issues, namely, as to whether biological science does supply us with an enlightened ethic, and whether the cosmic process is for us or against us (as Huxley taught), he does not seem to face. He sometimes covers up the difficulties with rhetoric, as when he tells us that "Truth is the ONE GREAT GUIDE, and he who closely adheres to it cannot possibly go wrong." Surely this is prolix nonsense: for what the truth is about these matters is just what we would like to discover. Mr. Watson evades the real religious problem, which is not: Does God exist? but, What sort of a God exists? The book seems to us to preach a sort of inverted Fundamentalism; it strikes us as well-intentioned but shallow.

In England, as was observed above, the Genesis *versus* science issue has retired into the background. This may be because there exists a higher level of general education and intelligence in this country; or it may be that amongst ourselves the general public takes little interest in religious problems, so that they are left to the experts who naturally treat them with more intelligence. Between these alternative explanations, we hesitate to pronounce. At any rate, in reading Dr. Matthews' book (4), we breathe a different air; the atmosphere of embittered polemics is absent.

This does not mean that Dr. Matthews sees no important difference between the views he himself holds and those held by some evolutionary philosophers and men of science. He devotes a certain amount of attention to Mr. H. G. Wells and Mr. Bernard Shaw; but, as he says, "there is no arguing with prophets," and we are relieved when he turns "to the less inspiring but more coherent writings of systematic thinkers." His treatment of Prof. Alexander interests us most. There has always seemed to us a difficulty, or even an inconsistency, in the views of this highly original thinker. He asserts that there exists in the universe a tendency, or 'nisus,' to produce a series of qualities of existence; a series like a hierarchy of values which increase as the process continues. We have matter, life, mind, and, in due course (we may hope), deity. But there is no 'purpose' or plan behind this. The elements of the series just 'emerge'; and we must accept their 'emergence' with 'natural piety,' *i.e.* with a devout agnosticism. But what *is* this 'nisus'? Is it just a word to signify that the world is so constructed that, as a matter of fact, it does produce what 'emerges' (in which case the word really has no meaning)? Or does it signify that there is an 'urge' in the universe which makes it creative? If so, we have got something indistinguishable from 'purpose.' Prof. Alexander is too clear a thinker to talk about 'unconscious purpose,' which is a contradiction in terms, and he prefers not to use the word at all. But 'nisus,' if it means anything, must end by meaning this.

Dr. Matthews seems to us at his best when engaged in philosophical criticism. We doubt if many biologists would follow him in attaching much importance to the views of Driesch, and although all the world recognises the debt which physiology owes to Dr. J. S. Haldane, few take his vitalistic theories seriously. The tendency now is clearly and strongly in favour of mechanistic interpretations. One strong point in Prof. Alexander's work is that he recognises this. We doubt if Dr. Matthews strengthens his case by patronising obsolete scientific theories. The most damaging criticisms of naturalism come from insistence on "the difficulties which inhere in any philosophy which excludes all idea of a supra-temporal reality" (p. 37). As a philosophical system, evolutionary naturalism is beset with difficulties: as a religion, it "is founded on as great an act of faith as any which the Christian doctrine of God requires of us." How true this is—but how unpopular!

We may hope that many students of science, as well as students of theology, will peruse these lectures. They are of a very high quality. We should like to wish them a good circulation in America as well as in Great Britain, when the contagion of Fundamentalist frenzy has passed. J. C. H.

The Races of Mankind.

(1) *Les races et les peuples de la terre.* Par Dr. J. Deniker. Deuxième édition revue et considérablement augmentée. Pp. 750. (Paris: Masson et Cie, 1926.) 75 francs.

(2) *Race and History: an Ethnological Introduction to History.* By Prof. Eugène Pittard. (The History of Civilisation Series.) Translated by V. C. C. Collum. Pp. xxiii + 505. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 21*s.* net.

THE reluctance of anthropologists whole-heartedly to apply to the human family the strict principles of classification and phylogenetic arrangement adopted in the wider field of biology is a very curious phenomenon. Yet it is a fact that students of man, even biologists, commonly disregard the significance usually associated in biology with such terms as race and species; and even when this element of confusion is eliminated there still remains some uncertainty as to what constitute the criteria of race. Many years ago Huxley humorously claimed exemption from the disturbing influence of race consciousness that so obviously distorts the outlook of many, if not most, writers on anthropology, on the ground that he enjoyed the serene impartiality of a mongrel.

This factor of personal or racial bias has been a potent factor in causing confusion in the study of race. When, early in the nineteenth century, efforts were made to emancipate the Greeks from Turkish rule, ethnology was used as a political instrument. Ever since then scarcely any national or social conflict anywhere in the world has been free from anthropological irrelevances, which have had the disastrous effect of hampering the calm and dispassionate study of a subject that teems with intrinsic difficulties. One has only to recall the distorting effects of such national prejudice in the claims for Teutonic ascendency and the northern origin of civilisation, the conflicts associated with the phrases 'Yellow Peril' and 'Nordic Race,' and the ever-present antagonism between black and white in the United States, to realise how scientific impartiality has been warped.

Even when such influences are exorcised, two other disturbing factors remain. There is first the selection of the qualities to be used in the determination of race and the estimation of their relative value. Secondly, the factor of racial admixture must be given due consideration by making allowance for its effects. The chief element of confusion in the definition of human races has been due to the former factor, and especially the lack of a due sense of proportion. Examples of this are the exclusion of Bushmen from the Negro race because their skin is not black, suggesting a close affinity between aboriginal Australians and Europeans because there are similarities in the hair, or between Negroes and Mongols because they both have flat noses. But perhaps the most potent element of confusion is the persistence of the term Caucasian, which involves the failure to accord adequate recognition to the fact that there are at least three definite and distinct races, commonly called Mediterranean, Nordic, and Alpine, in the population of Europe and western Asia. Even when the six easily differentiated races—Australian, Negro, Mongol, Mediterranean, Alpine, and Nordic are recognised, there still remains the problem of assigning to each its degrees of affinity to the rest. This can only be done by devising a tentative phylogenetic tree to indicate which races are primitive and which are specialised or advanced.

No work has yet been published that deals with the question of race in such a way as to give adequate recognition to these principles, but the books by Dr. Deniker and Prof. Pittard make a serious attempt to introduce some sort of order and a right perspective into these questions and to deal with the problems of race in a strictly biological way. They also emphasise the need for caution—never more necessary than at the present time—of not confusing race with culture, language, political aptitude, or distinctive moral qualities.

(1) Of the works dealing with the whole world, perhaps the sanest and the best-balanced is that written in 1900 by the late Dr. Deniker, the learned librarian of the Natural History Museum in Paris. By dealing with both race and culture in intimate association one with the other, he was immune from the sort of errors which writers are liable to commit when they deal with only one aspect of anthropology and neglect the other. Another factor that enhanced the value of Dr. Deniker's book was the information derived from Russian and other Slavonic literature, which is a sealed book to most western anthropologists. At the time of his death in 1918 he was engaged in the task of preparing a revised and considerably enlarged edition of his excellent book. With the help of a number of his colleagues in Paris the author's family has just brought out this new edition after a lapse of eight years. During this time anthropology has made great strides. Hence this book can scarcely be regarded as quite up-to-date. Nevertheless, the improved edition of a book which for more than a quarter of a century has been the standard text-book on the subject is most welcome.

(2) In his foreword to Prof. Pittard's book, M. Henry Berr tells us that in 1912 Dr. Deniker promised to write a volume on race and history for the series of monographs he is editing under the title "L'Évolution de l'humanité" (which is now being issued in English under the general title "The History of Civilisation"). On the death of Dr. Deniker he entrusted the task to Prof. Eugène Pittard, of the University of Geneva, who is well known as an industrious and careful worker in physical anthropology, especially of Switzerland and the Balkan area.

The book is not a treatise on race, nor does it deal in the strict sense of the term with history. It is rather a series of essays on some of the more contentious problems in which factors of race came into some relationship with history. The method of treatment is cautious, if not elusive. In fact much of the book is written in the form of questions to which the author gives no decisive answer. Here is a typical example of Prof. Pittard's method of exposition:

> "The abuse of the influence of physical environment as the principal determinant of variations in man reveals to us another attempt at facile explanation in the application of the law of minimum effort. What has not been solemnly put down to it? With what assurance has it been sought to convince us that environment is everything, that men are eminently plastic beings, submitting without protest to every sort of influence! No single character could resist the moulding hand of environment, that all-powerful sculptor who, just as education renders our intellect and moral character rigid, petrifies as with a glaze our different morphologies. Has not the influence of environment been invoked to explain the anatomical variety seen in Jews, thenceforward acquired by very reason of such influence? Does not the morphological Americanisation of various European immigrants in America call, on certain points, for all reserve on our part? What mechanism other than hybridisation could environment employ to mould the cranial character of the new Americans? No one is able to tell us." (P. 14.)

This quotation is typical of the style and method of the book as a whole. Two-thirds of the volume are devoted to Europe. The remaining third deals with Turks, Phœnicians, Jews, Arabs, Iranians, and Tatars, with brief essays on the peoples of India, China, Japan, Egypt, Mexico, the Malay Archipelago, and Oceania.

The book as a whole is a welcome corrective to much that is misleading and confusing in modern anthropological literature. Prof. Pittard does occasionally relent from his attitude of cautious avoidance of direct expression of his views. On most of these occasions he reveals a very conservative adherence to the opinions generally held by French anthropologists, and in particular by Prof. Boule. Thus he accepts without question the opinion that the figurines of the so-called Upper Palæolithic, so misleadingly described as steatopygous, afford evidence of the former presence of people of Hottentot affinities in Europe, a fallacy that Prof. Verneau justly exposed in his Huxley Lecture to the Royal Anthropological Institute in 1924. But Prof. Pittard also adopts Prof. Boule's theory that Verneau's Grimaldi race is really negroid and affords corroboration of the Hottentot speculation! Having recently examined the two skeletons from the Grottes des Enfants at Monaco, I am convinced that there are no just reasons for calling the 'Grimaldi race' negroid.

Prof. Pittard pours gentle scorn on the recent campaign in favour of the supremacy of the Nordic race. Nevertheless he ironically says that the

> "despised brachycephals, these representatives of the inferior race *Homo alpinus*, would seem to have invented and propagated two things of capital importance to the progress of civilisation. It is to them that we probably owe the culture of cereals and animal domestication, and that is by no means a small contribution. It might even be said to outweigh a certain number of raids and massacres. Did not these inventions, indeed, have a larger part in determining social progress, and for a longer time, and was not their influence of wider extent than all the warlike disturbances of the Northerners put together?"

There are, however, no valid reasons for assuming that the Alpine people did invent these fundamental contributions to civilisation. At the meeting of the Australasian Association for the Advancement of Science in 1921, Prof. Thomas Cherry set forth evidence establishing the fact that it was members of the Mediterranean race who made these inventions (see also Nature, June 10, 1920, p. 474).

The problems of determining the ancestry and the original home of the human family, and whether men everywhere spontaneously invented the Chellean *coup de poing*—which Prof. Pittard calls the hypothesis of prehistorians—are brushed aside in two pages of provocative queries, none of which are answered. Instead of this Prof. Pittard says "an attitude of doubt is the wisest." "If an answer must be given to the question put, we shall have to be honest and say that we do not know."

The book affords an amazing revelation of the extent of the misconceptions concerning the Piltdown skull still entertained on the continent. The Piltdown cranium reveals a closer approximation to the condition found in the young chimpanzee than any other human skull does. Yet Prof. Pittard tells his readers (p. 56) that it "would seem to indicate a more highly evolved race" than Heidelberg man. But he goes further than this when he suggests

> "the possibility of the Heidelberg race having given birth to the Piltdown race, and the Piltdown race of the type with progressive characters which we meet with in Aurignacian times."

In spite of these defects the book is valuable and interesting. If it adds a few more misunderstandings to the literature of anthropology, it more than atones for this by helping to remove a host of others.

In her translation Miss Collum has wisely kept as near as possible to a strictly literal version of the French. If at times the idiom is uncouth, it enables the reader to realise exactly what the author wrote in a highly controversial subject. The word 'humanité' would be more correctly rendered into English by 'mankind' and not by 'humanity.' The word 'peninsula' is wrongly spelt throughout the book. In fact both in Deniker's and Pittard's book there is an unusually large series of typographical errors.

G. Elliot Smith.

The Influence of Science.

Science and Civilisation. Essays Arranged and Edited by F. S. Marvin. (The Unity Series, 6.) Pp. 350. (London: Oxford University Press, 1926.) 6*s*. net.

RATHER more than nine centuries ago, Avicenna bestowed the title of "The Remedy" upon his great treatise on natural philosophy. It is not difficult to appreciate the meaning which lay behind the choice of this unexpected name: natural philosophy, or simply science as we prefer to call it now, was in Avicenna's opinion the cure for the manifold ills of mankind and a tonic to brace humanity for the future. The natural supplement to this opinion is Comte's statement *Savoir afin de prévoir*, which is the motto of the present book. It is now three years since "Science and Civilization" was first published, and because, amid the flood of ephemeral literature which issues from the innumerable presses of the world, those books which are of lasting value run a grave risk of being swept away, we are grateful to Oxford for this new and cheaper edition. The essays which Mr. F. S. Marvin has here edited are, indeed, so valuable and so inspiring that we could have wished for an even less expensive edition: six shillings, though a modest price for a book in these days, is still too much to allow of that wide diffusion which all of us would like to see in the present instance.

No one can feel satisfied with the results which the widespread teaching of science in Great Britain has so far produced. The majority of men appear not to have retained the merest fragment of the scientific facts they presumably learnt at school, and they certainly show no sign of having assimilated scientific principles and method. Even among men of science themselves it is not rare to find science regarded as a craft rather than as a philosophy, and a successful chemist or physicist is often on no higher an intellectual level than a skilled motor mechanic. In these circumstances, science will still advance so long as destiny throws up from time to time the man of insight and genius—the Dalton, the Clerk-Maxwell, the J. J. Thomson—but is that progress likely to be as thorough or as rapid as would be desirable? Is it in the least degree probable that the intellectual advance of the nation at large will keep pace with even a comparatively slow advance of science if present conditions continue? It seems that the answer to both these questions must be a regretful "No"; whereupon the further question arises: What will be the effect upon civilisation if the general intellectual level lags seriously behind the progress of science? In the last year or two this question has been discussed by several talented and imaginative novelists, philosophers and men of science, but [illegible] may draw a lesson from the past—the mobilisation [illegible] scientific resources for purposes of wholesale [illegible] tion during the War showed us only too [illegible] fate may lie in store for the world if th[illegible] forces of science are misapplied.

It is a common plea that men of scien[illegible] are not responsible for the evil uses to [illegible] may put scientific knowledge, but is n[illegible] fallacious ? A man who invents a new weed-killer and leaves it lying about, so that his child poisons himself with it, cannot be absolved from blame on the score that his invention was wrongly applied. If a chemist produces a tremendously effective explosive, fully realising that in all probability the first use men will make of it will be to destroy one another, it is very difficult to acquit him altogether. Read this extract from an account of the Spanish operations in Morocco : " Like the fiery rain of Dante, the bombs crashed from the skies, smashing villages, burning crops, slaying the wounded and murdering women and children. . . . For these bravos of the air there were not even the usual sporting risks of war—no fearless hostile airmen to grapple with ; no anti-aircraft guns to face. A good breakfast, a pleasant ride, a few brave men killed, a few children rendered homeless and orphans—then back to a good dinner." Has science, which made things like this possible, no responsibility ? Am I my brother's keeper ?

In a certain sense, of course, science is non-moral, and in the illustration given above it is clear that the wrongful action lay not in the invention of the weed-killer but in the carelessness which left it unguarded. Science *qua* science is not responsible for its misuse, and we are perfectly justified in insisting upon this when the opponent of progress points to the ruined village, the slave of cocaine or the blinded victim of the vitriol-thrower. It is, however, impossible to divorce science from the scientist, and the latter is human and shares human responsibilities. To adopt a sentence of Dean Inge's in a sense different from that in which he used it, " we must not regard the world of science as an objectively existing fact, wholly independent of us who observe it." The scientist, in fact, has a double duty ; he must not only further the course of science but must also do his utmost to ensure the right use of the control of Nature he places in men's hands.

Such books as " Science and Civilization " are eminently serviceable for the latter purpose, since they make the unreflective man of science reflect and at the same time manifest to the general public, in a way which more technical books could not, what Sir Richard Gregory has happily called the " Spirit and Service of Science."

Of all the good things which Mr. Marvin has collected
us it is difficult to single out any particular essay
l mention, *but* the attention of all who are
teaching science—whether in universities,
chools—may be earnestly directed to the
ence and Education." For the root of
lem appears to us to lie in the way in
s taught, and more especially in the
ught in our schools. Mr. Heath's thoughtful study should be read by every schoolmaster, whether a science master or not, and although his warm approval of the methods of Sanderson of Oundle may leave some of us cold, all of us will realise better than we did before the magnitude of our responsibility and of our opportunity.

The essays which deal with the history of science in its social aspects are still, as when first published, the best of their kind ; they show that a true internationalism, which the League of Nations is laboriously striving to effect in the world of politics, has already and for centuries past been effected in the world of science. Scientific internationalism, superior to but not destructive of local patriotism, affords the best safeguard for the future of civilisation, and Mr. Marvin and his collaborators have the solid satisfaction of knowing that they have made a not insignificant contribution to this end.

E. J. HOLMYARD.

Modern Industrial Chemistry.

(1) *An Introduction to Industrial Chemistry.* By Dr. S. I. Levy. Pp. xiii+288+16 plates. (London: G. Bell and Sons, Ltd., 1926.) 15*s.* net.

(2) *Industrial Chemistry: a Manual for the Student and Manufacturer.* Edited by Allen Rogers. Fourth edition. In 2 vols. Vol. 1: Inorganic. Pp. xx+511+xxiii. Vol. 2: Organic. Pp. iv+512-1267. (London, Bombay and Sydney: Constable and Co., Ltd., 1925.) 52*s.* 6*d.* net.

(1) IN his introduction to industrial chemistry, Dr. Levy presents an aspect of a branch of technology which is not usually portrayed in treatises dealing with the application of chemical principles to factory operations. The new departure consists in directing special attention to the utilisation of all factors involved in efficient large scale production, these essential factors being grouped under the heading of " Costing."

As a typical example the author selects the manufacture of aniline from such commercially available materials as benzene, sodium nitrate, sulphuric acid, and iron filings. The factory method of keeping stock accounts of raw materials, intermediates, and final product is illustrated. Plant record sheets and overall consumption figures are also computed and furnish data for the tabulation of a flow sheet showing the efficiency of the process at each stage. The cost price of the final product is determined by drawing up a cost sheet, taking into account not only the price of materials but also overhead charges and the cost of various services. The exact incidence of the separate items on the cost of production is readily revealed by expressing these data in simple graphical form.

Following on this concrete example of the importance of process costing, the author deals with such typical large scale operations as heating and cooling, pulverising, mixing, filtration, extraction, distillation, sublimation, and desiccation. A short section is devoted to the works equipment required in the storage, transportation, and manipulation of gases, liquids, and solids.

A general survey of chemical industry condensed into 40 pages is so sketchy that it is of doubtful utility and detracts from the merit of a treatise which otherwise sets up a new standard of excellence among technological text-books. A similar criticism applies to the short chapter on the fuel industries.

To the topic of sulphuric acid, however, an authoritative chapter is devoted which contains valuable details and includes the author's war experiences as shown by the data then collected in regard to the relative costs of production of sulphuric acid by the chamber process and by the various contact processes. The concluding sections deal with the alkali industry and with the manufacture of intermediates and explosives. The economic factor is again emphasised and flow sheets are appended giving the costs of production of the principal service explosives.

As indicated by Sir William Pope in his introduction to this volume, the treatise is modelled on unconventional lines and may accordingly be read with advantage by every one interested in the industrial applications of chemistry.

(2) These two volumes are the fourth edition of a comprehensive manual written by a group of American chemists and covering a wide range of industrial topics.

Vol. 1, which deals mainly with inorganic subjects, commences with a chapter on general processes as carried out in the factory; but sometimes, as in the case of autoclaves, the information given is only slight. Water for industrial use, a matter of general interest, receives attention in a separate chapter having its own bibliography. A very readable essay on sulphuric acid contains interesting details, especially in regard to American practice, but English readers will be surprised to find no mention of Messel and his associates in the survey of the historical development of the contact process.

A chapter on elements and compounds, arranged alphabetically, contains references to these materials which are sometimes misleading and generally too fragmentary to be of any practical value. Cobalt is dismissed in a few lines as colour producing element, but its increasingly important alloys are not mentioned. Under the heading of hydrogen peroxide there is no reference to the concentrated forms of this oxidising agent. The statement that sodium nitrite is prepared by heating sodium nitrate and metallic lead refers to an unhealthy process which happily has become obsolete. Altogether this section on elements and compounds is a hopeless attempt to compete with the larger chemical encyclopædias.

Ozone is discussed in the foregoing section and again in the section on electro-chemical industries, so that in future editions the editor might well consider the desirability of having a separate chapter on the atmospheric gases, including in this section oxygen and ozone.

The second and larger volume of this treatise contains instructive essays on various industries based on organic chemistry. The products of the distillation of coal are discussed from different viewpoints in several chapters, and the destructive distillation of wood is the subject of a separate section. In view of the increasing production of synthetic methyl alcohol, a chapter might appropriately have been added on this alcohol and its derivatives, including formaldehyde and its industrially important condensation products. The section on explosives is too short to be of value for reference purposes, and the following statement is misleading (p. 1183): "Titra-nitroaniline (*sic*) made by nitrating aniline." The patented nitration starts from *meta*-nitroaniline prepared from dinitrobenzene.

There are, however, many excellent monographs in this organic section, and among them may be mentioned the informative articles on essential oils, perfumes, and flavouring materials, on resins, gums, and turpentine, and on leather.

What is Mind?

Mental Life: an Introduction to Psychology. By Dr. B. Edgell. Pp. xvi+275. (London: Methuen and Co., Ltd., 1926.) 7*s.* 6*d.* net.

PSYCHOLOGISTS are faced with the difficult task of clearly distinguishing their field of study, on one side, from philosophy and, on the other, from biology. The domains of other sciences were originally defined in naive, common-sense terms that raised no initial difficulty. On the basis of common experience every one knew what was meant by 'heat,' but with its scientific study, unexpected difficulties arose. The 'caloric' proved weightless, and 'heat' was then described as a mode of motion. The facts of radiation raised fresh difficulty, and theory gave, first, 'insensible heat' and then motion of an immaterial ether. This entailed the difficulty of a kinetic energy from which the term mass had vanished: to be dealt with in turn by recasting the meaning of energy in the light of electro-magnetic theory and the theory of relativity.

Still, however, the definition of 'heat' presents difficulties which are but evaded in the modern tendency to fall back on some reference to crude introspective evidence and common-sense belief such as: 'The agent which produces in us certain sensations.'

Put 'mind' in place of 'heat' and just because 'mind' is of greater interest we find that, before the days of experimental science, it had been so studied that the problem of its ultimate nature had already reached the almost hopeless position in which 'matter' and 'electricity' now find themselves. Modern psychologists are tempted to benefit by the experience of experimental science and leave to philosophy their ultimate problem. Not—What is mind? but—What are its activities? seems problem enough. Psychology becomes the "science of mental life" (p. xi).

'Life' however is as elusive as 'mind.' Biology disowns the problem of 'life' and is content to be the 'science of living things.' Possibly, shorn of all that is best left to metaphysics, nothing remains of a 'science of mental life' that is not well within the purview of the 'science of living things'! Accept this conclusion and psychology becomes the 'science of behaviour.' But the crude facts of mental activity are known to every one, and even medicine has found in *mental* sickness, as opposed to *organic* lesion, the easiest explanation of certain forms of bodily incapacity. Explanatory theory in terms of 'unconscious mental activity' follows and leads the way into highly speculative regions of 'new psychology,' in which an attempt is made to supply the need felt of an abiding something that, through all changes, continues. Psychology becomes the 'science of the unconscious.' Physics in similar straits formulated the theory of the ether.

As a result of this difficult position, many an 'introduction' to psychology, after a few words on the foolishness of 'the old psychology,' reveals itself as concerned only with some particular modern development or school of thought. It is therefore refreshing to meet a work that is entitled to its claim: an introduction to *psychology*. With clear knowledge of the 'old,' Dr. Edgell has reviewed much of the 'new' and given it its place in that evergrowing body of knowledge in the formulation of which Aristotle played no unimportant part.

The general line of treatment follows James and Ward and brings their work up-to-date with new facts and theories that have taken sufficiently definite shape to be presentable in form suitable for the general reader and beginner.

Controversial matter has of necessity been included, and psychologists will welcome the author's statement of position on 'Freudian theory' and 'behaviourism.' Considering the theories of Freud, Adler, and Jung, she writes: "All attempts to reduce primitive values to one inclusive category seem futile, for, even when combined, these three types of appeal may be far from exhausting primitive possibilities" (p. 157). Then, dealing with Freudian theory in more detail, "It may well be that, notwithstanding the success attendant on psycho-analysis, the unconscious as conceived by Professor Freud, is a 'false cause' . . . the Freudian theory appears to conflict with any intelligible view of mental life" (p. 160).

In opposition to the narrow Freudian view of 'the unconscious' the author uses the term for the "organisation of meanings and values (knowledge and character) . . . the abiding structure of mind" (p. 158). This leads to interesting corollaries including apparently a disavowal of the fundamental Freudian belief in unconscious mental activities (p. 173).

Behaviourism is reviewed in an appendix. The inadequacy of the experimental basis to support the deductions drawn therefrom is stressed. Really to secure the behaviourist position "conditioned reflexes should be established in circumstances where there is reasonable evidence of the complete absence of what the psychologist calls consciousness" (p. 265). Behaviourism "breaks down as a system of psychology and is no more successful in shelving the problem of mind and body than was its precursor, epiphenomenalism" (p. 268).

The definition 'science of mental life' also attempts to shelve the difficulties surrounding the idea of mind as an abiding entity (p. xi), but leads to a position almost identical with that of James when he wrote: "The thoughts themselves are the thinker." "We must be on our guard," writes the author, "against treating . . . the subject or individual experient [as if he] were something over and above his experience" (p. 19). We find difficulty in attempting to harmonise this with the 'unconscious' as "an organisation . . . the abiding structure of mind." Then we realise that much of the book is concerned with this 'structure' rather than with 'experience,' and reading, "This structure is being built up by the events of mental life; in its turn it determines the function of mental events, their meaning and their value" (p. 126), we again grow hopeful that it will yet be possible for psychologists to follow Prof. McDougall back to the definition 'science of mind' as the best to cover both "facts of mental activity and facts of mental structure" ("Outline of Psychology," p. 41). In such a definition any particular theory of the ultimate nature of mind is no more posited or necessary than were theories of the ultimate nature of electricity and matter in the original definitions of the fields of study of the physicist and chemist.

R. J. BARTLETT.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Spectrographic Junction between the X-ray Region and the Extreme Ultra-Violet.

In previous papers (*Comptes rendus*, 182, 1083, and 183, 193, May and July 1926) a method was given, suitable for spectrographic work in the unknown region between 20 and 150 Ångström units. In the meantime, some *K*α lines belonging to light elements (oxygen, carbon, boron), and a few *N* barium lines, have been measured. It was interesting to apply the new method to the detection of lowest frequency *N* and *O* series of a heavy element. Thanks to the kind help of Dr. Holst, Director of the Philips Laboratory, I obtained a sample of thorium wire, prepared by Dr. de Boer, and I used it as a hot cathode in the X-ray tube of my vacuum spectrograph. With an exposure of 4 hours, with a current of 29 milliamperes under 2·8 kilowatts peak value, I obtained good thorium spectra. The middle part of each plate is covered by a filter consisting of goldbeater's foil, 7×10^{-4} cm. thick, used to estimate penetrating power and order of spectra. All the lines detected are new *N* and *O* thorium lines of very low frequency. A very strong 45·3 Å.U. line coincides with the *K*α line of carbon, but is a different one This is proved by three facts: that tantalum, molybdenum or zirconium hot-wire cathodes, used in the same conditions, do not show the carbon line; that the thorium deposit on the target was very important and visible to the naked eye, that measurements of critical potentials, made with another apparatus, by the ionisation method, do not show at all the carbon *K* critical potential (287 volts) but the two well-defined N_2 (355 volts) and N_{12} (312 volts) thorium critical voltages, corresponding to the respective emission of 45·3 and 51·5 Å.U. lines.

The strong 45·3 Å.U. line appears in three successive orders and covers, by its broadness, a new line, 48·2 Å.U., which appears only in the second order. This one cannot be the first order line, as it is shown by application of the combination principle, and is, in fact, the highest frequency line in the *O* series. All the recorded lines fit very closely into the theoretical requirements. Only one line, O_2P_3, is missing, probably owing to faintness, its probable intensity being supposed to be only half of that of the 71 Å U. line.

These lines are tabulated below and designated by the usual terminology:

λ· Å.U.	ν/R.	Line.	Intensity.	Combination	Corresponding Energy Levels ν/R.
45·3	21·0	*N*β	very strong	N_2-O_{12}	$N_2=26·2$ (directly measured), $O_{12}=5·2$
48·2	18·9	*O*δ	medium	O_1-P_{12}	$O_1=20·4$, $P_{12}=1·5$
51·5	17·7	*N*α	strong	$N_{12}-O_{12}$	$N_{12}=23·0$ (dir. m.); $O_{12}=5·3$
71·0	12·8	*O*γ	faint	O_4-P_2	$O_4=14·8$; $P_2=2$
121	7·5	*O*β	faint	O_3-P_{12}	$O_3=8·5$; $P_{12}=1$

The only low-frequency line escaping detection (*O*α) would have a wave-length of about 230 Å.U. It is the last pure Röntgen line waiting to be found. In the short wave-length side of the spectrum, higher frequency *N* lines are faint and fogged by the strong optical reflection upon the grating of very soft X-rays. Nevertheless two faint lines, 26 and 27·2 Å.U., have once been found.

Remarkable is the simplicity of these spectra in which there is neither spark- nor semi-optical lines, thanks to the small exciting potential. This series of measurements completes in this way our knowledge of Rontgen series and atomic levels and, at the same time, leads to the long-desired spectrographic junction between ordinary X-rays and Millikan optical spectra in the extreme ultra-violet (136 Å.U.: short wave-length limit of aluminium).

A. Dauvillier.

Laboratoire de Recherches Physiques,
sur les Rayons X,
12 Rue Lord-Byron 8ᵉ Arrᵗ., Paris,
September 16.

Prof. Labbé's Production of "Allomorphs."

Prof. Labbé in a recent paper (*Arch. Zool. Exp.*, t. 62, p 498, 1924), in speaking of some copepods and other animals, has made the following statement:—

"The eggs of species *A* laid in a medium of *p*H 8·2 would give the form *A*, but at *p*H 8·4 would give the form *A'*, and at *p*H 8·6 the form *A"*. . . .

"It is exact for Artemia, but for the other forms the fact is more important, for it brings about the transition [il conduit à l'émiettement] of one species to another; this is what I shall call the ***allomorph*** or the allomorphs of the species."

The paper then goes on to state that various allomorphs have been obtained experimentally by a gradual increase in *p*H. It also claims that *Cyclops helgolandicus* Rehberg is an allomorph of this type, *Cyclops bicuspidatus* Claus being the real species.

Mr. Robert Gurney (Nature, vol. 118, p. 336, 1926) has severely criticised Prof. Labbé's statements and leads one to think that the necessary attention to detail has not been given and that the allomorphs were not really the offspring of the species described. Mr. Gurney suggests that the mistake might have arisen through the accidental introduction of the minute larvæ of other species.

I wish to bring forward evidence of an entirely different nature which leads to the same conclusion as that of Mr. Gurney.

For the last three years I have been making a detailed study of the genus Cyclops, an important group of copepods, and in every case the *p*H value of the water in which the animals were actually living was taken. In this way in Great Britain alone I have recorded 31 species, 5 of which are new to the country and 3 new to science. I do not propose to give here either a full list of the species or of their ranges of *p*H since the work is by no means finished, but I will give simply the ranges observed for a few of the better known ones:

Species.	Range of *p*H.
Cyclops vulgaris	4·6–9 8
,, *strenuus*	4·6–8·6
,, *lucidulus*	4·4–7·4
,, *robustus*	4 6–8·2
,, *pulchellus* (syn. *bicuspidatus*)	5·8–8 6
,, *signatus* (syn *fuscus*)	5 0–8·0
,, *annulicornis* (syn. *albidus*)	4·4–9·8
,, *serrulatus* (syn. *Leptocyclops agilis*)	4 6–9 8
,, *prasinus*	4·6–9 8
,, *fimbriatus*	5·0–8·1
,, *nanus*	4·4–7 2
,, *venustus*	5·1–7·4

It is more than likely that as time goes on these ranges will be increased, but I have carried out observations in the following districts: The Isle of

Skye, Perthshire, Folkestone and Hythe, Dartmoor, Cambridge, Oxford, and of course Wilts.

When it is found that a number of well-known species such as those given above can be found with such large ranges of *p*H, it seems impossible to accept Prof. Labbé's statement that a small increase of *p*H is responsible for the transition of one species into another.

In this connexion further observations may be cited. I have found *Cyclops fimbriatus* living in three inches of foul muddy water and dredged it up on the same day in 100 feet of clear water from a Scottish loch. Prof. Sars records the dredging of exactly the same species from 300 feet of water. This is by no means an isolated case. In addition, many of the species of Cyclops are absolutely cosmopolitan, the same species being recorded from the Arctic Circle to the equator wherever there is fresh water.

As a third kind of direct observation I should add that in a series of experiments on the spine formulae of *Cyclops lacunae*, I bred several generations of the well-known species *C signatus* and *C. albidus*. The description of these experiments is now in the press and full details are given; suffice it to say here that the animals were bred in jars in an incubator, as controls, and that during the experiments the *p*H gradually went up from 7·2 to 8·6 The spine formulæ were observed as carefully as possible and both species bred absolutely true to type, and I do not know of any more exacting test.

My experiments and observations therefore do not agree with those of Prof. Labbé, and it is surely now almost an established fact that the alterations of *p*H within reasonable limits have little or no direct effect on freshwater entomostraca or insect larvæ, but a profound effect on most of the protozoa. It is well known of course that certain animals bred in captivity and under abnormal conditions may give rise gradually to a series of monstrosities, *e.g.* the Chinese gold-fish described by Tornier, but there is nothing in these experiments comparable to the transition of one species into another in Nature.

Finally, there is abundant literature, including that given by Prof. Labbé himself, dealing with the continual change of *p*H that takes place normally in any exposed piece of water, and since the entomostracan fauna often remains practically unchanged for weeks and in some cases for months, it is surely obvious that most of the species are not affected by small changes of *p*H, and in some cases they are not affected even by considerable changes.

A. G. LOWNDES.

Marlborough.

'Pwdre Ser' (The Rot of the Stars).

PERHAPS I may be allowed to reopen a subject which gave rise to a very interesting correspondence in NATURE in 1910. I refer to the mysterious jelly-like substance found lying about in open spaces, and popularly connected with 'shooting-stars,' about which Prof T. McKenny Hughes contributed an interesting article to these columns on June 23, 1910. Many suggestions as to the origin of this substance were made both by Prof Hughes and by later correspondents, but no definite conclusion seems to have been reached. Of course it cannot be taken for granted that the 'jelly' is always of the same nature. It may well be that the 'jellies' recorded by some observers were the plasmodia of Myxomycetes, or masses of Nostoc or some other organism. But it seems to have been suggested so early as 1667 by Merrett that the jelly consisted of the viscera of frogs. He says (I quote from Prof. Hughes) ". . . Regnae Societati palam ostendi solummodo oriri ex intestinis ranarum a corvis in unum locum congestis, quod aliis etiam ejusdem societatis viri praestantissimi postea confirmarunt."

The German observer Melsheimer, again, as was pointed out in these columns by Dr. G. H. Pethybridge, considered the jelly to be the remains of the oviducts of frogs. Melsheimer (*Jahresber. Westfälischen Provinzial-Vereins fur Wiss. u. Kunst*, Münster, Sitzung February 28, 1908, p. 53) believed that these were left on the ground, or thrown up undigested, by some animal which devoured frogs, such as the heron, polecat, or water-vole. He also carried out experiments which showed that the oviducts of frogs, if dissected out and exposed to moisture, formed just such masses of jelly, and in some cases eventually became covered with colonies of algæ of the type of Nostoc.

I am in a position to state that the explanation offered by these writers is, at least in some instances, the correct one. My father, the Rev. F. Baylis, who has for some years visited Dartmoor during the summer and autumn, has both last year and this found such jelly-like masses lying on the moor. This year he has forwarded his 'finds' to me for examination, and I have been able to satisfy myself that they consist of parts of the viscera of either frogs or toads. In one specimen the 'jelly' was accompanied by portions of both oviducts in a fair state of preservation, with part of the ovaries, containing the characteristic black eggs, resembling shot, and with the greater part of the animal's alimentary canal, to which the urinary bladder was attached.

What appears to happen is that the gelatinous secretion of the glands lining the oviducts, when exposed to moisture, swells up to such an extent that the oviducts split open longitudinally, and their contents soon assume the appearance of an amorphous jelly. With advancing decomposition, the jelly persists for some time, but the tissue from which it originated may become unrecognisable. I have carefully examined stained microscopic preparations of the tissue, which was on this occasion comparatively fresh, and compared them with similar preparations of the wall of the oviduct of a known frog, supplied by my colleague, Mr. H. W. Parker. By this means both Mr. Parker and myself were able to satisfy ourselves completely that the tissues were of the same kind. From the fact that the stomach, which evidently belonged to the same animal, contained recognisable remains of a fairly large earthworm, I am inclined to believe that the animal was a toad rather than a frog.

The question now arises: How do the viscera of toads or frogs come to be lying on the ground in such situations? One specimen came from near the top of a 'tor.' If the animal had been swallowed by a heron or other bird, and its remains disgorged, it seems probable that these soft parts would have been digested more rapidly than the muscular and bony portions, of which there is no trace. I am inclined, therefore, to believe that some carnivorous creature (such as the weasel, stoat, badger, crow, or buzzard) is in the habit of disembowelling toads or frogs, and leaving some of the viscera on the site of the 'kill.' It would be interesting to know whether any direct observations have been made which bear upon this question.

H. A. BAYLIS.

British Museum (Natural History),
Cromwell Road, London, S.W.7,
September 21.

Science and Psychical Research.

In Dr. Tillyard's rejoinder to my letter on this subject, published in Nature for August 28, he cites Richet as one of the great scientific men who have studied psychical phenomena and have become convinced of their genuineness. He couples Richet with Crookes, Lodge, and others in this respect, but without even suggesting any difference between the individual beliefs of these eminent men. Since I read this my attention has been directed to a statement published by Richet only a little more than two years ago, which appears to me to be of the highest importance.

As we know, Crookes believed that the phenomena which he observed were due to spirits—that is to say, to the discarnate manes of deceased human beings—and Lodge too appears clearly to be of the same opinion. From every human point of view this, of course, is a momentous belief, as indicating the survival after death of human personality. But what does Richet believe?—Richet, who is put by Dr. Tillyard in exactly the same category as Crookes and Lodge.

In the *Proceedings of the Society for Psychical Research* for May 1924, in an article on "The Difficulty of Survival from the Scientific Point of View," Richet, after some evident hesitation, makes the uncompromising statement: "I am forced to regard the spiritistic hypothesis, not only as undemonstrated, but, still more, as being in formal opposition to a great number of facts."

Some may perhaps criticise the word 'spiritistic' which Richet uses. It does not appear to be a dictionary word; but it seems clear from the rest of Richet's article that he uses it as meaning 'pertaining to spirits,' and that what he wishes to convey is that he is quite unconvinced that psychical phenomena are in any way due to spirits, or that such phenomena afford any evidence that spirits exist.

It seems to me, therefore, entirely wrong to class Richet as a spiritualist like Crookes and Lodge, as to do so is most misleading.

A. A. Campbell Swinton.

Amsterdam,
September 28.

As Mr. Campbell Swinton has directed attention to the National Laboratory of Psychical Research in his letter published in Nature of September 25, I may perhaps be allowed to modify his observations, which I strongly suspect were intended to be disparaging.

The National Laboratory is no more and no less a "purely private concern" than any other society founded for the purpose of scientific investigation and research. The institution is presided over by Lord Sands, and its vice-presidents and correspondents include Viscountess Grey of Fallodon and many eminent psychists and university professors in all parts of the world The National Laboratory is governed by a council consisting of well-known London medical men and others whose concern is solely to elucidate the deep mysteries of psychic phenomena and, if possible, to discover the laws governing them. A perusal of our list of members would reveal to Mr. Swinton many names famous in various branches of science.

If we have erred in the naming of our organisation, fellow-sinners to the extent of seven columns in the "Telephone Directory" have committed the same 'crime.' Only lack of intelligence or gross carelessness could possibly account for any confusion between the name of our institution and that of the National Physical Laboratory. Both organisations are engaged in an endeavour to increase the sum total of the world's knowledge by scientific means, the only difference being that the National Physical Laboratory is supported by the taxpayers and we are not. I admit that the substitution of the word 'International' for 'National' would more properly describe our activities. Mr. Swinton's remark that the name of our laboratory seems to be *suggestio falsi* is as untrue as it is unjust.

It is curious that 'emotional disturbances' have never before been recorded by means of a thermograph; it is still more curious that at séances with eminent mediums the changes in the sitters' thermal conditions should exactly synchronise with the production of phenomena, witnessed under excellent lighting conditions and simultaneously recorded by means of a dictaphone. The fact is, of course, that when no medium is present the graph shows a steadily rising curve with no lowering of the temperature. But if we have proved that 'emotional disturbances' on the part of the sitters three feet away from the thermograph will lower the temperature several degrees, the founding of the National Laboratory of Psychical Research will not have been in vain!

Harry Price.
(Honorary Director.)

National Laboratory of Psychical Research,
16 Queensberry Place, London, S.W.7,
September 29.

I would not follow Mr. Campbell Swinton further—I have already done so in the correspondence columns of four newspapers—if he did not make a specific attack upon my accuracy. I must vindicate this by explaining the incident mentioned, while admitting that his misreading of it is not unnatural

I had seen a representative of the *Morning Post* and had suggested that the picture be published He told me that he feared it would not reproduce. After one interview I thought that I would at least send it up, and I did so, quoting what their representative had said. Therefore I am quite accurate when I say that when I *first* approached the *Morning Post* I made no suggestion that the photograph would not reproduce. How could I, who profess no knowledge of such matters, instruct a newspaper as to whether they could reproduce or not?

Arthur Conan Doyle.

Windlesham,
Crowborough, Sussex,
September 30.

Distribution of Intensity in the Spectrum of γ-Rays.

New information concerning the spectrum of γ-rays may be obtained if we consider the energy of Compton's recoil electrons. As has been shown already (Nature, 116, p. 206, 1925), these electrons can be observed in a Wilson's cloud expansion chamber. In the case of very fast electrons, their velocity is determined from the curvature of the tracks photographed in a homogeneous magnetic field. The energy of recoil E and the frequency ν of the primary rays are connected by the following relation of Debye and Compton:

$$\frac{E}{h\nu} = \frac{2a}{1 + 2a + (1 + a)^2 \mathrm{tg}^2\theta} \quad \ldots \quad (D.\text{-}C.)$$

where $a = h\nu/mc^2$, m is the mass of the electron, and θ is the angle between the direction of the recoil and that of the primary rays.

Using photographs of the tracks, it is not possible to attain the same accuracy as with the usual methods. But, though only approximate values of the frequency ν can be obtained, this method, nevertheless, provides quite satisfactory results as regards the distribution of energy in the spectrum. Wilson's cloud expansion chamber allows a direct counting of the separate quanta of the scattered radiation, as in this case every observed recoil electron represents one single quantum.

I obtained about two hundred stereoscopical photographs of tracks of secondary electrons, produced in a gas under the action of γ-rays hardened by 3 mm. of lead. Out of all observed tracks, those were chosen where the angle θ lay approximately within the limits of 0°-20°. The value $H\rho$ (H = strength of the magnetic field, ρ = radius of curvature) was determined for 170 tracks, which satisfied the above condition.

The results are shown in the accompanying diagram (Fig. 1).

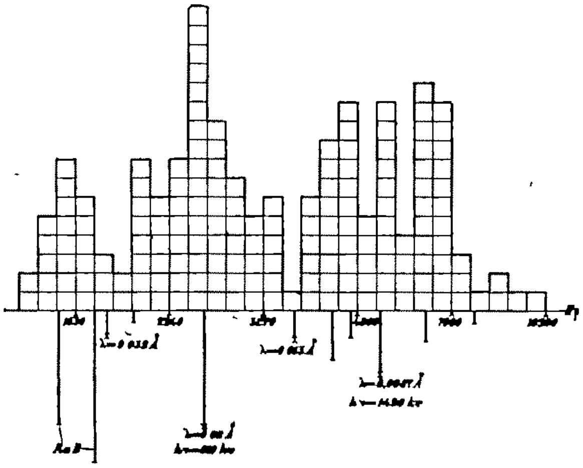


FIG. 1.

The values of $H\rho$ are plotted on a logarithmic scale, one division of which corresponds to about 8 per cent. of the value $H\rho$.

The number of squares corresponding to one division is equal to the number of observed electrons for which the value $H\rho$ was found to lie in the limits of the given division. Definite values of $H\rho$ are also given for each separate line of the spectrum of γ-rays, found by Ellis (*Proc. Cam. Phil. Soc.*, 22, 369, 1924); these values of $H\rho$ correspond to those for the energy E, which follow from relation (*D.-C.*) in the case of ν being put equal to the frequency of the given line and the angle θ to 10°. On the diagram the separate lines of Ellis's spectrum are represented by straight lines, the lengths of which are proportional to the intensity of the corresponding line, as given by Ellis.

The distribution thus obtained corresponds, in its outlines, to Ellis's spectrum, as could be predicted from the quantum relation (*D.-C.*)

It is probable that, in the interval $0{\cdot}03 > \lambda > 0{\cdot}014$ Å.U., there exists either a continuous γ-radiation or some more lines beside those registered by Ellis. (This assumption is in accord with Thibaud's research (*Ann. de Phys.*, vol. 5, 73, 1926).)

In order to determine the intensities in the primary beam, we have still to account for the probability of recoil in the given conditions ($\theta < 20°$). Compton's theory gives a definite value for this probability. The distribution of intensities which can be deduced directly from my experimental data did not agree with the distribution obtained by Ahmad, who has used the ionisation method and also based himself on Compton's theory (*Proc. Roy. Soc.*, 109, 206, 1925).

D. SKOBELTZYN.

The Physical-Technical and
Polytechnical Institutes,
Leningrad, August 22.

Light-Organs in Littoral Cephalopoda.

THE large group of pelagic 'squids' known as the Egopsida, which includes the greatest number of families of living cephalopods, is characterised by the frequent occurrence of light-organs situated in a variety of places both on the outer surface and within the mantle-cavity. The Myopsida (which include the true squids (Loligo) and cuttlefish (Sepia)), on the other hand, are poor in luminous species. Dr. S. S. Berry in his recent survey of the occurrence of luminous organs in Cephalopoda (*Biological Bulletin*, 38, 1920, pp. 141 and 171) lists 99 luminescent species of Egopsida (57 per cent.), 27 of Myopsida (12 per cent.) and 2 of Octopoda (1 per cent.). We cannot believe that these organs are necessarily correlated with the habit of living permanently in, or periodically descending to, great depths. Many of the Octopoda are permanent inhabitants of the deeper layers of the sea and are yet devoid of luminous organs. There may be some special source of correlation between the occurrence of light-organs and abyssal habitat which may be responsible for the occurrence of the former among the Egopsida, but not among the Octopoda. Of this we have no certain evidence at present.

The view that the presence of light-organs is directly correlated with reduction of light, and hence with abyssal habitat, gains some support from the fact that, while many Egopsida have a considerable vertical range, in the Myopsida, which are regarded as mainly littoral in habit, light-organs occur in only 12 per cent. of the species. The exact vertical range of individual genera of Myopsida is a little obscure, and it is obvious that in several of them it is considerable. Due consideration must of course be given to the fact that unless a specimen is taken in a closing net the exact depth of its regular habitat cannot be satisfactorily assessed. However, there is not much doubt that the Sepiolidæ inhabit relatively shallow water (down to about 100 fathoms), while the Loliginidæ and Sepiidæ are definitely littoral, though it is at present uncertain how deep they range in the course of their reproductive cycle. Nevertheless, paired photogenic organs situated immediately over the ink-sac were recorded by W. Meyer (*Zool. Anz.*, 30, p. 388, 1906) in *Sepiola rondeletii* (surface-100 fathoms). In the Loliginidæ and Sepiidæ, two very large families, no photogenic organs at all were recorded by Berry in his survey of the group (see above). Thanks, however, to the acuteness of M. Armand Krempf, director of the oceanographical and fishery service of Indo-China, and to the courtesy of Dr. R. Ph. Dollfus, Secrétaire Général de l'Institut Scientifique Chérifien, I am able to record the occurrence of rectal light-organs, exactly similar to those of *Sepiola rondeletii*, in a new species of Loligo (shortly to be described) from Indo-China. The species in question is obviously of littoral habit.

The general considerations outlined above and this new observation render it very desirable to collect exact data as to the distribution and habits of these animals. Without such data it must remain impossible to decide whether these luminous organs are adaptive in the usual sense of that word and, if so, to what needs they correspond (*e.g.* the search for food or the attraction of mating-partners), or whether they are at the offset developed without reference to the welfare of the organism. G. C. ROBSON.

British Museum (Natural History),
South Kensington, London, S.W.7,
September 22.

Electrostatic Moments of Molecules.

I HAVE made recently some observations on the electrostatic moments of molecules. A beam of molecules, all having sensibly parallel velocities, was passed through an electrostatic field, so arranged that the quantity d^2v/dx^2 (x measured perpendicular to the direction of the molecular motion) was of the order of 10^6 e.s.u./cm ^{2} Experiments were made on the metal potassium and on the compounds sodium chloride, mercuric chloride, and arsenic trioxide. It was found that potassium had a moment too small to detect, and it has been impossible so far to induce any polarisation in the molecule in the largest field used—330 e.s.u./cm. There was no deflexion which might be put down to the molecules (K)n. If such are present their concentration must be very small—less than 1 per cent. of the total number, or they have no moment and the field cannot polarise an appreciable number of them.

Some experiments of a qualitative sort have been done on the binary and ternary compounds sodium chloride and mercuric chloride. The molecules of both these substances were deflected appreciably by the field, and the moment was estimated to be of the order of magnitude 10^{-18} e.s.u. cm. As these experiments were done with the aid of a knife edge, it is difficult to estimate the field through which the molecules passed.

With a much better apparatus in which a charged wire was placed in the path of the moving molecules, an experiment was done on arsenic trioxide. In this case several deflected lines were visible, and the moment deduced appears to be somewhat larger than in the case of the other two salts. It is difficult without a systematic series of experiments to offer a definite interpretation of these observations, as there is to be taken into consideration a number of possible effects, for example, the rotational energy of the molecules, the polarisation which the field may induce in them, and finally, effects due to different molecular states. R. J. CLARK.

The Cavendish Laboratory,
Cambridge.

Lengthened Chain Compounds of Sulphur.

IN a recent issue of NATURE (August 21, p. 283) attention is directed to some lengthened chain compounds of sulphur described by Sir P. C. Rây and K. C. Bose-Rây (*J. Indian Chem. Soc.*, 1926, 3, 75) as products of the interaction of dithioethylene glycol and ethylene dibromide. Of the three points which are emphasised by the authors, namely, (*a*) the isolation of a compound containing bromine, (*b*) the high molecular weight of this compound, and (*c*) its formulation as having a long chain structure, two cannot be regarded as new, whilst the evidence for the third is unconvincing. For the very similar reaction of ethylene dibromide with potassium sulphide was shown by Crafts so long ago as 1863 (*Annalen*, 128, 220) to yield such substances of presumably high molecular weight containing 12-28 per cent. of bromine and with a ratio of C : H = 1 : 2. Moreover, the suggestion that these substances have a long open chain structure has recently been put forward on more than one occasion (*J. Chem. Soc.*, 1921, 119, 1861; 1925, 127, 2676).

It seems probable that such products are mixtures of substances of the general formula $A.(S.C_2H_4)_n.S.B$, where A and B may be alike or different and have any of the structures: $-CH_2.CH_2OH$, $-CH:CH_2$, or $-CH_2.CH_2X$ (where X is a halogen). If n be large, the composition of the whole will differ very slightly from that of a polymer of ethylene sulphide. But at the same time the easy isolation of a single pure chemical individual from such a mixture of closely related substances is not to be expected.

The experiments recorded by Sir P. C. Rây do not in fact provide any convincing evidence that such a separation of pure substances was effected, although it is claimed that this was so after one or two crystallisations. There are also several indications in the paper that the "compounds" were still mixtures. For example, it is improbable that members of what would constitute a single homologous series of compounds of the general formula $Br.C_2H_4(S.C_2H_4)_n.Br$ would have the following melting points when pure:

Value of n .	10	12	16	24	26	32	40	48
Melting point .	120°	100°	162°	147°	145-155°	157-159°	170°	165°

In no case was the molecular weight of one of these substances satisfactorily confirmed. The ebullioscopic determination made on one of them led to a value about half of that expected (1486 in place of 3068). The authors attribute this to a surprising disruption of the molecule by the ethylene dibromide used as a solvent, but it is much more likely to be due to the presence from the first of a mixture of substances some of which do not contain bromine. In any case it cannot reasonably be claimed that any substance was shown to have the high molecular weight stated. G. M. BENNETT.

The University,
Sheffield.

Prof. Paul Kammerer.

I REGRET to have to announce the death of Prof. Dr. Paul Kammerer, who shot himself on the Hochschneeberg, near Vienna, on September 23. In a letter (received after his death) he accuses himself of failures in his personal affairs, but emphasises that he has never committed the scientific tricks hinted at by some of his critics. He deemed the rest of his life too short to be able to take up again the same experiments, and declared himself too weary for this task. Although other than these seem to have been the main causes for his weariness of life, yet this sad end to a precious life may be a warning to those who have impugned the honour of a fellow-worker on unproven grounds. It is in fulfilment of a wish expressed by Kammerer that I beg the editor of NATURE to publish his last word on the much-debated but not solved question of a particular one of his specimens. Having convinced himself of the state it is in now, Kammerer alleges that someone must have manipulated it; he does not allude to a suspicion whom this might have been.

Need I add that Kammerer's work on the modifiability of animals, especially on poecilogony and adaptation to colour of background in Salamandra and the reappearance of functional eyes in Proteus kept in appropriate light, will secure him a lasting place in the memory of biologists, even if some other of his papers were open to criticism.

HANS PRZIBRAM.

Vienna II. Prater, "Vivarium."

English Provincial Universities: Demand and Supply.

THE elevation of University College, Reading, to full university status has naturally led to a certain amount of speculation as to the prospects of other colleges which aim at achieving a like development. A careful survey of the demand for and supply of university education in Great Britain was included in last year's Report of the University Grants Committee, which pointed out that in spite of serious financial distress among the classes from which university students are mainly drawn, in spite of a rise in fees and in personal expenses, there were 56·9 per cent. more full-time students of both sexes at British universities and colleges than before the War. There can, the committee thought, be little doubt that the demand for university education cannot long remain stationary even at this higher level, and that it will continue to grow both in volume and intensity. The growth is, in fact, clearly traceable to causes which are likely to operate in the future with increasing force.

One may distinguish between the demand for professional or vocational education at a university—the bread-and-butter studies—and the demand for the other advantages which a university education offers, advantages associated with the ideal of a 'liberal education.' Both have been and are being stimulated by the rapid increase in the secondary school population, which has multiplied the number of young people fitted for and capable of appreciating the value of university training while creating a demand for more teachers which the universities alone can properly supply. The ever-extending applications of science to industrial purposes, the instalment by industrial concerns of private laboratories and research departments, and the development of industrial research associations, provide an ever-widening field for men and women trained in the scientific departments of universities. There is, moreover, in the world of commerce and industry a growing appreciation of the value of the university-trained mind, and the opinion gains ground "that for the direction of operations which tend every day to become more and more dependent for their success upon the understanding of a complicated network of world conditions, disciplined imagination, breadth of outlook, and mastery of general principles are the qualities needed—qualities which it is the object of a good university education to develop." Meanwhile the demand of the learned professions and the public services grows no less, and the local government authorities have begun to compete with the central government for the services of university graduates.

Partly as a result of the widening of the university area of influence, there has come about a broadening of the basis of university studies in all faculties, and this has tended to increase the number of those who would pursue at a university the ideal of a 'liberal education.'

A potent cause of growth in the *effective* demand for university education in Britain has been the generous provision by local authorities of scholarships tenable in universities. It has been estimated that this amounts to something like 300,000*l*. per annum.

So much for the demand. In discussing the question whether the supply would be able to meet it, the committee directed attention to its statistics of students in attendance at each of the universities, and pointed out that there are few at which there is not ample scope for expansion without any danger of introducing the methods of mass production—expansion which would meet all the needs likely to arise for a good many years to come, at much less cost than would be incurred in creating new universities or raising to the university level institutions which are now below it: "We consider that a relatively small number of universities, staffed and equipped on a worthy scale, will be of more value to the nation than a larger number of universities of inferior strength."

Turning now from these general considerations to particular examples, the present position and prospects of the three university colleges at Nottingham, Southampton, and Exeter may be briefly described as follows:

UNIVERSITY COLLEGE, NOTTINGHAM.

This College was founded by the municipality of Nottingham and opened in 1881 by the Duke of Albany; it took up the Cambridge extension courses, of which Nottingham was one of the earliest centres, and the evening classes which for many years had been held at the Mechanics' Institution. From these beginnings it has developed its present work.

The College building, which houses also the Free Public Library, is situated in the centre of the city, but new buildings are in process of erection on a very fine site, three miles distant, presented by Sir Jesse Boot as part of a gift of 350,000*l*. made in 1920 to the city of Nottingham. From the gift, 110,000*l*. was allocated to the new buildings, for which Sir Jesse Boot made supplementary gifts amounting to 40,000*l*. An anonymous donor gave 100,000*l*. in 1922 as a contribution towards the establishment of an "East Midlands University," and this sum was added to the building fund, making 250,000*l*. in all. Sir Jesse Boot has since added to his benefactions; among other gifts he has provided 12,000*l*. more for the buildings and 9000*l*. for the sports ground. The present buildings in Shakespeare Street will continue to house the technical day courses and the evening classes.

At the ceremony of laying the foundation-stone of the new building on June 14, 1922, Lord Haldane suggested that a university for the East Midlands might be organised on something like the pattern which is now in operation in Wales, the university looking to the constituent colleges to develop the teaching of their own students and preserve all the records and to conduct examinations for degrees under the university's supervision. He thought it would be possible to start a university on these lines with four faculties: arts, science, engineering, and commerce. The other constituent colleges of the projected university were not named, but Leicester, Loughborough, and Derby are all within easy reach, and the colleges at those places would presumably come into the scheme.

The instruction at University College, Nottingham, is organised in faculties of arts (including education and music), economics (including commerce and law), pure science (including pharmacy), and applied science (engineering and technology, textiles and mining). A department of adult education is conducted by a whole-time professor, assisted by four staff tutors, two organising lecturers, and about thirty-five part-time tutors and lecturers. The College has shown great enterprise in developing this department to a high degree of efficiency since the War. It makes special provision for the instruction of foreign students throughout the academic year.

Much advanced work is carried on, there having been in 1924–25 twenty-four research students in addition to students doing post-graduation work in education or in secondary training. The total number of full-time students in 1924–25 was 472, including 175 women. The distribution by faculties was: arts and economics, 204 (women 130); pure science, 204 (women 45); medicine, 6; technology, 58. Ninety-seven students were accommodated in residential halls. Part-time students numbered 734 (women 97), and there were in addition 1545 students taking courses not of a university standard, and 1867 university tutorial class three-year students.

On the score of amount of instruction provided and research work undertaken, Nottingham ranks higher than Reading. It is in provision of residential halls for its students and in finance that it falls short. A scheme for providing additional halls of residence both for men and for women has, however, been begun and has already received contributions and promises of support. The total income of the College in 1924–1925 was 59,609*l*. as against Reading's 84,159*l*., and its income from endowments 1600*l*. as against 12,148*l*. Its grants from local authorities amounted to 14,532*l*. plus 2500*l*. set apart for scholarships, hostels, etc.; its parliamentary grants to 25,548*l*, its tuition and examination fees to 12,878*l*., and other income to 5051*l*.

The book value of its lands and buildings and permanent equipment is 495,888*l*., and its endowment investments 2381*l*. A few more bequests such as that of Mr. W. H. Revis (37,000*l*.) would enable the College, either alone or in association with others, to make out a very strong case for a university charter.

UNIVERSITY COLLEGE, SOUTHAMPTON.

The College at Southampton originated in the Hartley Institute for Technical Training, founded in 1850 and formally opened by Lord Palmerston in 1862. For thirty years its function was that of a technical college only, but in 1899 it was recognised by the Board of Education as a training college for teachers. Three years later (after investigation and report by the Treasury) the College was promoted to a place in the list of university colleges in receipt of Treasury grant. New buildings on the outskirts of the town were opened on June 20, 1914, by Lord Haldane. On the outbreak, six weeks later, of the War, the College authorities handed over the buildings to be used as a hospital, and it was not until October 1919 that the College actually took possession of its new home. The buildings are not yet completed, and a good deal of the work now being done is carried on with huts as lecture-rooms and laboratories.

The College prepares students for degree examinations of the University of London, the examinations of various professional bodies such as the Pharmaceutical Society, Institute of Chemistry, Institutions of Mechanical, Civil and Electrical Engineers, Royal Institute of British Architects, Surveyors' Institution, Law Society, etc., and for its own diplomas in engineering, commerce and economics, geography, law, music, and English (for foreign students). Its department of education for the training of teachers has a high standard of admission (London matriculation) and prepares students not only for the Board of Education's Certificate examination (conducted internally, at the College) but also for the teachers' diploma and higher diploma in pedagogy of the University of London and other advanced examinations in professional subjects. An increasing number of these students take also university degree examinations. The original work of the College as a technical institution still flourishes in the shape of evening classes in arts, pure and applied science, engineering, etc. There is an old students' association with nearly two thousand members.

In 1925–26 the number of full-time students was 316, including 157 women. The number resident in college hostels was 192 (women 94). Two-thirds of the full-time students (82 men and 131 women) were working in the Faculty of Arts; 86 were students of pure science; 17 were engineering students. Part-time students numbered 294, including 28 women. In addition, there were 253 students taking courses not of a university standard and 112 students attending university tutorial (three-year) classes. The book value of lands and buildings as at July 31, 1925, was 64,591*l*., and endowment investments amounted to 12,347*l*. The total income of the year 1924–25 was 31,962*l*., derived from: parliamentary grants (15,139*l*., increased in 1925–26 by 4000*l*.), local authorities' grants (9236*l*.), tuition and examination fees (6094*l*.), endowments (644*l*.), and other sources (849*l*.). Student expenses have been kept low, and it is claimed that a university education may be acquired at Southampton at an inclusive cost of 105*l*. a year.

Although the College is able at present to pay its way, further expansion and improvement are dependent on the success of efforts now being made to raise additional funds. In May 1925 an appeal was launched for 500,000*l*. for the endowment of chairs and the provision of additional buildings, with the view of eventually obtaining a charter for a projected "University of Wessex." Geographically, Southampton would seem to be the most appropriate centre for university education for East Dorset, South Hants, the Isle of Wight and Channel Islands, and West Sussex. The towns of Poole, Bournemouth, Salisbury, Portsmouth, Winchester, and Chichester are all within easy distance. In 1925–26, 119 out of the total number (316) of full-time students lived at home, and 72 others came from homes within a radius of thirty miles, whilst 125 came from beyond that radius.

The case for a University of Wessex rests partly on the regional demand, present and prospective, for regional facilities for university education, and partly on the incidental and indirect benefits likely to accrue to the inhabitants of the region in consequence of having a university in their midst. It may be anticipated, therefore, that Southampton will, like Nottingham, largely develop its university extension activities and its commercial and technological departments. Southampton being within such easy reach of French ports, a university with a strong faculty of commerce would attract many students from France. The engineering department of the College is at present a small one, but its efficiency is proved by the fact that the students when they leave college readily obtain employment, and some of them have already risen to very considerable distinction. Were money forthcoming, this department would be capable of important developments, especially in the study of marine and aeronautical engineering, for which Southampton offers excellent opportunities.

UNIVERSITY COLLEGE, EXETER.

The University College of the south-west of England, Exeter, formerly known as the Royal Albert Memorial College, originated in 1865, when memorial buildings consisting of a museum, a library, and adjuncts for the study of art, science, and literature were erected. With the co-operation of the Local Lectures Syndicate of the University of Cambridge, the work of the institution was re-modelled and co-ordinated in 1893, when the first principal was appointed, but it was not until 1901 that the educational work was organised for development on the lines of a university college with the provision of a curriculum for the external examinations of the University of London.

The College was placed upon the list of university institutions in receipt of grant from H.M. Treasury as from August 1, 1922, when it was incorporated under its present name as a company limited by guarantee, and the college buildings and halls of residence were transferred to it by the Exeter City Council. From that time its progress has been rapid, the number of degree students in the four years ending 1924–25 having been 96, 139, 187, and 211 respectively. The total number of full-time students in 1924–25 was 332, of whom 221 were in the teachers' training department. Residential halls provide accommodation for 134 women and 110 men students. Part-time students numbered 38 and occasional students 40. There are departments of biology, chemistry, classics, education, English, geography, history and economics, law, pure and applied mathematics, modern languages, music, philosophy, physics, and extra-mural studies. The total income was 29,067*l.*, including parliamentary grants 12,317*l.*, grants from local education authorities 10,384*l.*, tuition and examination fees 5040*l.*, income from endowment 674*l.*, and from other sources 1112*l.* The book value of its land, buildings, and permanent equipment is 81,433*l.*, and its endowment investments 11,603*l.*

These figures do not suggest that the College is likely to qualify soon for full university status, but it might conceivably join with the Technical Schools, Plymouth, the Seale-Hayne Agricultural College, Newton Abbot, and the Camborne School of Mines, to form a federal university. An important scheme for co-operation with the Technical Schools, Plymouth, has been worked out providing for degree and diploma courses in civil, electrical, marine, and mechanical engineering and in commerce at Plymouth, and the extension of the law teaching and extra-mural work already carried on there by the College. An appeal was launched in October 1925 for 100,000*l.* for the equipment and endowment.

University College, Hull.

The plans for the proposed University College for Hull, for which the Right Hon. T. R. Ferens gave 250,000*l.*, provide for an organisation somewhat similar in scope to that of University College, Southampton, with the addition of a department of agriculture and, eventually, departments of shipbuilding and applied chemistry of the oil, colour, gas, and spirit industries.

Lest the account already given of the policy of the University Grants Committee in regard to proposals for establishing new universities should be misunderstood, it must be added that the Committee is careful to point out that its "view of what is prudent at one particular stage of our history betokens no lack of sympathy with the general desire for a wider avenue to university education, or with the ambitions of certain large and populous cities to rival the more fortunate communities which already possess universities of their own." The Committee hopes that "as returning prosperity enables the schemes of local education authorities under the Education Act to be carried into effect, the local colleges will play an increasingly distinguished part in the higher education of the people, and will steadily raise the level of national knowledge and culture. It may well be that some of these will, in course of time, establish a claim to university rank and receive charters as independent universities."

Fluctuations in the Abundance of a Species considered Mathematically.[1]

By Prof. Vito Volterra, For. Mem. R.S., President of the R. Accademia dei Lincei.

A CONSIDERATION of biological associations, or of the mutual interactions between two or more species associated together, has led me to certain mathematical results which may be set forth as follows.

The first case I have considered is that of two associated species, of which one, finding sufficient food in its environment, would multiply indefinitely when left to itself, while the other would perish for lack of nourishment if left alone; but the second feeds upon the first, and so the two species can co-exist together.

The proportional rate of increase of the eaten species diminishes as the number of individuals of the eating species increases, while the augmentation of the eating species increases with the increase of the number of individuals of the eaten species. Having determined the laws of this increase and diminution, it is possible to establish two differential equations of the first order, non-linear, which can be integrated. The integrals reveal the fact that the numbers of individuals of the two species are periodic functions of the time, with equal periods but with different phases, so that each species goes through a cycle relative to the other during a period, a process which may be called the 'fluctuation of the two species.' Figs. 1 and 2 give representations of different possible cycles, corresponding to different initial values of the number of individuals of the two species: ordinates representing the eating, and abscissæ the eaten species.

The co-ordinates of a point on a cycle are the concurrent values of the numbers of individuals of the two species, those of the central point Ω being the mean values; and the following laws have been deduced from integration of the differential equations which represent the fluctuation:

I. The fluctuation of the two species is periodic, the period depending only on the coefficients of increase and of destruction of the two species, and on the initial numbers of the individuals of the two species.

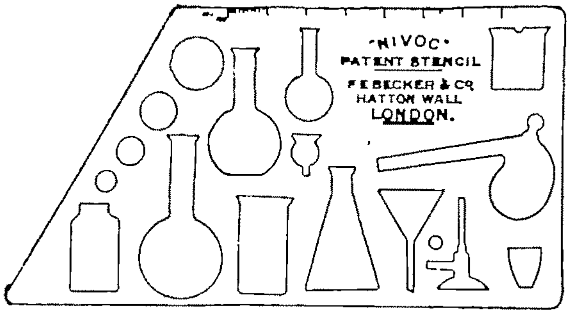
II. The average numbers of the two species tend to constant values, whatever the initial numbers may have been, so long as the coefficients of increase or of destruction of the two species and also the coefficients of protection and attack remain constant. (Laws I. and II. are illustrated in Fig. 2.)

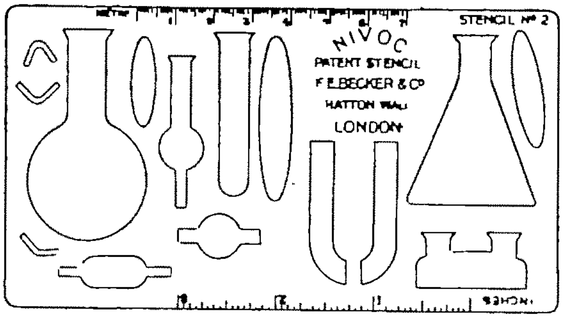
III. If we try to destroy individuals of both species uniformly and proportionately to their number, the average number of individuals of the *eaten* species grows and the average number of the eating species diminishes (see Fig. 1). But increased protection of

---

[1] V. Volterra.—Variazioni e fluttuazioni del numero di individui in specie animali conviventi.—*Memorie della R. Accademia dei Lincei* (Cl. di Sci. Fis. etc.), ser. 6, vol. ii. fasc. 3, 85 pp., 1926.

NIVOC PATENT STENCILS





FOR CHEMISTRY
DIAGRAMS

SIMPLIFY THE
TEACHING OF
SCIENCE

USED ALL OVER
THE WORLD
WHEREVER
SCIENCE IS
TAUGHT

The "Nivoc" Stencil consists of a flexible plate having "cut-outs" of various articles such as Flasks, Beakers, Bunsen Burner, Funnel, etc., so that by placing the point of a pencil inside these "cut-outs" and following the directions of the curves and lines, neat symmetrical diagrams can be rapidly made.

**NOS.
1 & 2
PRICE
ONE SHILLING
EACH**

EXAMINATIONS.

EXTRACTED FROM THE MATRICULATION AND SCIENCE PROGRAMME OF THE UNIVERSITY OF LONDON:

"CANDIDATES TAKING CHEMISTRY WILL BE PERMITTED, IF THEY DESIRE IT, TO USE A STENCIL FOR MAKING DRAWINGS OF APPARATUS"

USE "NIVOC" PATENT STENCIL.

F. E. BECKER & CO.

W. & J. GEORGE (LONDON) LTD., PROPRIETORS

17-29 HATTON WALL, LONDON, E.C.1.

**COMPLETE LABORATORY FURNISHERS
· CHEMICAL AND PHYSICAL ·
· · APPARATUS · ·
BALANCES AND WEIGHTS**

"Everything from a Test Tube to the complete furnishing of the largest Laboratory."

GREAT MICROSCOPE BARGAINS

Reichert Stand, rigid foot, inclinable to the horizontal, fine and coarse adjustment, double revolving nosepiece, circular stage, swing out sub-stage, spiral underfitting, iris plano and concave mirror, Reichert No 3 and No 7 triple compound objectives, 2 eyepieces, in case, as new. **£11 : 5 : 0**

Carl Zeiss Microscope, inclinable to the horizontal, fine and coarse adjustment, double nosepiece, circular revolving mechanical stage, Abbe condenser, with mechanical sub-stage, plano and concave mirrors, Zeiss D.D. objective, ⅙th and ⅛th Beck objectives, new condition, Zeiss No. 4 eyepiece. **£25 : 5 : 0**

Swift Microscope, inclinable to the horizontal, fine and coarse adjustment, double revolving nosepiece, square stage, plano and concave mirrors, 2 Beck objectives ⅔th and ⅙th, 2 eyepieces. **£8 : 5 : 0**

Carl Zeiss Microscope, fine and coarse adjustment, triple revolving nosepiece, circular revolving stage, with vernier, Abbe condenser, plano and concave mirrors, 2 Zeiss A.A. & D. objectives, two eyepieces, and case, new condition. **£12 : 12 : 0**

Leitz Microscope, inclinable to the horizontal, fine and coarse adjustment, triple revolving nosepiece, swing out Abbe condenser, spiral underfitting, plano and concave mirrors, Beck 1/12th, Ross ⅙th, and Beck ⅔th objectives, 3 eyepieces, and case, in new condition. **£15 : 10 : 0**

Leitz Microscope, fine and coarse adjustment, rigid stage, inclinable to the horizontal, double revolving nosepiece, square stage, Abbe condenser, iris, plano and concave mirrors, 3 Leitz eyepieces, Koristka 1/12th oil immersion and Koristka ⅙th and ⅔rd objectives, in case, as new **£16 : 17 : 6**

Watson Praxis Stand, inclinable to the horizontal, fine and coarse adjustment, square stage, three objectives 1", ⅔", and ⅙", 2 eyepieces, condenser, and case. **£10 : 10 : 0**

Watson's Edinburgh Stand, very rigid claw foot, inclinable to the horizontal, fine and coarse adjustment, triple revolving nosepiece, mechanical stage, and sub-stage, with Abbe condenser, with centering screws, plano and concave mirrors, 4 objectives, Watson's 2", 1", and ⅙" and Beck 1/12th objectives, 2 eyepieces, in case **£51 : 17 : 6**

Koristka Model "H" Binocular Prismatic Stand, inclinable to the horizontal, fine and coarse adjustment, interocular adjustment, focussing adjustment for eyepieces, triple revolving nosepiece, circular revolving stage, mechanical sub-stage, Abbe condenser, plano and concave mirrors, Koristka objectives, 1/12th semi-apochromatic oil immersion 2, 6, and 8 star, 5 pairs eyepieces 2, 3, and 4, 4 compensating and 6, complete in case **£42 : 0 : 0**

Koristka Model "K" Microscope, rigid horseshoe foot, inclinable to the horizontal position and well-balanced focussing adjustment, coarse by rack and pinion, fine by side micrometer screw, mechanical stage with scale and verniers, with a displacement of 40 mm. in each direction. Focussing sub-stage with swing out Abbe condenser, N.A 1/12th, with triple revolving nosepiece, 3 Koristka objectives ⅔rd, ⅙th, and 1/12th oil immersion, magnifications 60-1000, complete in case, splendid value at the price. **£24 : 0 : 0**

Or without 1/12th oil immersion objective **£18 : 0 : 0**

Koristka Microscope, Bacteriological C, fitted with double rack and pinion coarse and fine screw focussing adjustment, Abbe condenser with iris diaphragm, with screw underfitting, revolving stage, triple revolving nosepiece objectives, ⅔rd, ⅙th, and 1/12th Koristka oil immersion, and 3 eyepieces, complete in carrying case. **£22 : 17 : 6**

Swift Microscope, with double rack and pinion, coarse and micrometer screw fine focussing adjustment, square stage with swing out Abbe condenser, iris and screw underfitting, triple revolving nosepiece, achromatic objectives ⅔rd and ⅙th, with eyepiece, in polished mahogany case Cost £30. **£11 : 0 : 0**

Baker Dissecting Microscope, complete with stand, on solid foot, rack and pinion focussing, glass and metal bed-plates. 3 aplanatic lenses, complete in polished mahogany case. Cost £10 : 10 : 0. **£5 : 5 : 0**

Beck very compact Travelling Microscope, fitted with double rack and pinion coarse and fine screw focussing adjustment triple revolving nosepiece, swing out Abbe condenser with spiral underfitting, plano and concave mirror with 2 Beck achromatic objectives ⅔rd and ⅙th, and eyepiece, in polished mahogany case. Cost £20. **£5 : 10 : 0**

Koristka Greenough dissecting Binocular Microscope, with Parro prisms giving erect image, horseshoe foot at an angle of 90°, rack focussing adjustable for distance of observer's eyes, detachable arm rest fitted to 4" square stage, 1½" and ½" openings and fitted Dermatiscope base, 4 pairs eyepieces and objectives 54, 35, 44, and 27 mm., one pair 25 mm Plankton objectives, in new condition **£50 : 0 : 0**

INSTALMENTS TO SUIT YOUR CONVENIENCE.

Your own apparatus accepted in part or whole exchange.

The CITY SALE & EXCHANGE, Ltd.,
81 Aldersgate Street, London, E.C.1

NATURE for August 7, containing the Presidential Address of H.R.H. the Prince of Wales to the British Association, and Summaries of the Addresses of the Presidents of the Sections, can be sent to residents in the British Isles on receipt of 1s. 1½d., or to residents abroad on receipt of 1s. 2d.

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals, General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"*This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale.*"
NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

ADLARD & SON
LIMITED

SCIENCE PRINTERS.

Home and Export.

23 Bartholomew Close, London, E.C.1.

BY DR. T. S. P. STRANGEWAYS

The Technique of Tissue Culture 'in Vitro.' Illustrated Demy 8vo, cloth. **7s. 6d.** net. Postage 6d.

Tissue Culture in Relation to Growth and Differentiation. Illustrated with collotype plates. Crown 8vo, cloth. **6s.** net. Postage 4d.

"A model of clearness"—*Eugenics Review*

W. HEFFER & SONS, LTD., CAMBRIDGE, ENGLAND
And of all Booksellers

NATURAL SCIENCE
BOOKS AND PERIODICALS
INCLUDING THE PUBLICATIONS
OF THE LEARNED SOCIETIES

CATALOGUES GRATIS LIBRARIES PURCHASED

BERNARD QUARITCH LTD.
11 Grafton Street, New Bond Street, London, W.1

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

GERMAN BOOKS
AND PERIODICALS
supplied by
W. MULLER, Foreign Bookseller,
26 Hart Street, Bloomsbury, London, W.C.1
References in all countries.

MAORI SYMBOLISM

The Origin, Migration, and Culture of the New Zealand Maori

By ETTIE A. ROUT. With 32 plates and 18 text illustrations. Royal 8vo, 21s. net.

Preface by SIR ARBUTHNOT LANE, C.B., M.S.

Compiled from material supplied by Hohepa Te Rake, an Arawa noble, this volume surveys Maori civilization from the inside. Sir Arbuthnot Lane, in his long Preface, calls the book "one of the most valuable reports ever prepared regarding the natural mode of life of mankind." Full sections are devoted to Health and Race Culture, to Social Organization, and to Agriculture and Building.

The Babbitt Warren: A Survey of Modern Civilization. By C. E. M. JOAD, author of "Thrasymachus" With numerous illustrations from contemporary American life and manners, the author shows that American civilization is degenerate and degenerating. 6s. net.

The Borderland of Music and Psychology. By FRANK HOWES. Preface by Sir HUGH ALLEN. "May be recommended without reserve. . . . He attacks some of the most elusive problems in music with the aid of a mastery of modern psychological science. . . . As uncommonly well reasoned as it is refreshingly well written."—*Morning Post.* 6s. net.

Primitive Trade: its Psychology and Economics. By Professor E. E. HOYT. "Dr. Hoyt, in this all-too-short essay, makes her points with extreme clearness, and deserves the thanks of the student, whether anthropology, psychology, or economics be his primary interest."—*Times Literary Supplement.*

Sex in Man and Animals. By JOHN R. BAKER, Department of Zoology, University Museum, Oxford. Preface by Professor JULIAN S. HUXLEY. For the general public as well as for students of biology and medicine. An up-to-date account of the main facts and theories of sexual reproduction. 7s. 6d. net.

Psychology and Education. By Professor R. M. OGDEN. A valuable application of the important "Gestalt" psychology to the problems of education which should be read in conjunction with Kohler's "Mentality of Apes" (16s. net) and Koffka's "Growth of the Mind" (Sec. Imp., 15s. net). 12s. 6d. net.

Modern Psychology and Education: a Text-book of Psychology for Students. By MARY STURT, M.A., and E. C. OAKDEN, M.A. In the Foreword, the Warden of Goldsmiths' College writes: "The educated public desire to have the essentials of the subject placed before them in a readable form. Such readers will find what they want in this book. Indeed, I do not know where a better one is to be found."

LIBRARY OF PSYCHOLOGY

Three New Volumes.

This library, edited by C. K. OGDEN, in which nearly fifty volumes are now available, gives expression to the remarkable developments occurring in Psychology and its allied sciences.

Latest Volumes.

Psychology and Ethnology. By W. H. R. RIVERS, M.D., Litt.D., F.R.S. Preface by Professor G. ELLIOT SMITH, F.R.S. An important collection of hitherto inaccessible papers by Dr. Rivers on psychological, medical, anthropological and general subjects, including several on the "Diffusion" hypothesis. 15s. net.

Theoretical Biology. By J. VON UEXKULL. An application of Kant's philosophy to the problems of biology, a stringent criticism of the materialistic teaching of the extremer Darwinians. 12s. 6d. net.

Crime and Custom in Savage Society. By B. MALINOWSKI. "It is probably no exaggeration to say that the book is the most important contribution to anthropology for many years. Its effects are bound to be far-reaching. It should be read by everyone."—*Outlook.* 5s. net.

Full Prospectus on Application.

THE BROADWAY TRAVELLERS

A new series, containing translations and reprints of the best travel books of all countries and all ages. Full prospectus on application. Edited by Sir E. DENISON ROSS and EILEEN POWER.

[First Three Volumes.]

Travels and Adventures of Pero Tafur (1435–1439). Translated and edited from the Spanish by MALCOLM LETTS. This narrative of the travels of a Castilian knight in Europe and the Near East has been unduly neglected. Tafur was a person of outstanding qualities, who tells us nothing but the plain truth, while his shrewdness and dry humour give to his book a welcome and unusual quality of freshness. With 8 plates. 12s. 6d. net.

Don Juan of Persia, a Shi'ah Catholic (1560–1604). Translated and edited from the Castilian, with an Introduction by GUY LE STRANGE. The author was a Persian Moslem who became a Spanish Roman Catholic. During his long journey from Isfahan to Valladolid he kept a careful diary. With 3 maps. 12s. 6d. net.

Akbar and the Jesuits. Translated from the "Histoire" of Father Pierre du Jarric, S.J., with an Introduction by C. H. PAYNE. This compilation of Jesuit letters from the East is not only highly entertaining, but of special historical importance regarding the history of Akbar. With 8 plates. 12s. 6d. net.

Full Prospectus on Application.

THE HISTORY OF WITCHCRAFT

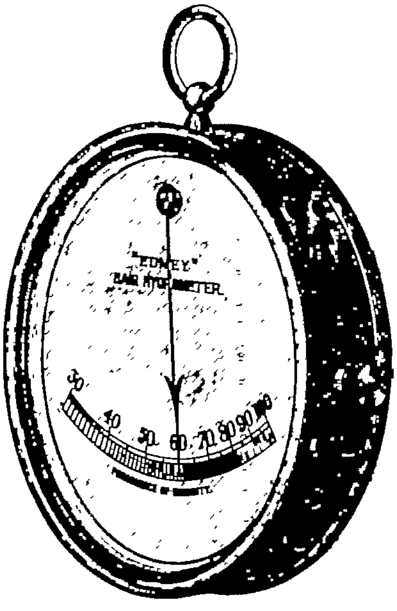
By MONTAGUE SUMMERS. With 8 plates. Royal 8vo, 12s. 6d. net.

This is the first comprehensive volume on Witchcraft to appear for many years. Mr. Summers includes every manifestation of malign occult art. The immodesty of the witch-cult is not shunned. The witch is revealed in her true colours as a social pest and parasite, the devotee of an obscene creed, a bawd, an abortionist, and a minister to vice and corruption. A very full Bibliography is included.

ROUTLEDGE : : KEGAN PAUL
Broadway House, 68-74 Carter Lane, London, E.C.4

"Edney" Hair Hygrometers

showing directly the
PERCENTAGE of MOISTURE
in the room or other position where placed



No. 1

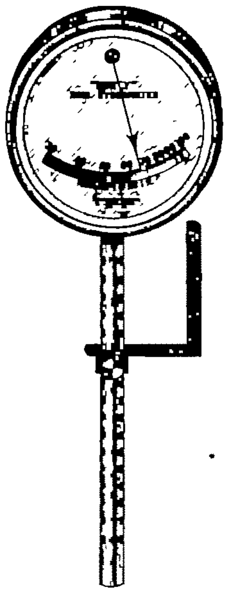
THE instruments are strongly made, and mounted in stout polished and lacquered brass cases, with 5-inch engraved and silvered metal dials which give a very open range, allowing the variations in humidity to be easily observed.

The action is by the contraction or expansion of a strand of 50 specially treated human hairs, which alters in length according to the percentage of moisture in the atmosphere.

This movement is conveyed by simple mechanism to a pulley on which the indicating hand is fixed.

Each instrument is tested against Standard Wet and Dry Bulb thermometers, and is guaranteed to give accurate readings.

A small adjusting screw is provided so that at any time the hand can (if required) be set to a standard.

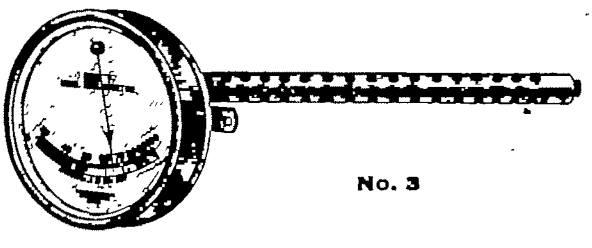


No. 2

GUARANTEED ACCURATE

PRICES

No. 1 Pattern, for hanging in a room, complete	**£2:2:0**
No. 2 Pattern, for fixing to wall, with bracket, 12-inch stem, complete	**£2:15:0**
No. 3 Pattern, for passing through a door or wall, to show humidity of room without opening the door, 12-inch stem, complete	**£2:15:0**



No. 3

SAFE DELIVERY FREE

Illustrated Descriptive List of above and other patterns of Hygrometers, also Hygrographs and Thermographs, post free from the Sole Manufacturers:

PASTORELLI & RAPKIN LTD.

Established 1750. Contractors to various Departments of H.M. Government.

Actual Makers also of Thermometers, Barometers, Barographs, Hydrometers, and Standard Meteorological Instruments.

46 HATTON GARDEN, LONDON, E.C.1.

Telephone: Holborn 1981] *Any instrument sent on approval if desired* [*Telegrams:* Rapkin, London

Carriage paid and safe delivery guaranteed of all instruments within the British Isles.

Messrs. Longmans & Co.'s List

THE ASCENT OF MAN

By Means of Natural Selection.

By ALFRED MACHIN. 8vo. **7s. 6d.** net.

"In a few eloquent final paragraphs he foreshadows a new gospel founded on evolution, which will reject the metaphysical doctrines of the religions, agree with them in their insistence on 'love and righteousness,' but have a larger view of the need for beauty and recreation."—*Times Literary Supplement.*

"The book is well written and will be a valuable addition to the shelves of any biological library."
Quarterly Review of Biology (U.S.A).

THE NERVOUS MECHANISM OF PLANTS.

By Sir JAGADIS CHUNDER BOSE, M.A., D.Sc., LL.D., C.S.I., C.I.E., F.R.S., Director, Bose Research Institute, Calcutta.
With 82 Illustrations. 8vo. **16s.** net.

PRACTICAL PHYSICAL CHEMISTRY.

By ALEXANDER FINDLAY, M.A., D Sc., F.I.C.
With 117 Illustrations. Crown 8vo. **7s. 6d.** net.

TABLES OF PHYSICAL AND CHEMICAL CONSTANTS AND SOME MATHEMATICAL FUNCTIONS.

By G. W. C. KAYE, O.B.E., M.A., D.Sc., F.Inst.P., and T. H. LABY, M.A., Sc.D., F.Inst.P.
Fifth Edition. Royal 8vo. **14s.** net.

PRACTICAL ORGANIC AND BIOCHEMISTRY.

By R. H. A. PLIMMER, D.Sc.(Lond.), Professor of Chemistry in the University of London at St. Thomas's Hospital Medical School.
New Edition. 8vo. **21s.** net.
In this Edition the theoretical part of Organic Chemistry has been extended and every chapter has been revised.

MONOGRAPHS ON PHYSIOLOGY.

Edited by PROFESSOR E. H. STARLING, C.M.G., M.D., F.R.S.

CARBOHYDRATE METABOLISM AND INSULIN.

By JOHN JAMES RICKARD MACLEOD, F.R.S., M.B.(Abdn.), D.Sc. (Hon.) (Toronto), LL.D., Professor of Physiology, University of Toronto.
With Illustrations. 8vo. **18s.** net.

THE SECRETION OF THE URINE.

By ARTHUR R. CUSHNY, M.A., M.D., LL.D., F.R.S., late Professor of Materia Medica and Pharmacology in the University of Edinburgh.
New and Revised Edition. With Diagrams. 8vo. **16s.** net.

WATTS' DICTIONARY OF CHEMISTRY.

Revised and entirely rewritten by M. M. PATTISON MUIR, M.A., F.R.S.E., and H. FORSTER MORLEY, M.A., D.Sc., Assisted by Eminent Contributors.
Four Volumes. 8vo. **£6 16s. 6d.** net.

NEW EDITION OF THORPE'S DICTIONARY OF CHEMISTRY.

A DICTIONARY OF APPLIED CHEMISTRY.

By Sir EDWARD THORPE, C.B., LL.D., F.R.S. Assisted by Eminent Contributors.
New Edition. In Seven Volumes. With Illustrations. Royal 8vo.

Vol. I. A to Calcium. **60s.** net.
Vol. II. Calculi to Explosion. **60s.** net.
Vol. III. Explosives to Kyrofin. **60s.** net.
Vol. IV. L to Oxydisulin. **60s.** net.
Vol. V. Oxygen to Rye. **60s.** net.
Vol. VI. S-Acid to Tetryl. **60s.** net.
Vol. VII. Thalenite to Z, with a full Index to the complete work. [*In the Press.*]

LONGMANS, GREEN & CO., LTD., 39 Paternoster Row, LONDON, E.C.4

McGRAW-HILL AUTUMN ANNOUNCEMENTS

NOW IN PRESS—READY SOON

BASIC MATERIAL FOR A PHARMACEUTICAL CURRICULUM. Charters.
INTERNATIONAL CRITICAL TABLES—Volume 2.
TEXTBOOK OF COMPARATIVE PHYSIOLOGY. Rogers.
KINETIC THEORY OF GASES. Loeb.
ENGINEERING METALLURGY. Stoughton and Butts.
CIRCUIT THEORY AND OPERATIONAL CALCULUS. Carson.
CONCRETE PRACTICE. Hool.
STEAM AND GAS TURBINES. Stodola.
THE SEWAGE PROBLEM. Fuller.
HANDBOOK FOR PROSPECTORS. Von Bernewitz.
BREEDING AND IMPROVEMENT OF FARM ANIMALS. Rice.
HYDROUS OXIDES. Weiser.
INDUSTRIAL SAFETY ORGANIZATION. De Blois.
MANUAL OF PLANT DISEASES. Heald.
COMPOUND INTEREST AND ANNUITY TABLES. Kent.
METALLOGRAPHIC RESEARCHES. Benedict.
MINE VENTILATION. Weeks.
CHEMISTRY OF CELLULOSE AND WOOD. Schorger
REPAIR SHOP DIAGRAMS AND CONNECTING TABLES. Braymer and Roe.

A FEW IMPORTANT BOOKS RECENTLY ISSUED

HANDBOOK OF NON-FERROUS METALLURGY. By Donald M. Liddell. Two Volumes.	1440 pages.	**60s. 0d.** net
CORROSION: CAUSES AND PREVENTION. By Frank N. Speller.	621 pages.	**30s. 0d.** net.
FUELS AND THEIR COMBUSTION. By R. T. Haslam and R. P. Russell.	807 pages.	**37s. 6d.** net.
CITRUS DISEASES AND THEIR CONTROL. By H. S. Fawcett and H. A. Lee.	582 pages.	**25s. 0d.** net.
INTRODUCTORY ELECTRODYNAMICS FOR ENGINEERS. By E. Bennett and H. M. Crothers.	655 pages.	**22s. 6d.** net.
ECONOMIC GEOGRAPHY OF SOUTH AMERICA. By R. H. Whitbeck.	430 pages.	**17s. 6d.** net.
INDUSTRIAL STOICHIOMETRY. By W. K. Lewis and A. H. Radasch.	175 pages	**12s. 6d.** net.
HYDRAULICS. By Joseph N. LeConte.	348 pages	**15s. 0d.** net.
MATHEMATICS FOR ENGINEERS. By R. W. Dull.	780 pages.	**25s. 0d.** net.
STEEL STRUCTURES—**Stresses in Simple Structures.** By L. C. Urquhart and C. E. O'Rourke.	278 pages.	**17s. 6d.** net.
ANIMAL ECOLOGY. By A. S. Pearse.	417 pages	**20s. 0d.** net
ROOT DEVELOPMENT OF FIELD CROPS. By J. E. Weaver.	290 pages	**15s. 0d.** net.
PRACTICAL COAL PRODUCTION—**Preliminaries of Coal Mining.** By Frank H. Kneeland.	419 pages.	**15s. 0d.** net.
PRACTICAL COAL PRODUCTION—**Getting out the Coal.** By Frank H. Kneeland.	403 pages.	**15s. 0d.** net
PRACTICAL COAL PRODUCTION—**Mine Transportation and Market Preparation.** By Frank H. Kneeland.	354 pages	**15s. 0d.** net.
PLANE TRIGONOMETRY. By L. L. Smail	246 pages.	**11s. 3d.** net

⁂ *We shall be pleased to send full details of any of the above books.*

McGRAW-HILL PUBLISHING CO. LTD.
6 BOUVERIE STREET, LONDON, E.C.4.

G. Bell & Sons

Vacuum Practice

L. Dunoyer

The first volume of the new series of "International Textbooks of Exact Science." *Science Progress* says: "Will be welcomed by all interested in the subject . . . The treatment is lucid and the volume abounds with practical information."

236 pp. Illustrated. 12*s.* 6*d. net.*

The Structure of the Atom

E. N. da C. Andrade, D.Sc.

A new revised and augmented edition of this book will be issued shortly.

Illustrated. About 21s. net.

Old Trades and New Knowledge

Sir William Bragg

Comprising the author's 1925–26 Royal Institution Christmas Lectures. Uniform with "Concerning the Nature of Things" and "The World of Sound." (Shortly.)

Crown 8vo. Illustrated. 8*s.* 6*d. net.*

An Introduction to Industrial Chemistry

S. I. Levy, Ph.D., F.I.C.

With an Introduction by Sir W. J. Pope, K.B.E., D.Sc., F.R.S. "The author has broken entirely new ground, and we fancy that this 'Industrial Chemistry' will soon become indispensable in all university courses in Chemistry."—*Journal of Education.*

402 *pp. Illustrated.* 15*s. net.*

Organic Chemistry

Historical, Structural, Economic

John Read, M.A., B.Sc.

Professor of Chemistry, University of St. Andrews.

"A well-proportioned treatment of this branch of science. . . . Deserves the careful attention of teachers."—*Times Educational Supplement.*

692 *pp.* 87 *Illustrations.* 12*s.* 6*d. net.*

YORK HOUSE, PORTUGAL STREET, LONDON, W.C.2

Blackie's Applied Physics Series

OPTICAL MEASURING INSTRUMENTS. **Their Construction, Theory, and Use.** By L. C. Martin, F.R.A.S., D.Sc., A.R.C.S., D.I.C., Lecturer in the Optical Engineering Department, Imperial College of Science and Technology, South Kensington. x+270 pp., with 172 figures. **17s. 6d.** net.

COLOUR AND METHODS OF COLOUR REPRODUCTION. By L. C. Martin, F.R.A.S., D.Sc., A.R.C.S., D.I.C. With Chapters on **Colour Printing and Colour Photography** by William Gamble, F.R.P.S., F.O.S. xiv+187 pp., with 73 figures and 3 plates, 2 of which are in colour. **12s. 6d.** net.

PHOTOGRAPHY AS A SCIENTIFIC IMPLEMENT. A collective work. viii+550 pp., with 258 figures in line and half-tone. Second Impression. **30s.** net.

Professor A. E. Conrady, A.R.C.S. PHOTOGRAPHIC OPTICS —Charles Rundle Davidson, F.R.A.S. ASTRONOMICAL PHOTOGRAPHY.—Charles R. Gibson, F.R.S.E. HISTORY OF PHOTOGRAPHY.—William B. Hislop. PHOTOGRAPHY IN PRINTING.—Squadron Leader F. C. V. Laws, O.B.E., F.R.P.S., R.A.F. AERONAUTICAL PHOTOGRAPHY.—John Henry G. Monypenny. PHOTOGRAPHY IN THE ENGINEERING AND METALLURGICAL INDUSTRIES.—H. Moss, D.Sc.(Lond.), A.R.C.S., D.I.C. PHOTOGRAPHY IN PHYSICS.—Arthur S. Newman. THE TECHNICS OF KINEMATOGRAPHY.—George H. Rodman, M.D., Hon. F.R.P.S. PHOTOMICROGRAPHY.—S. E. Sheppard, D.Sc.(Lond.), F.C.S. THE ELEMENTARY OPTICS OF PHOTOGRAPHY; THE THEORY OF PHOTOGRAPHIC PROCESSES AND METHODS.—W. L. F. Wastell, F.R.P.S. COLOUR PHOTOGRAPHY.—Wilfred Mark Webb, F.L.S., F.R.M.S. THE CAMERA AS WITNESS AND DETECTIVE.—Colonel H. S. L. Winterbotham, C.M.G., D.S.O. PHOTOGRAPHY IN SURVEYING

MECHANICAL PROPERTIES OF FLUIDS, THE. An Account of Recent Engineering Research. A collective work. xvi+362 pp., with 159 illustrations. Second Impression. **20s.** net

Engineer Vice-Admiral Sir George Goodwin, K.C.B., LL.D., late Engineer-in-Chief of the Fleet. INTRODUCTION.—Allan Ferguson, M.A., D.Sc.(Lond.). LIQUIDS AND GASES.—Professor Horace Lamb, LL.D., Sc.D., F.R.S. MATHEMATICAL THEORY OF FLUID MOTION.—A. G. M. Michell, M.C.E. VISCOSITY AND LUBRICATION.—Professor A. H. Gibson, D.Sc. STREAM-LINE AND TURBULENT FLOW.—PHENOMENA DUE TO THE ELASTICITY OF A FLUID.—HYDRODYNAMICAL RESISTANCE AND DYNAMICAL SIMILARITY.—G. I. Taylor, M.A., F.R.S. THE DETERMINATION OF STRESSES BY MEANS OF SOAP FILMS.—A. E. M. Geddes, O.B.E., M.A., D.Sc. WIND STRUCTURE.—C. V. Drysdale, D.Sc. SUBMARINE SIGNALLING AND TRANSMISSION OF SOUND THROUGH WATER.—F. R. W. Hunt, M.A. THE REACTION OF THE AIR TO ARTILLERY PROJECTILES.

FUEL AND REFRACTORY MATERIALS. By A. Humboldt Sexton, F.I.C., F.C.S. **New Edition,** completely revised and enlarged by W. B. Davidson, D.Sc., Ph.D., F.I.C. viii+382 pp., with 111 figures. **12s. 6d.** net.

ELECTRICITY AND ITS PRACTICAL APPLICATIONS. A Text-book of Electrical Engineering. By Magnus Maclean, D.Sc., LL.D., F.R.S.E., M.I.E.E. **New Edition,** with new chapter on Alternating Currents. xiv+528 pp., with 374 figures. **10s. 6d.** net

METEOROLOGY: An Introductory Treatise. By A. E. M. Geddes, O.B.E., M.A., D.Sc., Lecturer in Natural Philosophy in the University of Aberdeen. xx+390 pp., with 4 coloured plates, 16 half-tones, 103 figures, 11 charts, and 20 tables **21s.** net.

Full particulars of above books on application.

BLACKIE & SON, LTD.

50 OLD BAILEY, LONDON, E.C.4.

A Selection from

H. F. & G. WITHERBY'S
AUTUMN LIST

GENERAL

Tribal Dancing and Social Development
By W. D. HAMBLY, B.Sc.(Oxon). Demy 8vo. Photographs, Sketches and a Map. 21s. net.

Records of Birds bred in Captivity
By EMILIUS HOPKINSON, C.M.G., D.S.O., F.Z.S., M.B O.U. Demy 8vo. 15s. net.

By-ways of the Tropic Seas
Wanderings among the Solomons and in the Malay Archipelago. By HERMANN NORDEN. Demy 8vo. Photographs and Maps. 16s. net.

The "Arcturus" Adventure
An Account of an Oceanographic Expedition By WILLIAM BEEBE. Royal 8vo. 77 Coloured and other Plates. 25s. net.

Deep Sea Days
The Chronicles of a Sailor and Sea-Painter. By THOMAS M. HEMY. Demy 8vo. With Sketches by the Author. 12s. 6d. net.

The Diamond Trail
An Account of Travel among the little known Bahian Diamond Fields of Brazil. By HUGH PEARSON, M.I.M M., M.I.P.T., F.R.S.A. Demy 8vo With Photographs and a Map. 12s. 6s. net.

Sierra Leone in History and Tradition
By CAPTAIN F. W. BUTT-THOMPSON. Demy 8vo. Photographs and a Map. 15s. net.

Kilts Across the Jordan
Being Experiences and Impressions with the 2nd Battalion "London Scottish" in Palestine. By BERNARD BLASER. With Preface by Field-Marshal Viscount ALLENBY, G.C.B., G.C.M.G. Demy 8vo. Photographs and 2 Maps. 8s. 6d. net.

TECHNICAL

The Use of Power in Colliery Working
A Treatise on Mining Costs and Machinery Designs and Management. By J. KIRSOPP, M.I Min.E., M.I.M.E , M.I.&S.Inst , F.G.S. Royal 8vo. Photographs and Diagrams. 40s. net.

Coal and Allied Subjects: Compendium I of the First Ten Bulletins, and Compendium II of Bulletins Eleven to Sixteen. Issued by The Lancashire and Cheshire Coal Research Association. Crown 8vo Illustrated. Each 15s. net.

Low Temperature Carbonisation of Bituminous Coal
By ANDREW McCULLOCH, A I.C , A.M C T., and NEVILLE SIMPKIN, M.Sc.(Tech), A I C. Medium 8vo. With numerous Illustrations. 18s. net.

Wire Drawing and the Cold Working of Steel
By ALASTAIR T ADAM, A.R.T.C. (Metallurgist, Messrs. Bruntons, Musselburgh) Crown 4to. 40s. net.

A Course of Metallurgy for Engineers
By F. C THOMPSON, D.Met , B Sc Demy 8vo With numerous Photographs and Diagrams. 25s. net.

326 HIGH HOLBORN, LONDON, W.C.1

Just Published

EVOLUTION AND RELIGION IN EDUCATION

By Professor HENRY FAIRFIELD OSBORN, President of the American Museum of Natural History. 7s. 6d. net.

Professor Osborn's book, which sets forth the reasoned and tempered views of a great evolutionist who is also a religionist, comes at the appropriate moment. It presents the enlightening and clarifying essays and addresses which he has lately offered in the hope of resolving a vexed situation, such as "Crossing Swords with the Fundamentalists," "Evolution and Religion," "The Credo of a Naturalist," "The Tennessee Trial," "How to Teach Evolution in the Schools," "A New Basis of Creative Evolution," and "The Earth Speaks to Bryan"

Prospectus of Professor Osborn's Works sent free on request.

OUR MOBILE EARTH

By REGINALD DALY, Head of the Department of Geology in Harvard University With many photographs, diagrams and maps. 21s. net.

What is known of the earth's crust and the secrets of nature below it? Science has penetrated the reaches of outer space and the remote past, but the interior of the familiar earth is still for the most part more of a mystery than Betelgeuse or the Stone Age. "Our Mobile Earth" tells all that is known of the crust of the earth, its origin and structure; of earthquakes, of how the continents were formed; of how the mountain chains came into being—all the successive steps of nature in the making of the habitable world.

CHARLES SCRIBNER'S SONS

7 BEAK STREET, LONDON, W.1

Journal of Scientific Instruments

(Published on the 15th day of each month.)

PRODUCED BY THE INSTITUTE OF PHYSICS, WITH THE CO-OPERATION OF THE NATIONAL PHYSICAL LABORATORY.

PRICE: SINGLE COPIES, 2s. 6d. ANNUAL SUBSCRIPTION, 30s., including postage. Send subscriptions to the CAMBRIDGE UNIVERSITY PRESS, Fetter Lane, London, E.C 4.

CONTENTS OF SEPTEMBER ISSUE.—VOL III , No 12

SOUND PULSE PHOTOGRAPHY AS APPLIED TO THE STUDY OF ARCHITECTURAL ACOUSTICS. By A. H. DAVIS and N FLEMING.

THE USE OF THE HOT WIRE DETECTOR IN DETERMINING THE PATH OF VORTICES. By E. TYLER.

ON THE TECHNIQUE OF MAKING THIN CELLULOID FILMS. By JAMES TAYLOR.

THE USE OF GLASS ELECTRODES. By PHYLLIS M. TOOKEY KERRIDGE.

ON SOME SENSITIVE REFLECTING FLOW-METERS. By R. M. ARCHER

NEW INSTRUMENTS.

LABORATORY AND WORKSHOP NOTES.

REVIEW.

TABULAR INFORMATION ON SCIENTIFIC INSTRUMENTS: XII. PERMANENT MAGNET VOLTMETERS AND AMMETERS.

INDEX TO VOLUME III.

This journal is devoted to the needs of workers in every branch of science and manufacture involving the necessity for accurate measurements. Its scope includes Physics and Chemistry, Optics and Surveying, Meteorology, Electrical and Mechanical Engineering, Physiology and Medicine.

Volume IV. commences with the October number. This volume only will contain 15 parts and the Annual Subscription will be 37s 6d. Vols. I., II and III. can be obtained complete, bound in cloth, for 35s. each

Supplement to NATURE

No. 2972 OCTOBER 16, 1926

Our Bookshelf.

Ability and Behaviour.

Ability: a Psychological Study. By Victoria Hazlitt. Pp. ix+147+2 plates. (London: Methuen and Co., Ltd., 1926.) 6s. net.

PART 2 records three years' work on "tests for special abilities in the work for Arts and Science degrees." Part 1, the result of the author's consideration of current theories of 'intelligence,' capacity and ability in the light of this work, is a capable analytic treatment of these theories coupled with an interesting new synthesis. General capacity is inborn: special abilities are developed. "The original endowment may be used in a number of ways. However it is used, it will lead to the development of special abilities" (p. 74). Prof. Spearman's 'engines' are not innate but acquired.

The construction of tests is easier in science than in arts. This is due to two causes. First, the practical work necessary in all sciences constitutes common ground which is readily tested. Secondly, special arts abilities are intrinsically more difficult to test because "the material of the natural sciences is less complex than that of the humanities" (p. 144). Still, three tests, successful in diagnosing arts ability, have been found, and results obtained support "the hypothesis that good general intelligence is more necessary for work in the Arts faculty than for work in the Science faculty" (p. 144). R. J. B.

Brains of Rats and Men: a Survey of the Origin and Biological Significance of the Cerebral Cortex. By Prof. C. Judson Herrick. Pp. xiii+382. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1926.) 15s. net.

IN this book Prof. Herrick attempts to interpret the behaviour of rats and men in terms of cerebral anatomy. In the present state of our knowledge, any satisfactory solution of this interesting but immensely difficult problem is obviously unattainable. Nevertheless, it is a fascinating occupation to wander in the borderland between brain and mind and collect stray ideas as to possible points of contact.

The book may be of value to the student of psychology and the general reader. For those who are ignorant of such matters it provides an easily understood introduction to certain aspects of the comparative anatomy of the brain, in particular the cerebral cortex, and the results of an interesting series of experiments on the behaviour of rats, with tentative suggestions as to how and why some of the activities of the brain should express themselves as mental phenomena.

The book is, however, too elusive to be of much use to the serious student. This is due not solely to the fact that the author overuses vague phrases until they become little more than meaningless catchwords, but even more to his neglect of the fundamental conceptions of neural physiology that are associated with the names of Hughlings Jackson, Sherrington, Head, and Magnus, among many others, which represent the essential principles for the interpretation of animal behaviour. The inhibitory influence of the cerebral cortex and the phenomena due to the release of its control, the regulation of posture and the amazing perfection of the automatic mechanisms for controlling the attitude of the body, and in particular the conception of a hierarchy of neural levels upon each of which a different kind of functional result is achieved—these are all matters that are of primary importance for the interpretation of animal behaviour in neurological terms, which are not given due consideration in this book. In particular, however, the chief criticism of Prof. Herrick's fascinating attempt to give a biological explanation of mental phenomena is his failure, when using his terminology, to appreciate the full significance of Sir Charles Sherrington's contribution to the general fund of knowledge of such matters.

Manners and Customs.

Le monde islamique. Par Max Meyerhof. (Bibliothèque générale illustrée, No. 3.) Pp. 80+59 planches. (Paris: F. Rieder et Cie, 1926.) 15 francs.

THIS little book aims at extending among the general public a knowledge of the origin, the character, and the extent of Islam—a civilisation which, as the author says, is composed of the most heterogeneous elements, and yet is not without a certain unity. To this unity has been added since the War an element of hostility towards European control and intervention which is very real, even though its effect as a consolidating force may have been exaggerated in some degree. M. Meyerhof's treatment has necessarily been very summary, and of his sixty-eight pages, nearly half is devoted to an analysis of the recent course of political events. In these, pan-Islamism and the racial movement tend to obscure undercurrents of opinion which have been potent forces in counteracting the movement towards unity. Admirable as is M. Meyerhof's sketch of Moslem religion and culture within the very restricted limit imposed by the nature of the popular series of which his book forms a part, it would have gained still further as a picture of actual conditions had he given a more systematic account of the divisions in the Mohammedan faith which set one sect over against another. Apart from this, it is a clear and lucid introduction to an understanding of one of the grave world problems of the day.

The Southern New Hebrides: an Ethnological Record. By C. B. Humphreys. Pp. xvi+214. (Cambridge: At the University Press, 1926.) 12*s.* 6*d.* net.

ANTHROPOLOGISTS will be grateful to Mr. Humphreys for this ethnological record of the Southern New Hebrides for two reasons. Very little systematic work has been done on this interesting little group of five islands, if Speiser's work on the New Hebrides as a whole be excepted; and, as everywhere in the Pacific, changing conditions make it imperative that ethnological investigations should be pushed on before it is too late. Sophisticated as the natives of the New Hebrides are through their contact with Europeans, Mr. Humphreys was fortunate enough to find a few old men who still retained a memory of old customs. How important and how fortunate this was is attested by the intricate and somewhat puzzling character of the culture, especially on the island of Tanna. Mr. Humphreys puts forward a very interesting hypothesis to account for the differences in the form of the chieftainship in that island, the nebulous form of totemism found in the group, the variations in the cephalic index, and other physical characters as well as other peculiarities. It is difficult to suggest an alternative, and Mr. Humphreys' hypothesis must for the present hold the field; but it involves an exceptional history for the island of Tanna for which it is hard to account satisfactorily.

Natural History.

British Spiders: their Haunts and Habits. By Theodore H. Savory. Pp. xxi + 180. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 6*s.* net.

IN recent years, both in England and America, various attempts have been made by writers on the habits of spiders to direct the attention of the budding naturalist to a group of animals little studied, though everywhere abundant. But when interest has been aroused and the reader has been tempted to pursue the matter further and attain to a more intimate acquaintance with these curious creatures, he finds himself at a loss. The would-be student of butterflies or birds has his way made plain before him by a multitude of more or less satisfactory handbooks, but the books which deal in detail with the British spider fauna are either antiquated or unprocurable, or both.

Mr. Savory's book will help the aspiring araneologist at least one step on his way; and we have little doubt that it will be received with the hearty welcome it deserves.

Mr. Savory's main object being 'first aid' in the identification of specimens, he might perhaps have 'cut the cackle and come to the horses' a trifle more quickly. We by no means imply that the 'cackle' is not excellent, or that it is a mere imitation of previous prattlers—Mr. Savory is a keen observer on his own account—but, presumably, his greatest appeal will be to those who already know something of the biological side of the subject and are impatient to get to business. We heartily approve his plan of giving, where possible, the Blackwallian names of species, and thus rendering available Miss Staveley's book with its excellent reproductions of Blackwall's coloured figures—a book which he informs us is still obtainable. Savory plus Staveley should be a real help forward.

The illustrations of the book before us are its chief weakness. The figure of *Segestria senoculata* (Fig. 13) is really too crude, and Fig. 18 gives *Walcknæria acuminata* ten eyes! Then an accurate detailed drawing of the chelicerae seems absolutely necessary. Without it, how is the student to interpret such terms as "primary fang teeth" and "lower margin of the chelicerae" used in the dichotomic tables? We venture to direct attention to these slight blemishes in view of future editions, for which we anticipate a demand.

C. W.

Index Kewensis Plantarum Phanerogamarum. Supplementum Sextum: *Nomina et Synonyma Omnium Generum et Specierum ab initio anni MDCCCCXVI usque ad finem anni MDCCCCXX nonnulla etiam antea edita complectens.* Ductu et consilio A. W. Hill. Pp. iii + 222. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 70*s.* net.

THE appearance of a new supplement to the "Index Kewensis" is matter for rejoicing among botanical taxonomists, on whose behalf we thank the Director and the members of the Herbarium staff who have brought the record of names and synonyms of genera and species of flowering plants up to the end of 1920. The present supplement nominally deals with the years 1916–1920, but also includes many names unavoidably omitted from publications issued in 1914 and 1915, and also earlier names which have been traced since the publication of the original work and its successive supplements. One of the latter, "Stilla," W. Young (1783), followed by the remark 'nomen. Quid?' raises a question as to the desirability of indexing *nomina nuda*. Taxonomically they do not exist; they are neither 'names' nor 'synonyms,' and space would be saved by their omission. A certain French botanist is credited (?) with one or more in almost every other column.

It would be ungrateful, however, to cavil at so trivial a matter in a periodical of such interest; for the "Kew Index" makes as interesting reading as does a good dictionary; at any rate for the taxonomist who takes his work seriously. He may, for example, speculate as to what proportions of the entries in the columns represent genuine botanical work, and what are mere exercises in nomenclature; and as to whether the round-table conference between taxonomists at the recent Botanical Congress at Ithaca will prove a step forward towards the attainment of uniformity in nomenclature. The restoration of names which had been neglected or overlooked by earlier workers is responsible for a large number of entries, especially on behalf of American botanists; these are indicated by citation of the earlier name following the entry.

The "Index" records impartially foibles and follies and the results of honest work, and it brings to the notice of botanists rare and obscure publications. One of the latter (erroneously dated 1889) has yielded two and a half columns of names, credited almost entirely to one individual, under the genus Cinnamomum; a somewhat surprising entry is "*Crucifera*—genus omnia genera *Cruciferarum* amplectens"; while the immortality of a foolish action is illustrated by the first item in the volume, "AA," under which genus several recent species are recorded. A. B. R.

Goldfish Culture for Amateurs: How to Breed and Rear Goldfish in Aquaria and Ponds. By A. E. Hodge and Arthur Derham. Pp. xi + 103 + 11 plates. (London: H. F. and G. Witherby, 1926.) 5*s.* net.

THIS small book describes a dozen or so of the varieties of goldfish and gives very clear and complete instructions for breeding and rearing them in aquaria. It deserves to be widely read, partly because the goldfish has in the past probably suffered more than any other domesticated creature from neglect, ignorance, and mistaken kindness, and partly because the authors show, in convincing fashion, that their cultivation is of great fascination. Moreover, considerable scientific interest attaches to an animal able to produce such remarkable mutations. This book may well inspire research into the origin and genetic relations of these varieties, with the possibility of results of unexpected value.

Birds in England: an Account of the State of our Bird-Life and a Criticism of Bird Protection. By E. M. Nicholson. Pp. xi + 324 + 8 plates. (London: Chapman and Hall, Ltd., 1926.) 12*s.* 6*d.* net.

UNDER the somewhat vague title of "Birds in England," Mr. E. M. Nicholson has given us a useful and stimulating book: its scope is better indicated by the sub-title, "An Account of the State of our Bird-Life and a Criticism of Bird Protection." The opening chapters discuss losses and gains in our avifauna and the operative causes. The middle portion of the book centres round an account of the lives and work of famous ornithologists. The final chapters deal with the practical problems of protection—sanctuaries, legislation, and the evils of collecting. The last part of the book, especially, is frankly polemic. The author holds decided personal views on questions of protection, and he presents these with force and skill. Not all his conclusions will be generally accepted, but his arguments always deserve serious consideration and often carry conviction.

Mr. Nicholson takes a rather unusual line, for example, on the subject of bird-sanctuaries, but the truth of many of his contentions must be admitted. He draws a useful distinction between sanctuaries in towns and those in solitary places. The object of the former is to attract birds where none lived before. The country sanctuary, on the other hand, is a retort to persecution, and the author regards it as in many ways an unfortunate one, tending to shelve the question of protection on a national scale. He points out how little can be done by scattered sanctuaries for the preservation of rare species other than those which breed in colonies, and he sees the true remedy in the effective prohibition of collecting. Nor does he omit to notice the unfortunate results which sometimes follow from indiscriminate protection.

From a purely scientific point of view, the earlier chapters, dealing with the "Balance of Birds," are the most valuable. These constitute a careful survey of the subject, from which much that is of interest emerges. In dealing with total gains and losses, Mr. Nicholson counts that fifteen breeding species have been lost, as such or altogether, since Tudor times, while seventeen have been gained: the figures include three which have been lost and regained and thus appear on both sides of the account. Of the gains, four are due to artificial introduction and the rest to natural colonisation, all within a century, by former purely visitant species, including seven ducks. The account of the decrease and increase of other birds, which have not been either totally lost or gained as breeding species, is perhaps even more interesting, and the thoughtful discussion of the probable parts played by different factors gives evidence of the author's thorough knowledge of the subject.

A Naturalist's Pilgrimage. By Richard Kearton. Pp. xiii + 246 + 8 plates. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1926.) 7*s.* 6*d.* net.

MR. KEARTON, by his photographs and lectures, has done much to popularise the simpler type of natural history, and he is justly proud of the achievement. This chatty autobiography traces his progress from the fell farm to the study and lecture hall, and with naïveté recounts the experiences, some instructive, many trivial, which he encountered by the way. The naturalist will be interested in the elaborate means sometimes adopted for the delusion of birds, and in the trying adventures of the pioneer days of bird photography; and if the impression is created that the author insists too much on his own cheerfulness and *bonhomie*, it is simply because he realises that here lies one of the secrets of his success.

Insect Studies.

The Fauna of British India, including Ceylon and Burma. Edited by Sir Arthur E. Shipley, assisted by Dr. Hugh Scott. (Published under the Authority of the Secretary of State for India in Council.) *Coleoptera: Chrysomelidæ (Chrysomelinæ and Halticinæ).* By S. Maulik. Pp. xiv + 442. (London: Taylor and Francis; Calcutta: Thacker, Spink and Co., Bombay: Thacker and Co., Ltd., 1926.) 25*s.*

THE family Chrysomelidæ, which comprises the leaf-beetles, is one of the largest in the animal kingdom. It includes to-day probably not far short of 20,000 described species which are grouped into sixteen subfamilies. The first eleven of the latter were dealt with in the "Fauna of British India" series in the volume by the late Mr. Martin Jacoby, published in 1908. In 1919 Mr. Maulik wrote the volume on the Hispinæ and Cassidinæ, while the Chrysomelinæ and Halticinæ form the subject of the present contribution. This leaves the Galerucinæ for future treatment, and, it may be added, they are exceedingly numerous in species. Of the subfamily Chrysomelinæ, only 63 species are recorded and are comprised in 18 genera. This paucity is remarkable, considering the richness of the faunal area surveyed, and it is evident that there are still far too few resident entomologists to do the necessary intensive collecting over so wide a region.

In the introduction to the Chrysomelinæ an account is given of the external morphology of the larva and imago, notes on the life-histories, and a list of injurious species found in various parts of the world. In the subfamily Halticinæ 287 species, in 70 genera, are recorded, and there are similar introductory remarks on structure and habits. It is noteworthy that very many of the members of this subfamily are represented by single records only, and evidently these rather obscure beetles have afforded very little interest to collectors. In this volume, as elsewhere, Mr. Maulik has manufactured many new names from Sanskrit roots—a procedure which he says has saved him time which might have otherwise been used in discovering whether a name is preoccupied or not. The volume is clearly illustrated, although the sex of the examples figured might have been added with advantage. Its type and general arrangement are similar to those of its predecessors, and there appears to be an almost entire freedom from misprints. A. D. I.

Descriptions of new Genera and Species of Lepidoptera Phalænæ of the Subfamily Noctuinæ (Noctuidæ) in the British Museum (Natural History). By Sir George F. Hampson. Pp. iv + 641. (London: British Museum (Natural History), 1926.) 20*s.*

THIS volume contains the descriptions of more than 200 genera and a still larger number of new species of moths belonging to the subfamily Noctuinæ contained in the British Museum. Its MSS. was left by the author when he retired from the Natural History Department in 1920. Owing to the suspension of the Catalogue of Moths as the result of financial stringency occasioned by the War, a large number of species have remained in the Museum under Sir George Hampson's manuscript names without the necessary published descriptions. In order to obviate this disadvantage it has been deemed necessary to issue the present volume. Apart from bare descriptions, it contains no illustrations or other aid to the identification of this great mass of material.

Rural Science.

Insecticides, Fungicides and Weed Killers. By Dr. E. Bourcart. Translated from the French and adapted to British Standards and Practice. Second English edition, revised and enlarged by T. R. Burton. Pp. xii + 431. (London: Scott, Greenwood and Son, 1925.) 15*s.* net.

AGRICULTURISTS and horticulturists alike will welcome the appearance of a new edition of Bourcart's useful work of reference. During the fifteen years since the publication of the original edition of this volume, very considerable advances have been made in the application of chemical methods to agriculture. This has been specially marked in connexion with the suppression of plant pests and diseases, though much of the work is still in the experimental stage and needs applying with caution. In presenting a revised and enlarged English edition the translator has retained the fundamental basis of the original work, while replacing part of the old historical sections by details of modern methods and recipes which have been thoroughly tested and are worthy of recommendation.

Work on insecticides has proceeded rapidly in the United States, where it is aided and supervised by the Government, and in other countries also research is being actively carried on as the regions of cultivation extend, specially in the tropics and warmer temperate zones. This has greatly increased the possibility of dealing effectively with insect and fungus pests, and the volume under review aims at presenting the present state of our knowledge on the subject in so far as it has been sufficiently tested. For the sake of convenience, the entomological glossary, hitherto a separate section, is now incorporated in the body of the book. No bibliography is appended, probably on the score of space or unwieldiness, though recipes are in the majority of cases carefully attributed to their authors. W. E. B.

Rural Scotland during the War. By David T. Jones, Joseph F. Duncan, H. M. Conacher, W. R. Scott. With an Appendix by J. P. Day, and an Introduction by W. R. Scott. (Publications of the Carnegie Endowment for International Peace, Division of Economics and History: Economic and Social History of the World War, British Series.) Pp. xvi + 311. (London: Oxford University Press; New Haven, Conn.: Yale University Press, 1926.) 12*s.* 6*d.* net.

THIS valuable work embraces a complete survey of the economic and social history of Scotland during the War in its chapters on fisheries, agriculture with special reference to food production, the agricultural labourer and land settlement. There is also an appendix on the jute industry. No occupation suffered more severely, or was forced to undergo more drastic reorganisation, than fishing. The withdrawal of vessels and men, the closure of many fishing-grounds, and the shifting of the fishing ports from the east to the west coast, with the consequent difficulties of transport, are the chief problems discussed in Mr. Jones's survey. In agricultural Scotland, in spite of the heavy enlistments, there was an increased supply of food, especially as regards oats and sheep. Mr. Conacher deals fully with the problem the Scottish farmer successfully solved. Mr. Day's study of the jute industry traces the difficulties this industry had to face in its import of raw material, the rapid soaring of prices for jute goods, and the equally rapid post-War return to normal prices. The book is admirably arranged for easy reference and contains an abundance of statistical matters.

Cornish Geology.

Handbook of Cornish Geology. By E. H. Davison. Pp. 106. (Penzance: Royal Geological Society of Cornwall, 1926.) n.p.

MANY excellent books, pamphlets, and papers have been written about the rocks and geological problems of the Cornish peninsula. There are many unsolved riddles in this western land, so that there will always be a number of persons with some geological knowledge ready to turn a portion of their holidays to pleasurable account. The chief drawback of these excellent treatises is that they are too technical and obscure. They describe features in language which is not clear enough to the ordinary layman stranger, who requires to be directed to spots where these particular phenomena are to be seen at once with nothing to obscure the issue. Mr. Davison's book is perhaps scarcely free from the modern vice of multiplying technical terms and names, which to the older geologist become confusing. The book supplies, however, a long-felt want. It brings the geological knowledge of the county up-to-date in very terse language, and it describes clearly and concisely the places and positions where the keys to various problems may be found. The chapters are short, but to the point; those on "The Granite," the "Lizard Rocks," and the "lodes of Cornwall" are especially good.

On such subjects as "the pneumatolysis [unpleasant word !] of the granite and other rocks" Mr. Davison is, of course, on controversial ground, but it is his own subject, and he steers clear of any points of fierce dispute in his own inimitable way. The chapter on "Geological Localities of Interest" is one which will be appreciated by those who have only a few days to spare in the Duchy. One feels that practically every spot worth visiting has been mentioned. Mr. Davison might perhaps have dealt a little more with the early Pre-Cambrian and Ordovician aspects of the region, in something of the style of Mr. Jukes Brown's excellent "Building of the British Isles"; but, no doubt, many of his readers will find the hints he gives in his little book a substantial basis for building further framework upon. The bibliography is very complete, but why did not Mr. Davison take it back a few years earlier? The period between 1890 and 1906 was a very prolific and useful one in Cornish geology. F. J. S.

Geophysics.

Was lehrt uns die Radioaktivität über die Geschichte der Erde? Von Prof. Dr. O. Hahn. Pp. v+64. (Berlin: Julius Springer, 1926.) 3 gold marks.

In this little book on radioactivity and geology, Prof. Hahn summarises in a form very convenient for German readers the outstanding results that have been achieved in recent years. Radioactivity is of fundamental importance to geologists in two main respects: the constant emission of heat, which is now held to control the surface history of the earth; and the accumulation of end-products in minerals, the analysis of which is making it possible to establish a geological time-scale and to correlate the Pre-Cambrian rocks.

Dealing with the age of the earth, Hahn discusses Joly's reasons for preferring lower estimates than those advocated by Holmes. He rejects the solvent-denudation method as being too uncertain to give trustworthy results, and suggests that the older geological estimates should be multiplied by ten or twenty. The results from thorium minerals are also rejected on account of the unsuitability of the minerals. These he regards either as secondary products or as leached residuals. The argument from pleochroic haloes is thought to be inconclusive, and the opinion is expressed that it is very improbable that uranium disintegrated more rapidly in past ages than now No mention is made of the possibility of attributing the anomalies of the 'uranium' halo to the actinium series. It is clear that Hahn accepts the straightforward reading of uranium minerals, though it is unfortunate that he does not refer to the geological support given to the longer estimates by the remarkable work of Barrell ten years ago.

In his account of the earth's thermal state, Hahn reviews the work and opinions of Joly, Holmes, and Jeffreys (who, however, is not an American). He goes further than any of these writers in suggesting that life itself depends on the radioactivity of the rocks: without carbon dioxide, no life; without volcanoes, no carbon dioxide; without radio-elements, no volcanoes. A brief résumé is given of the reasons for supposing that uranium and thorium have been concentrated in the outer crust. The book concludes with a discussion of Joly's theory of basaltic cycles and the physical possibility of continental drift.

International Hydrographic Bureau Special Publication No. 12: Investigation of Harmonic Constants, Prediction of Tide and Current, and their Description by Means of these Constants. By Rear-Admiral Phaff. Pp. 80+6 plates. 5 Swiss francs. *Supplement to Special Publication No. 12: Tables for the Calculation of Tides by Means of Harmonic Constants.* Pp. 136. (Monaco: International Hydrographic Bureau, 1926.)

The needs of the seaman are not adequately met by tide tables for a limited number of ports; he cannot always deduce from them the best times for attempting to enter other ports, especially where there is large diurnal inequality in time and height of high water. The simplest solution of his problem is to compute by the harmonic method the tidal variation for a few hours of the required day. He should be provided with a list of the important constants for as many places as possible, with means to facilitate the computations, together with rules which cannot easily be misunderstood. These recent publications of the International Hydrographic Bureau profess to meet his needs; it is regrettable that they appear to have been thrust upon the world with little consideration and with great haste, even if we only judge by the liberal errata and corrigenda pasted in each volume.

The 'Tables' are for use with a method of computation based upon the work of Van de Stok; apart from an unsatisfactory method, the constants are not up-to-date, there is no value of mean sea-level and the phase-lags are given in degrees, local *or* zone time, without any indication as to which is used in any given case. The 'Tables' are not self-contained, lacking simple rules and typical forms for computation; the seaman, therefore, must first read the manual, and that will be fatal, for the language is frequently loose and obscure, and it is difficult to follow some of the processes (p. 53), even for one capable of independent reproduction of the results. The author gives formulæ and symbols without explanation (p. 59), and tables that are neither self-evident nor properly explained in the text (p. 57). In short, the manual appears to be transcribed from the author's notebook. It is incorrect to say that the constituents K_1, K_2 can be reciprocally eliminated in one day, whereas 365 days are required to eliminate K_1 from S_2; also, that 55 days are required to give a negligible contribution from O_1 in the analysis for N_2; less than 55 hours would suffice for that purpose. The objects are indeed laudable, but it is to be regretted that these volumes are unworthy of international acceptance.

Probleme der kosmischen Physik. Herausgegeben von Prof. Dr. Christian Jensen und Prof. Dr. Arnold Schwassmann. Band 7: *Der Massenaustausch in freier Luft und verwandte Erscheinungen.* Von Prof. Dr. Wilhelm Schmidt. Pp. viii + 118. (Hamburg-Altrahlstedt: Henri Grand, 1925.) 6 gold marks.

This useful little book summarises the literature of the last fifteen years or so relating to transport phenomena in the atmosphere (and also, as a natural extension of the same ideas, similar phenomena in the ocean). The transport of heat and momentum and water vapour by atmospheric eddies is of great importance in meteorology, though the fact has been recognised only in recent years (largely through the work of Prof. G. I. Taylor). The author has himself written widely on these problems.

Modern Physics.

Reflections on the Structure of the Atom. By Florence Langworthy. Pp. xi + 260. (London: Watts and Co., 1926.) 12*s.* 6*d.* net.

This volume, which covers a wide range, is concerned mainly with an atomic model in which the neutral atom of hydrogen is assumed to be built up of three "atoms of its isotope, ur-hydrogen," and three electrons. On this purely speculative foundation is raised an elaborate superstructure. "In my atom the double-positives (Alpha particles) are massed at the centre, and so I have the single positives free to unite with electrons and form planets that can be neutral, negative, or positive." The author is of opinion that a chemist will find the structure of her atom far more to his mind than that of the Bohr atom, which presents to the world outside negatives (electrons) only. The latter model she holds in scorn, going so far as to say that our knowledge of atomic structure "has been marking time all these years since the Rutherford atom became the Bohr atom"!

In the new wave-theory of matter associated with the name of Schrödinger, a material particle is regarded as a singularity in a wave, but to the author of the present volume even the wave-theory of light is anathema. "Those who have handicapped their intellectual faculties by believing in 'waves' are now engulfed thereby." She claims to be one of the few who have always believed in Newton's corpuscular theory of light. Whatever may be the final solution of the problem of reconciling the quantum theory and the undulatory theory, it will not be reached by turning a blind eye to one side of the questions at issue. Truth is great, and will prevail; but in our view the cause of knowledge will not be advanced by the speculations in this book.

A Numerical Drill Book on Physics. By Prof. L. W. Taylor. Pp. viii + 95. (Boston, New York and London: Ginn and Co., 1926.) 1 dollar.

This collection of problems in physics, which should prove useful to teachers, presents some novel features of interest. Nearly every problem is first formulated in algebraic terms; four independent sets of numerical data are provided for each example, these being chosen so as to cause the results to pass through maxima and minima wherever possible; answers are given usually correct to four significant figures. The mathematical tables at the end of the book are clearly printed.

Chemistry and its Borders.

An Introduction to Chemistry. By C. G. Vernon. Pp. 276. (London: George Harrap and Co., 1926.) 4*s.* 6*d.*

Mr. Vernon's book is based on the application of the heuristic method. It proceeds from an account of the beginnings of chemistry, which is cryptically and incorrectly said (p. 177) to have been founded by Jabir, to the work of Dalton. The study of the oxides of nitrogen, 'muriatic' acid and the halogens, sulphur, etc., then follows, and by p. 179 the structure of the atom is attained. The rest of the book deals with practical work, and several interesting experiments are described. There are many excellent illustrations, including portraits of Boyle, Priestley, and Lavoisier.

Even those teachers who do not believe in the rather literary method of introduction to the science here adopted will find Mr. Vernon's book interesting and suggestive. The historical details appear to have been compiled from trustworthy sources, although the judgment passed (on p. 19) on the Alexandrian School is somewhat startling.

A Dictionary of Applied Chemistry. By Sir Edward Thorpe; assisted by eminent contributors. Vol. 6: S. Acid to Tetryl. Revised and enlarged edition. Pp. viii + 791. (London: Longmans, Green and Co., Ltd., 1926.) 60*s.* net.

The characteristic features of the new volume of Thorpe's "Dictionary" are so similar to those of the preceding volumes that very little comment is possible. There has been a considerable expansion, from 572 to 791 pages, in the new edition, but this has been distributed with remarkable uniformity, and the reviewer has been unable to discover any striking novelties in the present volume, except that the 'article' on tetryl, which in the old edition was confined to the single word '= butyl,' now contains an account of an important auxiliary explosive. Articles on sodium, sulphur, sulphuric acid, synthetic drugs, and tartaric acid have been expanded considerably, but again mainly by interlining with new matter rather than by additions in bulk. It, therefore, only remains to express appreciation of the completion of what is presumably the penultimate volume of the "Dictionary."

Photochemical Reactions in Liquids and Gases: a General Discussion held by the Faraday Society, October 1925. Pp. 435-658. (London: Gurney and Jackson, 1926.) 15*s.* 6*d.* net.

With the natural growth of the experimental sciences, the gaps between physics and chemistry somewhat unexpectedly expand rather than contract. From time to time, however, from one side or the other, some new point of view is presented, and in a few years a large portion of this 'terra incognita' is explored and mapped out. In support of this thesis may be mentioned the recent rapid advance in knowledge of the behaviour and properties of interfaces, a subject which until only some ten years ago appeared to be but a sterile flower cultured by pure physics.

The action of radiation in promoting chemical action has long been an interesting experimental field for chemists, but it cannot be said that much real knowledge has been reaped as a result of their labours. During the last few years, however, physical investigation has revealed certain apparently fundamental laws in the interaction between radiation and matter, and has given us a definite concept of the 'active' molecule postulated by Arrhenius. It is in the application of these laws to photochemical action that we may anticipate a revival of interest in photochemistry.

The Faraday Society has since its inception pursued the policy of promoting discussions, international in character, so as to obtain not only a record of the growth of these various physicochemical subjects, but also to apply the necessary stimulus of interest. The contents of this volume certainly fulfil these conditions. In it we find the signs of the revival of photochemistry, for nearly all the contributions deal with the mechanism rather than with the products of reactions. Whilst it is clear that certain reactions which are simple from the chemical point of view are in reality extremely complex, yet hope is offered from the fact that even complex chemical reactions may result from a series of physical actions which are capable of isolation and identification. It is also evident that a very close collaboration of physicist and chemist will be necessary to make real progress in photochemistry, and to prepare the way for the plant biologist. The Society is warmly to be congratulated for the success it has achieved.

E. K. R.

Practical Physiological Chemistry. By Sydney W. Cole. Seventh edition. Pp. xii+481. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1926.) 16*s.* net.

THE fact that this well-known work has reached its seventh edition is its own recommendation. Its usefulness has been enhanced by the inclusion of accounts of electrical methods for the measurement of hydrogen ion concentration, and of chapters on biological oxidations and reductions and on the analysis of the blood. The work itself is more suitable for the advanced student and the research worker than for the ordinary medical student, though by judicious selection of material a course for the latter could be easily arranged. The directions for all practical exercises are given in very full detail, preceded in each case by a short theoretical account of the subject. Among the more recent additions, the following appear to be especially noteworthy: the description of the hydrogen and quinhydrone electrodes, the account of glutathione in the chapter on oxidations, and the description of the Hagedorn-Jensen method of estimating the sugar of the blood. The inclusion of a method may be considered as a guarantee of its trustworthiness, provided that the details are faithfully followed.

Practical and Applied Mathematics.

Advanced Calculus. By Prof. William F. Osgood. Pp. xvi+530. (New York: The Macmillan Co., 1925.) 25*s.* net.

PROF. OSGOOD has here given us a very valuable book on the calculus. It will be useful "not merely to the specialist in mathematics or physics," but "to all who would possess themselves of the calculus as a method for understanding . . . the quantitative relations which follow from the laws of Nature." There are excellent chapters, to mention only a few, on the general methods of integration, with multiple integrals and their transformation; elliptic integrals; vector analysis; the calculus of variations; and finally, a sketch of the theory of functions of a complex variable. The whole is treated with modern rigour and with special reference to physical applications, of which there are many. There are numerous examples for practice together with answers, and the book is excellently produced.

Advanced Calculus: a Course arranged with Special Reference to the Needs of Students of Applied Mathematics. By Prof. Frederick S. Woods. Pp. ix+397. (Boston, New York and London: Ginn and Co., 1926.) 21*s.* net.

THIS book has been written for those students who are "chiefly interested in the applications of the calculus," but are not "primarily concerned with theoretical questions." The author has, however, wisely included some essential theory not only to render the practical rules intelligible, but also "to introduce the students to theoretical questions and possibly to incite in some a desire for more thorough study." The work ranges from a discussion of elementary functions to partial differential equations, Bessel functions, the calculus of variations, and elliptic integrals. There is a good chapter on the functions of a complex variable, and the whole text throughout is well illustrated by practical examples.

Practical Mathematics. By A. Dakin. (Bell's Mathematical Series for Schools and Colleges.) Part 2. Pp. viii+363-629+xxv-xxxiv. (London: G. Bell and Sons, Ltd., 1926.) 4*s.* 6*d.*

MR. DAKIN's useful little book completes a course specially planned to give practical students a sound knowledge of fundamentals. The treatment is designed to be of real educational value, and the judicious combination of experiment, deduction, and concrete application is a highly commendable feature.

Mechanics and Applied Mathematics: Statics—Dynamics—Hydrostatics. By W. D. Hills. Part 2: *Applied Mathematics.* Pp. xi+248. (London: University of London Press, Ltd., 1926.) 5*s.*

THIS volume completes the course, begun in Part 1, to cover the London Intermediate Science syllabus. The author has well carried out his aim "to temper theory and practice." The numerous worked examples are clearly explained and, with the text, excellently illustrated. The book should prove very useful.

Geometry.

(1) *Practical Geometry: based on the various Geometry Books by Godfrey and Siddons.* By A. W. Siddons and R. T. Hughes. Pp. x+264. (Cambridge: At the University Press, 1926.) 4*s.*

(2) *Theoretical Geometry: based on the various Geometry Books by Godfrey and Siddons.* By A. W. Siddons and R. T. Hughes. Pp. xvi+173. (Cambridge: At the University Press, 1926.) 3*s.*

These two books are intended to be used together in order to give a sound course in the methods of geometry.

In the practical geometry, intuition and experiment are skilfully employed to develop the power of intelligent inference.

In the volume on theoretical geometry, the Assistant Masters' Association's sequence of theorems has been followed, the object being to cover the requirements of the non-specialist. The whole treatment is so good that many teachers will regret the omission of the powerful method of limits in its application to tangency.

Analytic Geometry. By Prof. Maria M. Roberts and Prof. Julia T. Colpitts. Second edition. Pp. xii+261. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 9*s.* net.

The courses given to students of engineering and science at the Iowa State College form the basis of this book, which embraces Cartesian geometry in two and three dimensions. Special emphasis is placed upon those portions of the subject essential to a working knowledge of the calculus. The treatment is lucid and practical, and there are numerous exercises designed to stimulate independent thought.

Miscellany.

Teaching Science in Schools. By John Brown. Pp. x+170. (London: University of London Press, Ltd., 1925.) 3*s.* 6*d.* net.

The author of this small book is, as a critical onlooker in the rôle of a London County Council inspector of schools, eminently qualified in taking upon himself the task of a review of the present position of the teaching of science in schools. Much that he has to say is primarily the concern of the elementary-school teacher. Nevertheless, there is much that is common in aims and ideals and methods as between the elementary and the secondary school, and the teaching profession owes its thanks to Mr. Brown for a most valuable contribution to the literature of educational method.

A careful reading of his work impresses one vividly with a sane sense of balance. The swing-swang of the pendulum of method as between too much and too little formal laboratory work rightly has very little sympathy from the author. The pendulum must be damped down to its mean position. At the same time, we are bound to submit that there is no sign of an indifference to a rational realisation of the need for improvement on the part of teachers of science as a whole such as might be inferred to exist from a reading of this book. On the contrary, so far as secondary schools are concerned, there are few 'subject' organisations that compare either in vigour, effect, or for that matter in numerical strength, with, for example, the Science Masters' Association. Most of the points and submissions contained in Mr. Brown's book have been or are being thrashed out by the science teachers of to-day. Nevertheless, this in no way detracts from the value of a book that succeeds admirably in placing before the reader a résumé of the problems that confront teachers of science, and the lines along which a sound solution may be found. I. B. H.

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 35, No. 1. Pp. xii+988. (London: The Institute of Metals, 1926.) 31*s.* 6*d.* net.

A subject which is assuming great importance in metallurgical discussions is that of 'creep' at high temperatures, and the new volume contains two papers on this topic. R. W. Bailey reviews the experimental evidence and supplies the first real attempt to provide an explanation, whilst H. J. Tapsell and J. Bradley contribute the results of experiments with an alloy of nickel and copper. The constitution of the alloys of silver and tin, which is of importance for the knowledge of dental alloys, has been determined satisfactorily by A. J. Murphy, previous determinations having been badly in error, and another careful alloy investigation is that of the aluminium-copper-tin alloys rich in copper, by D. Stockdale. W. Hume-Rothery makes a bold and ingenious attempt to apply the Bohr theory of the atom to intermetallic compounds, supporting his theoretical work by interesting experimental data. The speculations have given rise to much discussion, but chemists will follow with interest an effort to find some system in these peculiarly puzzling compounds. Among the more practical papers, a useful account of the die-casting of aluminium alloys, by G. Mortimer, may be mentioned. The May lecture this year was by Prof. Carpenter, who dealt with some of the properties of single crystals. The high standard reached by several of the contributors in their photomicrographs is to be noted with satisfaction. As usual, the volume contains a very extensive and exceptionally valuable collection of abstracts.

A Catalogue of British Scientific and Technical Books. Supplement, 1925. Arranged by Daphne Shaw. Pp. viii+166. (London: British Science Guild, 1926.) 2*s.* 6*d.* net.

Book catalogues intended to occupy a permanent place on the reference shelves of libraries must be kept closely up-to-date, if the hopes of their compilers are to be realised. We are, therefore, pleased to note that the British Science Guild has found the means to publish a supplement containing 2258 entries completing its useful Catalogue of 1925, and that it further proposes to print annual supplements early in each year if sufficient support is obtained for these issues. Though the change of system of publication from the class to the dictionary order of headings has advantages, the break in the continuity of system in a serial publication may be resented by its users. The present dictionary headings and references are also not up to the standard of modern library practice. The entries, however, which have been taken from the monthly lists in Nature, are admirably full, and the allotment of entries to their respective headings is generally satisfactory.

Printed in Great Britain by R. & R. Clark, Limited, *Edinburgh.*

COLLINS

ANNOUNCE

A NEW BOOK BY

J. W. N. SULLIVAN

Aspects of Science

SECOND SERIES

This volume of essays is concerned chiefly to show science in perspective. The author believes that the arts have an intimate connection with the sciences; that they are not merely delightful additions to life, but are truly revelations of reality. For that reason these essays, besides dealing with the scientific outlook, touch directly upon some aspect of literature or music.

Cloth 12/6 *net.*

By the same Author

THREE MEN DISCUSS RELATIVITY

Third Impression. 7/6 *net.*

PROSPECTUS POST FREE

48 PALL MALL LONDON S.W.1

CROSBY LOCKWOOD & SON'S NEW TECHNICAL BOOKS

ROTARY AND MOTOR CONVERTERS. By ERNEST F. SMITH. 248 pp. Illustrated. Crown 8vo. Net **7s. 6d**

ELECTRIC LIGHTING, STARTING AND IGNITION FOR MOTOR CARS. Featuring British Productions. A Practical Explanation of the most modern methods By H. H. U CROSS Fourth Edition, Enlarged. 356 pp Illustrated Demy 8vo Net **15s.**

THE LIGHTNING GRAPHS. (Series I.) General Designed and drawn for the use of Engineers, Physicists, Architects, Surveyors, Draughtsmen, Students, etc By I S DALGLEISH, A.M I.E.E. Oblong Crown 4to. Net **5s**

STEEL BRIDGE WEIGHTS. Being Particulars of 133 Examples with Diagrams based thereon. By W H. THORPE, A M. Inst.C E. Illustrated. Oblong Crown 4to Net **7s. 6d**

MODERN SOAP AND DETERGENT INDUSTRY. By G. MARTIN, D Sc., Ph D, F I C. A Complete Practical Treatise in Three Vols Vol III. MANUFACTURE OF GLYCEROL. (Including Index to Complete Work.) 276 pp. Illustrated Royal 8vo. Net **30s**

CHEMICAL SYNONYMS AND TRADE NAMES. By W GARDNER, Works Chemist A Dictionary and Commercial Handbook 3rd Edition. Revised and much Enlarged 364 pp Royal 8vo Net **30s**

LOCATION OF MINERAL FIELDS. By M H. HADDOCK, F.G S, A.M I.M.E 296 pp 213 Diagrams 10 Plates Crown 8vo Net **9s. 6d.**

METALLOGRAPHY OF STEEL AND CAST IRON. By W. E WOODWARD, M.A., M I & S Inst. 156 pp. Photomicrographs and Diagrams Demy 8vo. Net **15s.**

DREDGING AND DREDGING APPLIANCES. By P. M. DEKKER With an Introduction by SIR ROBERT HADFIELD. Translated from the Dutch. 169 pp 94 Illustrations Demy 4to [*Nearly Ready.*

Complete Catalogue post free on application.

Crosby Lockwood & Son, 7 STATIONERS' HALL COURT, LONDON, E.C.

PITMAN'S NEW TECHNICAL BOOKS

ELECTRICAL INSULATING MATERIALS

By ALLAN MONKHOUSE, Jun., M.I.E.E., A.M.I.Mech.E.

Mr. Monkhouse, owing to his experience as a research engineer with the Metropolitan-Vickers Electrical Company, and through his intimate connection with the Electrical Research Association, has been enabled to collect very complete information on the various materials used for electrical insulation. The book deals with the physical and electrical properties of these materials, and also with the various methods used in their manufacture and application to various purposes.

In demy 8vo, 409 pp., with 112 illustrations and 26 tables. **21s.** net.

"From the first page to the last the author's work has been well done. . . . Its extensive use as a book of reference throughout the electrical industry will do much to help forward this backward yet all-important subject."—*Electrical Review.*

METALLURGY OF CAST IRON

By J. E. HURST.

A complete treatise, dealing with the production and composition of cast iron, with very full details as to the physical properties and chemical composition of the many grades of cast iron which are now used by engineers and others. This book should be in the hands of every blast furnace metallurgist and of every one interested in the production and use of cast iron in the foundry.

In demy 8vo, cloth, 326 pp. **15s.** net.

"The author has followed closely and critically the application of metallographic methods to the metallurgy of cast iron"—*The Times Engineering Supplement*

"The arrangement of the material and the presentation are excellent."—*Manchester Guardian Commercial.*

CONDENSING PLANT

By R. J. KAULA and I. V. ROBINSON

A complete treatise on the design and operation of modern condensers and their auxiliary plant. The authors have had unique experience in the design of condensing plant, and have an exceptionally wide knowledge of all modern types. This book should be in the office of every engineer interested in the design of steam power plant. It will also be found indispensable to engineers responsible for the upkeep of any power plant of which condensers form an adjunct.

In demy 8vo, 450 pp, with 260 illustrations. **30s.** net.

"The book is thoroughly up-to-date in its treatment of the subject, and the author's handling of the numerous difficult problems of design are admirable"—*Marine Engineer.*

OF ALL BOOKSELLERS.

Complete List of Technical Books will be sent post free on request by

SIR ISAAC PITMAN & SONS, LTD.

Parker St., Kingsway, London, W.C.2

"In years to come the publication of this monumental work will rank as one of the milestones in British applied science."—*Nature.*

Sir Richard Glazebrook's DICTIONARY OF APPLIED PHYSICS

Can NOW be purchased on the Convenient System of DIVIDED PAYMENTS

CONTENTS

Vol. I. Mechanics—Engineering—Heat.
" II. Electricity.
" III. Meteorology, Metrology, and Measuring Apparatus.
" IV. Light—Sound—Radiology.
" V. Aeronautics—Metallurgy—General Index.

THE COMPLETE WORK
IN 5 VOLUMES
Delivered
at once
FOR A FIRST PAYMENT OF
21/-
AND 14 FURTHER MONTHLY PAYMENTS OF 21/- THUS COMPLETING THE SUBSCRIPTION
PRICE - £15 15 0

Authoritative Reviews:

"This encyclopædic work differs from many that have preceded it in that it is produced by those who have worked strenuously and successfully to promote knowledge. Originality of treatment and masterly handling are everywhere exhibited."—*Engineering.* (Vol. I.)

"A book which every electrical engineer ought to possess. . . . A mine of information in a field which, at present, is not adequately covered by any one work."—*The Electrician.* (Vol. 2.)

"As a summary of our present knowledge of certain aspects of meteorology, the work is of great value. It will perhaps be regarded in future as a milestone showing the stage reached by the science at the end of the great war."—*The Meteorological Magazine.* (Vol. 3.)

SINGLE VOLUMES
ALSO SUPPLIED ON DIVIDED MONTHLY PAYMENTS AS FOLLOWS:
Immediate
Delivery
AGAINST A FIRST PAYMENT OF
2/6
AND 13 FURTHER MONTHLY PAYMENTS OF 5/- THUS COMPLETING THE
SUBSCRIPTION PRICE
£3 7 6

7 DAYS FREE ☞ EXAMINATION

To the GLOBE PUBLISHING COMPANY, LIMITED,
Gloucester House, 19 Charing Cross Road, London, W.C.2.

Please send me for 7 days free examination
A complete copy of the "Dictionary of Applied Physics" in 5 volumes.
Volume....................of the "Dictionary of Applied Physics."
(*Strike out lines not applicable.*)

It is understood that I can examine the $\frac{\text{work}}{\text{volume}}$ for seven days after I receive it, and that I can return it to you on the eighth day if I decide not to keep it. Should I decide to retain the volume(s) I undertake to send you a first payment of $\frac{\text{21/- for the complete work}}{\text{2/6 for Volume........only}}$ on the eighth day and to complete the purchase of the $\frac{\text{complete work}}{\text{Volume}}$ by remitting $\frac{14}{13}$ further monthly payments of $\frac{\text{21/-}}{\text{5/-}}$ until the full price $\frac{\text{£15 : 15 : 0}}{\text{£3 : 7 : 6}}$ is paid. (I am not under 21 years of age.)

NAME ....

ADDRESS ....

N.100 ....

CARNEGIE INSTITUTION OF WASHINGTON.

215A. JOHNSON, E. R., T. W. VAN METRE, G. G. HUEBNER, and D. S. HANCHETT, with an Introductory Note by H. W. FARNAM. **History of Domestic and Foreign Commerce of the United States.** Octavo, 785 pp., 110 maps $3.00

215B. CLARK, VICTOR S. **History of Manufactures in the United States, 1607 to 1860.** Octavo, 687 pp., 7 pls., 7 figs. Although the Institution now has no copies of this book for sale, copies are available for reference in a great number of libraries, the names of which will be sent upon application.

215C. **History of Transportation in the United States before 1860.** Prepared under the supervision of B. H. MEYER by CAROLINE E. MACGILL et al. Octavo, 688 pp., 5 pls. $6.00

358. BIDWELL, P. W., and J. O. FALCONER. **History of Agriculture in the Northern United States, 1620–1860.** Octavo, 524 pp., 114 figs. . . $4.00

351. HOWARD, W. T., Jr. **Public Health Administration and the Natural History of Disease in Baltimore, Maryland, 1797–1920.** Octavo, 571 pp., 2 maps, 141 tables, 41 graphs . . . $3.25

185. HASSE, ADELAIDE R. **Index to United States Documents relating to Foreign Affairs, 1828–1861.** In three parts: I., 793 pp. $9.00; II., 536 pp. $6.00; III., 647 pp. $7.00.

258. ROWE, L. S. **Federal System of the Argentine Republic.** Octavo, 174 pp. $2.00

334. JAMES, H. G. **Constitutional System of Brazil.** Octavo, 276 pp. $2.50

370. STUART, G. H. **The Governmental System of Peru.** Octavo, 162 pp. $2.00

Recently Issued.

299. Vol. 3. **Letters of Members of the Continental Congress, January 1 to December 31, 1778.** Octavo, 634 pp. $5.00

363. **Contributions to Embryology,** Volume XVIII., papers Nos. 90 to 97. Quarto, 150 pp., 39 pls., 6 figs *Price later*

90 **Cultivation of Embryonic Heart-Muscle.** By W. H. LEWIS.

91. **Correlation of External Genitalia and Sex-Glands in the Human Embryo** By K. M. WILSON.

92. **The "Miller" Ovum — the Youngest Human Embryo thus Far Known** By GEORGE L. STREETER.

93. **Detailed Form of the Wolffian Body in the Human Embryos of the First Eight Weeks.** By JUJIRO SHIKINAMI.

94. **Lens Ectoderm and Optic Vesicles in Allantoic Grafts.** By VERA DANCHAKOFF.

95 **Menstrual Records and Vaginal Smears in a Selected Group of Normal Women.** By J. L. KING.

96 **Transformation of Mononuclear Blood-Cells into Macrophages, Epithelioid Cells, and Giant Cells in Hanging-Drop Blood Cultures from Lower Vertebrates.** By MARGARET M. LEWIS and WARREN H. LEWIS

97. **Origin of Thrombocytes and of the Different Types of Blood-Cells as seen in the Living Chick Blastoderm.** By S. SUGIYAMA

Orders for books should be addressed to your bookdealer or to

CARNEGIE INSTITUTION OF WASHINGTON,
WASHINGTON, D.C.

FROM CONSTABLE'S LIST

PRINCIPLES OF HUMAN GEOGRAPHY. By P. VIDAL DE LA BLACHE. Edited by EMMANUEL DE MARTONNE. Demy 8vo. Illustrated. 18s. net.

NOMOGENESIS or EVOLUTION DETERMINED BY LAW. L. S. BERG, D.Sc. Demy 8vo. Illustrated. 28s. net.

OUTLINES OF EVOLUTIONARY BIOLOGY. ARTHUR DENDY, D.Sc., F.R.S. Fourth Edition Demy 8vo. Illustrated. 16s. net.

SOCIAL LIFE AMONG THE INSECTS. WILLIAM MORTON WHEELER, Ph.D., Sc.D. Medium 8vo. 116 Illustrations. 16s. net.

INTRODUCTION TO THEORETICAL PHYSICS. ARTHUR HAAS, Ph.D. Translated by T. VERSCHOYLE. 2 volumes. Demy 8vo. Illustrated. Vol. I., 21s. net. Vol. II., 21s. net.

HYDRAULICS AND ITS APPLICATIONS. By A. H. GIBSON, D.Sc., A.M.Inst.C.E., M.Inst.Mech.E., F.R.S.E. Third Revised Edition. Demy 8vo. Illustrated. 24s. net.

PHOTOMETRY. JOHN W. T. WALSH, M.A., M.Sc., A.M.I.E.E., F.Inst.P. Royal 8vo. Illustrated 40s. net.

SYSTEMATIC ORGANIC CHEMISTRY. A complete laboratory guide to the preparations and estimations of Organic Chemistry. W. M. CUMMING, D.Sc., F.I.C.; I. V. HOPPER, Ph.D., B.Sc., A.R.C.Sc.I., F.I.C.; and T. S. WHEELER, Ph.D., B.Sc., F.R.C.Sc.I., F.I.C. Demy 8vo. Illustrated. 25s. net

THE STATES OF AGGREGATION: THE CHANGES IN THE STATE OF MATTER IN THEIR DEPENDENCE UPON PRESSURE AND TEMPERATURE. GUSTAV TAMMANN, Director of the Institute of Physical Chemistry at the University of Gottingen. Authorised translation from the 2nd German Edition by R. F. MEHL, Ph.D. Demy 8vo. 308 pages. Illustrated. 24s net

HIGH TENSION LINE PRACTICE: Materials and Methods. By ERNEST V. PANNELL, M.Inst.E.E., M.Am.Inst.E.E. Demy 8vo. Fully Illustrated 22s. 6d. net.

THE THEORY OF ELECTRIC CABLES AND NETWORKS. By ALEXANDER RUSSELL, M.A., D.Sc., LL.D., F.R.S. Third Edition. Demy 8vo. Illustrated. 24s. net.

A TEXT-BOOK OF GLASS TECHNOLOGY. By F. W. HODKIN, B.Sc., A.I.C., and ARNOLD COUSEN, M.Sc., A.R.C.Sc., A.I.C. With an Introduction by Professor W. E. S. TURNER, D.Sc., M.Sc. Demy 8vo. Fully Illustrated. 42s. net.

THE SCIENCE OF SOILS AND MANURES. J. ALAN MURRAY, B.Sc., Lecturer in Agricultural Chemistry at University College, Reading. Third Edition. Demy 8vo. Illustrated. 12s. 6d. net.

Complete Lists of Scientific Books sent Post Free on Request.

10 & 12 ORANGE ST., LONDON, W.C.2

MACMILLAN'S NEW AND RECENT BOOKS.

IN UNKNOWN ARABIA. By MAJOR R. E. CHEESMAN, O.B.E., F.R.G.S., His Majesty's Consul in North-west Abyssinia. With a Foreword by MAJOR-GENERAL SIR PERCY Z. COX, G.C.M.G. With 32 pages of Illustrations in half-tone and 3 Maps and Plans. Super Royal 8vo. 25s. net.

COTTON AND ITS PRODUCTION. By W. H. JOHNSON, lately Agricultural Adviser to the Australian Cotton Growing Association. With an Introduction by SIR WYNDHAM DUNSTAN, F.R.S., and a Foreword by SIR WILLIAM HIMBURY, Managing Director of the British Cotton Growing Association. With 26 Maps showing the Cotton Areas of the World. Med. 8vo. 30s. net.

INTERNATIONAL COTTON BULLETIN.—"The book is 'sound' and can be confidently recommended to those engaged in cotton growing, but seeing that spinners the world over are consuming more and more 'outside growth' of cotton, they ought to study this book as well, for it deals extensively with these kinds of cotton."

HOLISM AND EVOLUTION. By GENERAL THE RIGHT HON. J. C. SMUTS. 8vo. 18s. net.

The work deals with some of the problems which fall within the debateable borderland between Science and Philosophy.

RITUAL AND BELIEF IN MOROCCO. By EDWARD WESTERMARCK, Ph.D., author of "The History of Human Marriage," etc. Illustrated. 2 vols. 8vo. 50s. net.

ORIGINS OF EDUCATION AMONG PRIMITIVE PEOPLES. A Comparative Study in Racial Development. By W. D. HAMBLY, B.Sc., Anthropologist for the Wellcome Expedition to the Sudan, Assistant Curator, African Ethnology, Field Museum, Chicago. With a Preface by DR. CHARLES HOSE (of Sarawak). With 74 pages of Illustrations in half-tone and line. 8vo. 25s. net.

SUNDAY TIMES.—"It is not necessary to be an anthropologist to appreciate and enjoy Mr. Hambly's most entertaining book, for it is written as much for the layman as for the student.'

CRYSTALLINE FORM AND CHEMICAL CONSTITUTION. By A. E. H. TUTTON, D.Sc., M.A.(Oxon), F.R.S., Past President of the Mineralogical Society, London; Author of "Crystallography and Practical Crystal Measurement." With 72 Illustrations. 8vo. 10s. 6d. net.

THE MINERALOGICAL MAGAZINE.—"The book is well printed and illustrated, and it gives a very clear and readable account of the subject. It should be seen by all students of chemistry as well as those of crystallography."

AN INTRODUCTION TO THE THEORY OF INFINITE SERIES. By T. J. I'A. BROMWICH, M.A., Sc.D., F.R.S., Fellow and Lecturer of St. John's College, Cambridge. Second Edition Revised with the assistance of T. M. MACROBERT, D.Sc., Lecturer in Mathematics in the University of Glasgow. 8vo. 30s. net.

WORLD POWER.—"It represents in its second edition the most complete dissertation on the subject, at any rate the English language, and is an invaluable asset to the library of research engineers."

IGHER MATHEMATICS FOR STUDENTS OF ENGINEERING AND SCIENCE. By FREDERICK G. W. BROWN, M.Sc.(London), F.C.P., Senior Mathematical Master, West Ham Secondary School. Crown 8vo. 10s.

EDUCATION.—"Everything in the book is well done. It shows that the author is a mathematical enthusiast and i ent on teaching mathematics in the proper way. . . . Mr. Brown has compiled a book that will be of inestimable service t any a teacher."

*** ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

LEWIS'S CIRCULATING LIBRARY

OF SCIENTIFIC, TECHNICAL, AND MEDICAL BOOKS

Covering the widest range of subjects, including **Astronomy, Aviation, Biology, Botany, Chemistry, Electricity, Civil Engineering, Geology, Microscopy, Mining, Philosophy, Physics, Sociology, Technology, Travels, Zoology, &c.,** in addition to **Every Branch of Medical Science.**

NEW BOOKS ON THESE SUBJECTS ARE ADDED IMMEDIATELY ON APPLICATION

Corner of Gower Street and Gower Place

ANNUAL SUBSCRIPTION, (Town or Country), FROM ONE GUINEA.

CATALOGUE OF THE LIBRARY, revised to December 1917, with Supplements, 1918-20 and 1921-23, containing Classified Index of Subjects and Authors. Demy 8vo. Price **12/6** net. (To Subscribers **6/-** net.)

Supplements, 1918-20, 64 pp.; 1921-23, 85 pp. Separately. Price 1/- net each, postage 2d.

MONTHLY LIST of **New Books** and **New Editions** added to the Library, post free to any address regularly.

Metropolitan Railway, **Euston Square Station.** All Tube Railways, **Warren Street.** Telephone: MUSEUM **1072.**
HOURS: **9 a.m.—6 p.m. Saturdays to 1 p.m.**

The LIBRARY READING AND WRITING ROOM (first floor) is open daily

---

BOOKSELLING DEPARTMENT

Complete Stock of Works and Text-Books in all Branches of

GENERAL, TECHNICAL, AND MEDICAL SCIENCE

Books in General Literature also supplied. Periodicals at Subscription Rates.

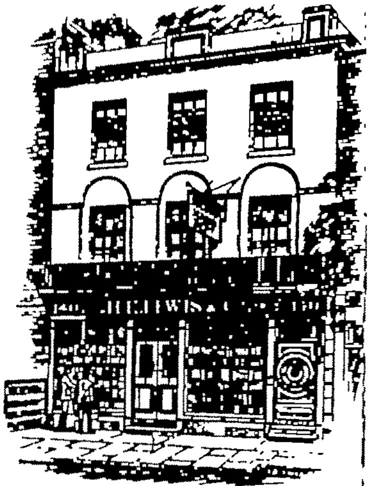
Classified List of Scientific, Technical, and Industrial Books Post Free on Request.

SPECIAL FACILITIES FOR EXECUTION OF ORDERS FROM ABROAD; effectually protective packing and without charge.

STATIONERY DEPARTMENT—**Large Stock of Note Books, Loose Leaf and Bound, Card Index Systems, Squared Paper, Slide Rules, and all kinds of Scientific and General Stationery.**

SECOND-HAND BOOK DEPARTMENT

140 GOWER STREET



140 Gower Street

LARGE STOCK OF SECOND-HAND RECENT EDITIONS

of books on Chemistry, Botany, and Science generally. Transactions, Proceedings, etc., of Scientific Societies. Sets of Scientific Periodicals.

Also Standard Works of all dates.

Out of Print Works sought for and reported when found.

(Close to Euston Road) Telephone: Museum 4031.

H. K. LEWIS & CO. LTD., 136 GOWER ST., and 24 Gower Place LONDON, W.C.1

SCIENTIFIC WORTHIES.

THE FOLLOWING IS A LIST OF THE STEEL AND PHOTOGRAVURE PORTRAITS THAT HAVE APPEARED IN THE ABOVE SERIES:—

Michael Faraday
Thomas Henry Huxley
Charles Darwin
John Tyndall
Sir George Gabriel Stokes
Sir Charles Lyell
Sir Charles Wheatstone
Sir Wyville Thomson
Robert Wilhelm Bunsen
Lord Kelvin
Baron A. E. Nordenskjöld
Hermann L. F. Helmholtz
Sir Joseph Dalton Hooker
William Harvey
Sir George B. Airy
J. Louis R. Agassiz
Jean Baptiste André Dumas
Sir Richard Owen
James Clerk Maxwell
James Prescott Joule
William Spottiswoode
Arthur Cayley
Sir C. W. Siemens
John Couch Adams
James Joseph Sylvester
Dmitri Ivanowitsh Mendeléeff
Louis Pasteur
Sir Archibald Geikie
Lord Lister
Stanislao Cannizzaro
Von Kölliker
Simon Newcomb
Sir William Huggins
Lord Rayleigh
Eduard Suess
Sir William Crookes
Sir William Ramsay
Dr. A. Russel Wallace
Prof. H. Poincaré
Sir J. J. Thomson
Sir Norman Lockyer
Prof. H. A. Lorentz
Prof. I. P. Pavlov
Prof. A. A. Michelson

¶ **The Portraits of Sir A. GEIKIE, LORD LISTER, Prof. CANNIZZARO, Prof. VON KÖLLIKER, Prof. S. NEWCOMB, Sir W. HUGGINS, LORD RAYLEIGH, Prof. SUESS, Sir WM. CROOKES, Sir WM. RAMSAY, Dr. A. R. WALLACE, Prof. H. POINCARÉ, Sir J. J. THOMSON, Sir NORMAN LOCKYER, Prof. LORENTZ, Prof. PAVLOV, and Prof. MICHELSON belong to a New Series and are Photogravures.**

Proof Impressions of any of the above, printed on India Paper, may be had from the Publishers, at 5s. each.

Cheques and Money Orders should be made payable to MACMILLAN & CO., Ltd.

OFFICE OF "NATURE," ST. MARTIN'S STREET, LONDON, W.C.2.

TO KEEP IN TOUCH WITH SCIENTIFIC MATTERS
IT IS NECESSARY TO SEE "**NATURE**" REGULARLY

Subscription rates

Inland		*Foreign*
£2 12 0	*Year*	£2 17 0
£1 6 0	*Half-year*	£1 10 0
13 0	*Quarter*	16 0

All Subscriptions are payable in advance.

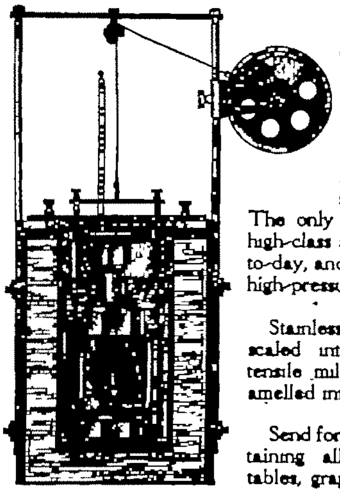
Cheques and Postal Orders should be made payable to Macmillan & Co., Ltd

Please send me "NATURE" for . . . months, for which I enclose remittance value

Name . . . . . .
Address . . . . . .
. . . . .
Date . . .

THIS FORM MAY BE HANDED TO A BOOKSELLER OR NEWSAGENT, OR SENT DIRECT TO MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.

THE
MAHLER-COOK
BOMB CALORIMETER



For determining the calorific value of Fuels (Coal, Coke, Oils, etc.).

The original Bomb Calorimeter, used all over the World and first introduced by the present makers in 1900. The only reliable, accurate, and high-class apparatus on the market to-day, and made by Engineers and high-pressure experts.

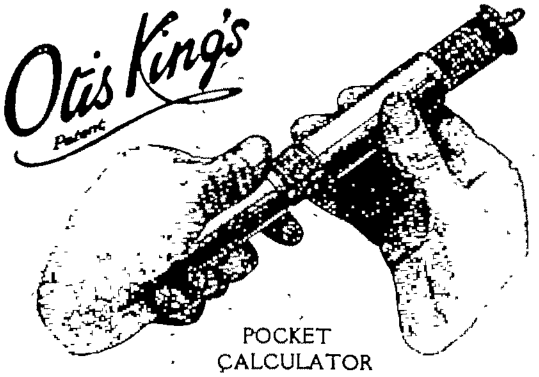
Stainless steel Bombs with descaled internal finish, or high tensile mild steel Bombs with enamelled interior.

Send for Illustrated Booklet containing all working instructions, tables, graphs, etc.

High Pressure Apparatus, Centrifuges, Microtomes, Electroscopes, Steam Meters, Electric Furnaces, etc.

CHAS. W. COOK & SONS,
ROYAL HOTEL WORKS,
ASHBY-DE-LA-ZOUCH, LEICS.

LONDON STOCKISTS **Messrs. Baird & Tatlock (London) Ltd., Cross Street, Hatton Garden, E.C. 1.**



"accuracy is about four times that of the ordinary ten-inch slide rule . . ."

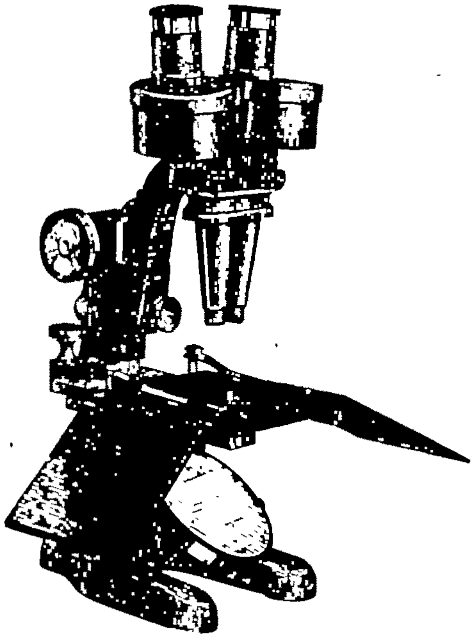
writes a B.Sc., from Canada. This unsolicited letter goes on to state: "My estimate is that I have made about fifty thousand calculations with your product. About twenty-two thousand hydraulic calculations have been made in the last month with a probable error of any one calculation not greater than 5/100 of 1%."

Otis King Model K for multiplication, division, proportion, percentages. Model L gives, in addition, all powers and roots—fractional or otherwise—of all numbers without limit.

Price, packed in leather case, 21/- (special Black Cursor 1/6 extra), post free within U.K.

Write for illustrated and fully descriptive folder.

CARBIC LIMITED
(Dept. N), 51 Holborn Viaduct, London, E.C. 1.
Agents in most Dominions and Foreign Countries



Bausch and Lomb

NEW WIDE FIELD
BINOCULAR MICROSCOPE

Designed to meet the increasing need for a high grade binocular microscope that fulfils the following conditions:

1. Stereoscopic Vision.
2. Extremely Large Field.
3. Long Working Distance.
4. High Eye Point.
5. Wide Range of Magnification.

It gives the advantage of viewing the image in its true position, not inverted or reversed.

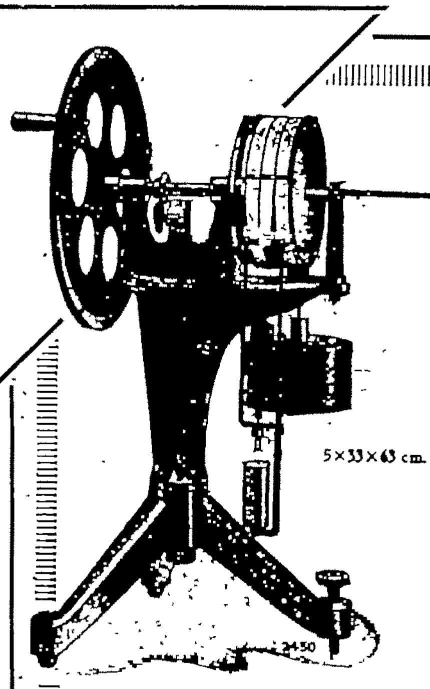
Supplied on four different stands covering every requirement, the microscope being interchangeable on each stand.

Illustrated descriptive list sent on request.

Also Microscopes for all purposes, Microtomes, Photomicrographic Apparatus, Centrifuges, Colorimeters, Hæmoglobinometers, Balopticon Projection Lanterns, etc.

Bausch & Lomb Optical Co. Ltd.
Contractors to British, Indian, Colonial and Foreign Governments.

37-38 HATTON GARDEN
LONDON E.C.1.
Our instruments may be obtained through all Dealers.



CALLENDAR'S APPARATUS

for determining the

MECHANICAL EQUIVALENT OF HEAT

This apparatus, designed by Prof. H. L. Callendar, F.R.S., provides a dependable method whereby the value of "J" can be rapidly determined. By its use, the mechanical work done can be measured by a student to an accuracy of 0·5 per cent in 10 minutes. Friction is practically independent of the rotation of the drum.

DELIVERY FROM STOCK.

Further particulars on request.

CAMBRIDGE INSTRUMENT CO LTD

WORKS:—
LONDON, &
CAMBRIDGE

Head Office & Showrooms:— 45, GROSVENOR PLACE
LONDON, S.W.1

AMERICAN COMPANY:
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

33

THE HERBERT SMITH REFRACTOMETER

For determining the Refractive Indices of Gem Stones and Minerals, and approximately of Liquids and Fats. The Scale gives the Indices without calculation to ·01 and by estimation to ·001. The instrument will accommodate either large or small specimens.

The H.S. Refractometer, in case complete with pamphlet . . .	£9	10	0
Case containing the necessary refracting liquid in two dropping bottles .	0	15	0
Descriptive Pamphlet containing complete tables of the physical characters of gem stones and index to their varieties, by Dr. Herbert Smith . . . . *post free*	0	2	6

J.H. STEWARD, LTD.
406 & 457, Strand, London, W.C.2

MANUFACTURE OF SCIENTIFIC INSTRUMENTS

We have recently installed new machinery in our workshops, and are prepared to undertake the manufacture of new instruments to special design. We have a large selection of school microscopes suitable for educational purposes, workshop microscopes suitable for industrial use, microscope lamps, and special microscopical accessories, all of which are manufactured in our own workshops.

REPAIRS TO SCIENTIFIC INSTRUMENTS

Our facilities for carrying out all kinds of repairs to scientific instruments having been increased, we are now able to undertake additional work, and to carry out the repairs in a shorter time than hitherto. Our men are highly skilled mechanics, of long experience in this type of work, and produce results of the highest quality.

Catalogues and Estimates

Catalogues will be sent post free on request, and estimates are submitted free of cost.

Microscopes—Microtomes—Dark Ground Condensers—Photomicrographic Apparatus—Hæmatological Appliances—Dissecting Stands and Lenses—Microscopical, Medical and Dental Illuminating Apparatus—Micro-projection Apparatus—Epidiascopes—Colorimeters—Prismatic Field Glasses—Cameras, etc.

OGILVY & CO.
Optical Engineers
20 Mortimer Street, London, W.1

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

the eaten species increases the average numbers of both.

In the case of small fluctuations, we have the following approximate laws:

(1) Small fluctuations are isochronous, *i.e.* their period is not sensibly affected either by the initial number of individuals, or by the conditions of protection and offence.

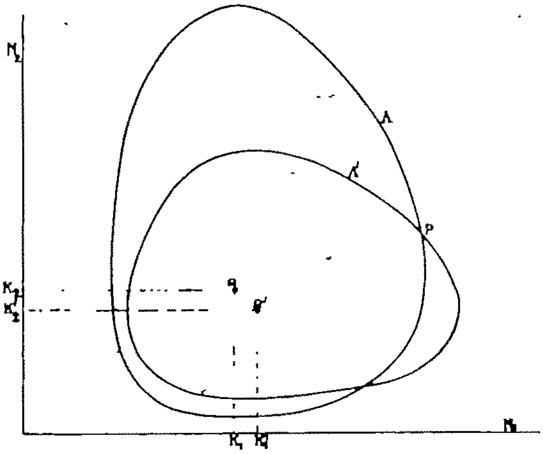


Fig 1.

(2) The period of fluctuation is proportional to the product of the square roots of the time required for the first species to double itself, and for the second species to reduce itself to half. If the first species doubles itself in the time t_1 and the second species is reduced to half in the time t_2, the period is $T=\frac{2\pi}{\log_e 2}\sqrt{t_1t_2}=9{\cdot}06\sqrt{t_1t_2}$.

(3) The steady destruction of individuals of the eating species accelerates the fluctuation, and the destruction of individuals of the eaten species retards it.

With the contemporaneous and uniform destruction of individuals of the two species, the ratio between the amplitude of the fluctuation of the eaten species and that of the eating species tends to increase.

In Fig. 1 are represented two cycles, the second of which corresponds to a perturbation produced in the first by a constant and proportionate destruction of the individuals of the two species. The centre Ω' of the perturbed curve is displaced, in respect to the centre Ω of the primitive curve, downwards and to the right; this reveals an augmentation of the average number of individuals of the first species, and a diminution of the average number of the second.

Law III. is undoubtedly the most interesting of all, because it affords the best actual verification so far found of the theory. For Dr. U. d'Ancona, comparing fishery statistics in the Adriatic Sea before the War, during the War (when fishing almost ceased), and after fishing was resumed at the end of the War, has ascertained that the voracious species (selachians), which feed on other fishes, had increased during the War as compared with the preceding and following periods, while the contrary had been the case for the number of individuals of the eaten species.[2] In other words, a complete closure of the fishery was a form of 'protection' under which the voracious fishes were much the better and prospered accordingly, but the ordinary food-fishes, on which these are accustomed to prey, were worse off than before. This is in agreement with Fig. 1, and with Law III. My theoretical researches, which I was induced to undertake by the statistical studies begun by Dr. d'Ancona, correspond accordingly with his results.

Charles Darwin had an intuition of these phenomena in relation to the struggle for existence when in Chap. iii. of his "Origin of Species" he wrote: "The amount of food for each species of course gives the extreme limit to which each can increase; but very frequently it is not the obtaining food, but the serving as prey to other animals, which determines the average number of a species. Thus there seems to be little doubt that the stock of partridges, grouse, and hares on any very large estate depends chiefly on the destruction of vermin. If not one head of game were shot during the next twenty years in England, and at the same time if no vermin were destroyed, there would in all probability be less game than at present, although hundreds of thousands of game animals are now annually shot."

Law III. is, however, true only up to a certain limit. It is evident that if the destruction of both species continue, their exhaustion will ensue. It is therefore necessary to ascertain up to just what point it is profitable to destroy both species in order to obtain the greatest augmentation in the average number of the eaten species. We arrive in this manner at a curious example of a mathematical *upper limit* without the existence of a *maximum*. There is in fact a limit of destruction beyond which both species are exhausted. If we remain below it, the average number of the eaten species grows as this limit is approached; but once the limit is reached, the eating species tends to exhaustion and the fluctuation ceases, while the number of individuals of the eaten species tends asymptotically towards a value which is less than the average formerly reached.

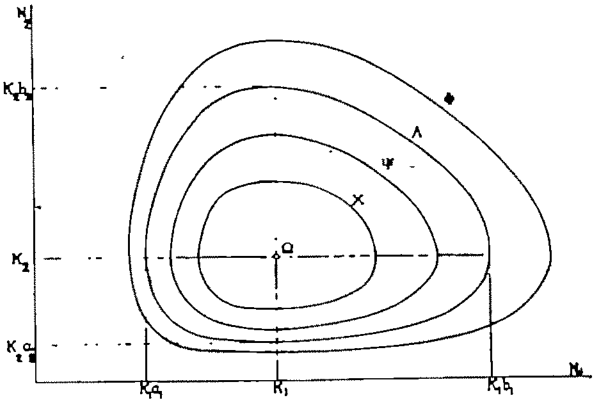


Fig. 2.

Besides the case dealt with above, a study of variations in the number of individuals of two associated species can also be made in all cases in which the species interact either favourably or injuriously, in all possible degrees or combinations. All such cases can be classified in distinct types, and in each of these it is possible to follow the numerical variations of the two species by the help of formulæ, or of diagrams to correspond. It is easy to see from these diagrams *which species is winning in the struggle for existence, and which of them is in process of extinction.*

---

[2] U. d'Ancona.—Dell' influenza della stasi peschereccia del periodo 1914-1918 sul patrimonio ittico dell' Alto Adriatico.—*Memorie del R. Comitato Talassografico Italiano* (in course of publication).

Again, it is certain that many facts of medical interest may be classed among phenomena resulting from concurrent and reciprocal action between different species—between the human species and pathogenic germs, between parasitic species and those on which they are parasites. The periodicity of epidemics may be connected with the same phenomena.

A second part of my investigation is devoted to a general study of biological association, where any number of species may be living together. I have studied two types of association, and have called them *conservative* and *dissipative associations.*

For the first or conservative association, equivalent values may be assigned to the different species so that the destruction of a certain number of individuals belonging to one species by another species, to its own benefit, corresponds to an increase in numbers of the latter species, in the precise ratio which the said equivalents express. Moreover, in a conservative association, the number of individuals of every species has no influence on its own augmentation. The case of two species, already dealt with: the case of *n* species, where individuals of the first eat those of the second, and the latter those of the third, and so on to the *n*th; the case of four species so connected that the first eats the second and the second is also eaten by the third, which in its turn is eaten by the fourth; all these cases are examples of biological conservative associations, if we neglect actions between individuals of the same species. The variation in numbers of the conservative associations depends on a system of differential quadratic equations associated with a skew-symmetric determinant.

Owing to the peculiar properties of these skew-symmetric determinants, and to the differences between those of odd and those of even order, we must treat in different ways the cases where odd and where even numbers of biological species are associated together. When the number is odd, then, if the coefficients allow a 'stationary state,' we shall always have fluctuations such as to maintain the number of individuals of each species between positive limits. These limits are dependent on initial conditions, which may be so assumed as to restrict these limits to any extent we please.

The average numerical values of the different species tend, in periods of time of infinite duration, towards the corresponding values for the stationary state, and are therefore independent of the initial values.

The case of an odd number of species does not correspond to a condition of stability for a strictly conservative system.

In the case of associations which I call *dissipative,* if a stationary state exists, the variations will be fluctuations which slowly extinguish themselves, or are asymptotical. From an analytical point of view, the dissipative association is characterised by a definite positive quadratic form.

The analogous form is null in the case of a conservative system. The dissipative actions work in a way analogous to friction in a mechanical system.

Therefore the terms conservative and dissipative may also be applied to the fluctuations, which in the first case continue to exist, and in the second are dissipated. It will be observed that to prove the existence of the fluctuations, we follow an analysis different from that used in elastic or electric vibrations, the equations here employed being not linear but quadratic.

Applying this theory to a particular case, suppose three different species living together in a limited area, such as an island. Of these three species the first eats the second, which in turn eats the third. We may take for example a carnivorous species, feeding upon a herbivorous animal, which in turn feeds on a certain plant species—assuming that for the last the same method may be used which we apply to animals. The same method may also be employed in the case of insects parasitic upon plants, and of parasites of such parasites.

If we suppose that system to be conservative, that is, if we neglect the actions between individuals of the same species, we may have two different cases which are distinguished by the values of the coefficients occurring in the equations:

(1) The food which reaches the carnivorous species through the herbivorous is not sufficient to maintain the carnivorous species; and so the latter is exhausted, while the herbivorous animal and the plant tend to a periodical fluctuation.

(2) The vegetable species grows indefinitely. This case is, however, incompatible with the limitation of the island, which does not allow the indefinite multiplication of the plant. It is therefore necessary in this case to suppose the system to be dissipative, admitting that the coefficient of increase of the vegetable species is dependent on the number of existing plants, and then we have three cases: Either (1) both animal species are exhausted; or (2) only the carnivorous species is exhausted, while the herbivorous and the plant tend to a fluctuation of gradually diminishing amplitude or to an asymptotic variation; or (3) all three species live together without exhausting themselves, but vary asymptotically in a common fluctuation of gradually diminishing amplitude, the characteristic elements of which can be determined.

Side by side with the general theory, we may make various special inquiries. Thus, for example, we may suppose the coefficient of increase of the species to have an annual period, a supposition tending to establish a law of forced fluctuations superposed on the free fluctuations of the biological association considered.

We may also study how exhaustion takes place of a species in a biological conservative association of an uneven number of species; or in general how exhaustion takes place of species in dissipative associations; or what perturbation is produced when a new species is introduced into an association in equilibrium.

Seeing that a great number of biological phenomena are characteristic of *associations* of species, it is to be hoped that this theory may receive further verification and may be of some use to biologists.

Obituary.

Arthur Walton Rowe.

HARD as it is to see friends go who have played their part upon our shifting stage, it is still harder to lose those who are in the plenitude of their power, before they have fully delivered the message you know they have in them. Arthur Rowe was one of the most remarkable, complex and cryptic natures it has been my fortune to encounter. During the past five and twenty years, probably no one has been on closer terms of continued intimacy with him than I was. We came together in a curious way. At the close of 1900, I had a bad attack of influenza. Feeling very miserable and having little faith in local medical opinion, I said I should go to Margate and put myself into the hands of a physician there who, I knew, had done remarkable geological work: therefore, should be of exceptional intelligence. I did so and fortunately called in Rowe—only to discover that I had pneumonia upon me. Happily we soon disposed of this and then began to talk shop together. I had advisedly taken with me a bookful of my photographs displaying the geology of the Dorset coast. He had just published the first of his papers on "The Zones of the White Chalk of the English Coast—Kent and Sussex," unillustrated. He proposed that we should join forces. So it came that I illustrated for him Parts II. to V. (Dorset 1901, Devon 1903, Yorkshire 1904, the Isle of Wight 1908), which were published by the Geologists' Association.

Rowe was born September 27, 1858. He died September 17, 1926. He was the son of Dr. Thomas Smith Rowe of Margate. He led a very lonely childhood and started geology when quite a boy—in fact, he was a naturalist from birth. His parents were very strict with him, stinted his pocket money and allowed him no youthful companions. He was educated at King's School, Canterbury, at the University of Durham and St. Mary's Hospital.

Rowe began to practise with his father in 1884 and held the house surgeonship at the Royal Sea Bathing Hospital at about that time. He retired in 1910, after having long been the leading practitioner in Margate. He was adored by his patients. He worked very hard at his practice and was able to develop his bent as a scientific inquirer only on Sundays and holidays—a fortnight at Easter and a fortnight in the autumn.

Rowe was a very difficult character to understand. Naturally reticent, his reticence was accentuated by the overmastering tendency of medical etiquette to compel reticence and he became more and more asocial with time. He was given to hobbies and an unusual mixture of the naturalist-collector with the highest type of scientific inquirer—I use the term inquirer advisedly. Excepting Lapworth, no one has so impressed me in the field. He had an exceptional faculty of learning and mastering a subject, an exceptional sense of order and exactness, an exceptional care for truth. His devotion to work was extraordinary. The phrase used by W. P. D. S. in the *Times*—"Whatever he took up (and he took up many things) he did more thoroughly than any other man I have known"—is an exact description of him. Whatever subject he took up, for the time being he thought of nothing else and could talk of nothing else. Unfortunately, he had in him no element of personal ambition—years ago, when some of us wished to prefer his claim to the Royal Society, he would allow nothing of the kind. As the Society has no means of discovering modest men, he remained unencouraged—except by the Geological Society, which gave him the Wollaston award in 1901 and a Lyell medal in 1911. Quite exceptionally, two Lyell medals were awarded that year, the other recipient being Dr. Bather. There was a tie in the voting between amateur and professional.

We owe the earliest attempts at zoning the Upper Cretaceous to Price and Barrois. Little was done, especially with the Upper Chalk, until Rowe took it in hand. He had developed a beautiful method of uncovering and displaying the exterior characters and internal structure of fossils, especially the more delicate forms preserved in the Chalk (involving the use of the dental engine). This enabled him to reveal minute variations in shape and aspect previously unsuspected. Collecting the material personally, he noticed that these variations were in sensitive relation with the exact position of the organisms in the succession of the Chalk strata and it occurred to him that the fossil sea urchins in particular might be useful as indicators of the age of any particular portion of the Chalk sequence: in fact, his first scientific contribution was "An Analysis of the Genus Micraster" (1899). A trial in the Dover area convinced him that he had found the key to the succession and he used this in many localities and published many maps and correlating memoirs which have thrown clear light upon the lapse of time and upon geological evolution in the later Cretaceous period. His methods proved to be of use in the hands of other observers and practically the whole of the British Chalk has now been zoned and correlated, Rowe's services being not merely those of a pioneer but the generous helper and inspirer of his contemporaries and successors.

There also fell into Rowe's hands, possessed as he was of an accurate and delicate time scale, most important details with regard to the time succession of evolutionary changes in the chief types of organisms that he studied. He was able to put on record a long series of accurately observed facts bearing upon their evolution and thus made contributions to zoology as important as those which he made to geological science. It should be added, he was greatly aided by C. Davies Sherborn.

Rowe lived at the back of Margate, at Shottendane, in a most beautiful sylvan hollow. He acquired the site in 1903 and very soon developed a passion for gardening which for a time overcame all other interests. About three years ago, he suddenly dropped gardening to excavate an old Roman site, near at hand, work which he did almost entirely himself. He had a profound knowledge of Margate history and had accumulated an invaluable collection of prints and documents. He was also a student of words, having been influenced in early life by Trench's fascinating book. At one time, he was very active in local affairs and did much to raise public taste in music. He sang well in early days and his wife was an accomplished musician. Their son inherits the gift of music.

Year after year I have urged him to get back to his chalk work. We had even talked of producing a chalk atlas together. I am glad to say that his interest in geology was so far revived that only six weeks before he died, when I was about to visit him, he wrote to me that he was ill but had finished a paper on the serpulids and I hear also one on "The Great Chalk Sea," which he probably, of all men, was the most competent to picture. He had been in bad health but would not give in until the papers were written and told his medical adviser, his former partner, that he had waited to send for him until they were finished. The act was characteristic of the man—he never thought of sparing himself. It is sad that the world is ever selfish and has no way of caring for such men and providing that they use themselves with consideration and full effect: we respect genius but little until we can no longer use it. Some day, when work such as Rowe's is described in readable form, the walls of ignorance will be shattered and the wondrous beauty of the lowly organisms of which chalk is composed will be made manifest. Our present indifference to geology is little short of criminal, seeing that it is the story of our earth.

HENRY E. ARMSTRONG.

REV. F. D. MORICE.

THE Rev. Francis David Morice, well known as an authority on certain families of Hymenoptera, died at Woking in his seventy-eighth year, on September 23. Educated at Winchester, from which he passed in 1866 to New College, Oxford, he gained high distinction as a classical scholar, and in 1874 was appointed a master at Rugby under Dr. Jex-Blake. Here he remained for twenty years, retiring ultimately in 1894 to Woking, where he took a house next to his great friend Edward Saunders, and devoted himself to entomological research.

During the latter half of the years at Rugby, Mr. Morice had frequently consulted Saunders regarding his captures of local bees and wasps. The results were published from time to time (1888–92) in the *Report* of the School Natural History Society. From this time until recently Mr. Morice made numerous contributions to the literature of his subject, at first dealing mainly with the chrysids (cuckoo wasps), aculeates, and fossores, but latterly confining himself almost solely to the Tenthredinidæ (saw-flies). Here, probably, his most valuable work was done in his careful tabulation of British native species (1903–16). His conclusions were arrived at only after full discussions with continental students and an exchange of material, and it had long been his wish to gather his scattered papers in monographic form. But he had barely begun this revision when his death occurred.

Mr. Morice wielded a considerable influence, both among British and continental Hymenopterists. His knowledge of the palæarctic non-parasitic Hymenoptera, and of their distribution, was comprehensive and exact, and he had besides made several specialised studies, *e.g.* on the structure of the terebra in saw-flies. In nomenclatural discussion also his opinions were valuable, backed as they were by a sound scholarship, aware not merely of the rules but also of the elasticity in practice of classical usage. He will be remembered, however, chiefly as a consultant and helper of younger workers. A constant stream of collections, small and great, found its way to Woking for identification, and the work was never refused.

Mr. Morice joined the Entomological Society in 1889, and became its president in 1911. He was a regular attendant at entomological gatherings, and so recently as July of last year was present at the third International Entomological Congress held at Zurich; for, to the end, he greatly enjoyed the society of his fellow-workers. He also spent much time as a voluntary worker on the British Museum collections at South Kensington, to which institution he presented the important British collection formed by Edward Saunders. His own collection he bequeathed to Oxford.

J. W.

WE regret to announce the following deaths:

Mr. G. W. Lamplugh, F.R.S., lately assistant director of the Geological Survey of Great Britain, and president in 1918–20 of the Geological Society, on October 9, aged sixty-seven years.

Major W. E. Marshall, Principal Medical Officer of Health to the Sudan Defence Force, formerly an assistant bacteriologist at the Lister Institute of Preventive Medicine, on September 24.

Mr. H. W. Page, consulting surgeon to St Mary's Hospital, London, past president of the Neurological Society of London, and the author of numerous contributions to medical and surgical literature, on September 9, in his eighty-first year.

News and Views.

DURING the recent Church Congress at Southport, one day was largely engaged with discussion on the 'religion and science' issue. The most notable utterances were a sermon by Dr. Lang, the Archbishop of York, and a paper written by the late Vice-Chancellor of the University of Liverpool, the distinguished pathologist Dr. Adami, whose recent death was a grave loss to medical science. Dr. Lang directed attention to the change of outlook in contemporary science, which "is beginning to ask questions about fundamental presuppositions hitherto taken for granted; about the meaning of the universe as a whole." Science, in other words, seems to be becoming more philosophical. The Archbishop then made a strong plea that this new orientation in science should be met, on the part of the Church, by "an attitude of the fullest sympathy and trust." "The Church will not merely be detached. Its members will be ready to accept whatever truths in the region of natural science or historical criticism seem to be really established, and to welcome them as new revelations of the divine working." This must rank as a really significant utterance, and, if it speaks for the Church of England as a whole, is a most hopeful sign of the times.

DR. ADAMI's paper to the Church Congress outlined the attitude of the man of science towards faith and the spiritual life Three possible attitudes are indicated: (1) Negation of everything that is outside the boundaries of the senses and therefore incapable of being tested by physical means. (2) Acceptance of and belief in things of the spirit as of a world that is wholly apart from the material universe, and so from science This was the attitude of Pasteur (under whom, it is interesting to note, Dr. Adami studied). (3) Belief that science and faith are governed by the same laws and that their methods are essentially identical. Rejecting the first two attitudes, Dr. Adami developed the third, showing how scientific knowledge advances by the use of hypotheses and the perpetual revision of theories in respect to new facts Thus the Newtonian physics has been revised by Einstein, and Dalton's chemistry by J. J. Thomson and Sir Ernest Rutherford. The method of science is that of a search after truth by "progressive assumptions," and the search for religious truth is guided by a similar principle. It, too, is 'pragmatic,' and based on hypothesis and experiment.

DR. ADAMI's paper was followed by one read by the Rev. J. C. Hardwick, which dealt primarily with certain ethical difficulties presented by the facts of biological science, instancing the behaviour of the ichneumon wasp. He suggested that the difficulties arise from regarding Nature as a completed system rather than as an incomplete process, various stages of which co-exist and find themselves in disharmony. If Nature is to be judged, she should be judged by her latest products, *i.e.* in the light of man and his ideals, rather than by the wasp or the slug. It was refreshing to find authoritative spokesmen expressing views which cannot fail to create a new atmosphere. How far the audience realised the implications of all they heard may be doubtful. Dr. Lang's allusion to the results of "historical criticism" is especially significant, for it is these, rather than the facts of natural science, which create problems for theologians to-day. Furthermore, Dr. Adami's policy of revised hypotheses would spell the end of all theological finality; though, to be sure, this might give religion a new lease of life

SIR OLIVER LODGE, on October 7, began at the Mansion House, London, a series of lectures endowed by Mr. Halley Stewart on the general theme of religion and science, with special reference to human progress. Sir Oliver said that he is impressed with the majesty and possibilities of the universe, as contrasted with the comparatively narrow outlook of the average of those engaged in the work of the world. With regard to religion and science, he does not feel oppressed by any conflict between them when both are reasonably understood. Both involve knowledge of certain aspects of the same universe, and controversies arising between them must spring from misunderstanding and limitation of outlook. As for scientific knowledge, we little know whither its increase will lead us. The aspect of science which appeals to the majority of mankind is to be found in the applications and conveniences which can be derived from it. But the power to control the forces of Nature and to adapt them to our ends must depend for its value on what those ends are. The uses we now make of our increased powers may not be such as really conduce to the progress of humanity In spite of the scientific and mechanical progress of the nineteenth century, no one can feel that we have arrived at a stable and satisfactory stage of civilisation. Though material development ought to conduce to human progress, there is no inevitable connexion between the two Increased power over Nature involves increased power to destroy. Yet, on the other hand, if competition gave place to co-operation, and if each individual sought the welfare of the whole, the possibilities of life on this planet would be found to be such as have scarcely yet been imagined. Sir Oliver is inclined to believe that the possibilities of Christ's teaching of love and forgiveness are to-day being more clearly realised, and there will come a day when human intercourse will be saturated with it. The lecture was characteristic of the new outlook which sees that the chief problem raised by the rapid development of scientific technique is an ethical problem, and it is doubtful if this can be solved in isolation from religion.

MR DANIEL GUGGENHEIM, the copper magnate, has given a sum of 500,000*l.* for the promotion of aeronautics. His son, Mr. Harry Guggenheim, is president, and Admiral H. I Cone is vice-president, of the board of management of the fund. Admiral Cone was in command of the U.S A. naval forces on foreign service in 1917–18, was wounded in the sinking of a British destroyer by submarine, is a Commander of the British Empire, and holds the Distinguished Service Order. Major R. H. Mayo, well known in British technical aeronautics, represents the board in Great Britain, and has assisted the president and vice-president, during a recent visit, in considering methods of applying the fund They have come to the conclusion that the Royal Aeronautical Society is an appropriate body through which direct expenditure may be made in Great Britain towards co-ordinating international scientific and technical information, and a grant of 1000*l.* has been made for the year 1926–27. In the U.S.A. 60,000*l.* has been allocated to each of two Californian institutions—the Leland Stanford University at Palo Alto and the California Institute of Technology at Pasadena—for the purpose of equipping and carrying on schools of areonautics. Prof. W. F. Durand holds the chair of engineering at Leland Stanford University, and Dr. R. A. Millikan is president of the California Institute of Technology; their names suggest a due balance between technical development and physical research.

THE seventh year of the Tidal Institute of the University of Liverpool, according to the annual report for 1925 just issued, has been devoted mainly to the analysis of tidal observations and the preparation of tide tables. The method devised in 1923 for the execution of such work on a large scale has been thoroughly tested, and has proved effective and in all respects satisfactory. New advances have been made in regard to the prediction of tides in shallow waters; a request to analyse records from Avonmouth, where the shallow-water effects are extremely acute, led the secretary, Dr. Doodson, to devise harmonic corrections which are more general and more widely applicable than the non-harmonic corrections hitherto used in such cases. An entirely new problem of great importance to navigation in many regions was raised by a request of the Canadian Hydrographic Office for a method of predicting the times of turning of tidal currents, affected by large diurnal constituents, from records of such times alone; Dr. Doodson has devised such a method, which is being applied and tested. The Institute has undertaken tidal analyses or predictions for the Admiralty, the Port of London Authority, the Lower Liao River Conservancy for Newchang, the International Council for the Exploration of the North Sea, the New Zealand and Queensland Governments, and the other bodies already mentioned. A radio receiving set has been installed so that weather reports may be utilised to assist in a proposed new service of daily predictions of meteorological perturbations of sea-level at Liverpool.

THE papers read at the recent Conference of Public Lighting Engineers in Newcastle-upon-Tyne dealt with matters of professional rather than scientific interest, but there were several points mentioned that are not generally known. Mr Colquhoon, in the course of his paper, stated that Scottish boroughs have a statutory obligation to provide proper public lighting, but there is apparently no similar obligation in England, the only legal requirement being that obstructions on roadways (such as those due to repairs) must be lighted by night. Similarly, in a paper entitled "Lighting Hours," Mr. Beveredge explained that there is no standard legal schedule of the hours for which public lamps must be lighted; each authority acts at its discretion, and there is considerable variation in the practice of different towns. It is only the drivers of vehicles who are required to exhibit lights during specified hours. There was some discussion on the practicability of a standard schedule for lighting hours, but it was suggested that at least two schedules, one for the south and one for the north of England, might be required. The possibility of compliance with a rigid scheme of lighting hours also depends largely on the facilities for lighting up and extinguishing, *i.e.* the extent to which automatic methods of control are available. The question of the lighting of important arterial roads designed for motor-traffic was also discussed. There is a general feeling that the lighting of such routes ought not to be left entirely to the discretion of the individual authorities in areas traversed, and that a portion of the Roads Fund might be applied to lighting by the Ministry of Transport, which is already interested in the maintenance of the surfaces of roads.

AUTUMN in Great Britain has this year continued generally exceptionally fine and mostly warm. In September the weather was fine and dry, the total rainfall being remarkably low in some southern districts; Southampton had a total of only a quarter of an inch. The weather was very warm in the third week of September, the thermometer in the shade registering 88° at Greenwich on September 19, and in many places the highest temperature of the year was experienced. In the south-east of England, the mean temperature for the month was about 4° above the normal. There were four days during the month at Greenwich with the solar radiation temperature above 140°. For the first three weeks there was not a single day with the mean temperature below the average. There was a considerable drop of temperature after September 25. Some October temperatures during the first ten days of the month touched 70°, mostly registering about 65°, in 1921, five years ago, October was remarkably fine and warm, the thermometer at Greenwich exceeding 80° on several days in the early part of the month There was a break on Saturday, October 9, due to the arrival over Great Britain of a vigorous secondary disturbance from the Atlantic, and gales were experienced in places on the coasts, with heavy rain-showers in places. Colder weather spread over the country in the rear of the disturbance and the conditions became more normal for the season of the year.

THE inaugural address at the opening of the eighty-fifth session of the School of Pharmacy of the Pharmaceutical Society was delivered on October 6 by Dr. J. F. Tocher, of the University of Aberdeen. In the course of his remarks, Dr. Tocher commented on the possible reasons which lead to the adoption of pharmacy as a career, and hoped for the time when students of all kinds might be classified according to their ascertained intelligence, so that their teachers would be able to impart knowledge to them more successfully. But such tests would scarcely distinguish between those who favoured pharmacy as a profession and others whose thoughts turned towards different careers. With increasing knowledge, the training of the pharmacist becomes more arduous: the rapidly expanding list of drugs used in medicine requires knowledge of their properties and uses, and of the tests necessary to ensure their purity. In the Pharmacological Laboratory which the Society has recently opened, the student will be able to gain first-hand experience in the testing of those drugs which require for their assay the use of animals. Thus although the minimum standard of knowledge has been raised with the advance in knowledge in the other sciences, the enthusiastic student will find ample opportunity not only to reach this standard but also to progress beyond it.

A REPORT by Prof. J. Borozdin, quoted by the Riga correspondent in the issue of the *Times* of October 8, gives a brief account of the results of excavations carried out by Prof. Farmakovsky in the neighbourhood of Nikolaieff, where he has been working for the last twenty years, on the site, hitherto not identified, of the Milesian colony of Olbia (which was described by Herodotus), at the mouth of the River Bug. The excavations now embrace an area of 287,000 sq. yd., not including a necropolis, and the objects brought to light include dwellings, temples, and vaults. In the centre of the town stand the ruins of a temple of Apollo. Nine successive strata of remains have been discovered; these show a variety of influences from several sources, including Attica and the Roman Empire as well as Miletus. Of even greater interest are the excavations at the village of Usatoff, some five miles out of Odessa. Here a culture has been found which is said to exhibit the transition from neolithic to bronze and to be advanced of its type It is that of a settled agricultural community with earthen dwellings closely resembling the culture of Tripolje The pottery is of the characteristic painted type, having strong points of resemblance to the widely diffused painted pottery which, with wide divergences and of varying epochs, it is true, is found in China, central Asia at Anau, India, Elam, Mesopotamia, Cappadocia, and Syria, and in Europe in southern Russia, Rumania, Bulgaria, Thessaly, and southern Italy. An example is said to have been discovered in the Crimea. Further information will no doubt confirm the importance of the discovery, which should serve to throw additional light on the difficult question of the relationship and lines of diffusion of this remarkable type of prehistoric ware.

The Trueman Wood Lecture of the Royal Society of Arts will be delivered on October 27 at 8 P.M. by Dr R. J. Tillyard, chief of the Biological Department of the Cawthron Institute of Scientific Research, Nelson, New Zealand, who will take as his subject "The Progress of Economic Entomology."

The James Forrest Lecture for 1926 of the Institution of Civil Engineers, which was to have been given in May, will be delivered at the Institution on Tuesday, October 26, at 6 o'clock, by Senator G. Marconi, who will take as his subject "Radio Communications." Before the lecture, the Kelvin Medal for 1926, which has been awarded by the Kelvin Medal Committee to the Hon Sir Charles A Parsons, will be presented to him by Sir William Ellis, president of the Institution.

Prof. Hans Thirring, professor of physics in the University of Vienna, will deliver a lecture in English on October 19, on "The Position of Science towards Psychical Research," at the National Laboratory of Psychical Research, 16 Queensberry Place, South Kensington, London, S W 7. This lecture is one of a series arranged for the season 1926–27, which includes one by Mr Stanley de Brath on "Animism, Spiritism and Spiritualism" (February 15), and another by M. René Sudre (in English) on "Psychical Research and Psychology" (March 15).

The three Cantor Lectures on thermometry which have been given by Mr. W. F. Higgins of the National Physical Laboratory to the Royal Society of Arts are reproduced in the issues of the *Journal* of the Society for September 3, 10, and 17. They furnish the best account available in English of the properties and behaviour of the mercury-in-glass thermometer, of the methods used in its standardisation, and of the precautions to take in order to obtain the most accurate results from it. Mr Higgins looks forward to the time when the mercury-in-silica thermometer will be substituted for the mercury-in-glass thermometer for all accurate work

The seventy-ninth annual meeting of the Palæontographical Society was held at Burlington House on October 1, Dr. F. A Bather, vice-president, in the chair. The annual report announced the completion of Miss Chandler's monograph of the Upper Eocene flora of Hordle, and the early issue of further instalments of the monographs of Gault Ammonites, Malacostracous Crustacea, and Palæozoic Asterozoa. The council appealed for the help of more personal subscribers, the larger number of the supporters of the Society being now public institutions Prof. W. T Gordon, and Messrs. G Barrow, A T Hopwood, and J. Pringle were elected new members of council. Mr. E. T. Newton was re-elected president, and Mr. Robert S Herries and Sir A. Smith Woodward were re-elected treasurer and secretary respectively.

The council of the Institution of Civil Engineers has made the following awards for the session 1925–1926 in respect of selected engineering papers, published without discussion · A Telford Gold Medal and the Indian Premium to Mr C R. White (London) a Telford Gold Medal to Mr. E. L Everatt (Bombay) and Telford Premiums to Dr B. Hague (Glasgow) Prof A H. Gibson (Manchester) and Mr. S Labrow (Bury) jointly; and Dr W. J. Walker (Johannesburg) The following awards have been made in respect o papers read at students' meetings in London or b students before meetings of local associations durin the same session The James Forrest Medal and Miller Prize to Mr D. S Matheson (London), an Miller Prizes to Mr. H R. Lintern (Shepton Mallet Mr R. D. Carr (Cupar), Mr. C Peel (Frodsham Mr R. S. Bamber (Leeds), Mr N R Rice (Dar-e Salaam), Mr J G Kimber (Eastbourne), and M J B Mayers (Birmingham).

The Earl of Balfour presided at a congregation Cambridge on Tuesday, October 5, when the U versity commemorated the three-hundredth an versary of the death of Francis Bacon, Lord Verula by awarding honorary degrees to the Cavendi professor of physics, Sir Ernest Rutherford, a to Prof. W S. Holdsworth, Vinerian professor English law in the University of Oxford. The pub orator spoke of Bacon, eminent in civil law a natural science, as a follower of the Stoics, w taught us to strive to adjust our laws to the laws Nature; Dr. C. D Broad, Trinity College, who tured to the University on Bacon, described him the father of inductive philosophy, one who covered and explicitly stated the methods and p ciples of scientific research, which his successors h used with success. An afternoon reception was gr by Trinity College and a dinner in the evening which the Earl of Balfour spoke to the toast Bacon's memory

A recent issue of the *Weekly News Bulletin* of U.S.S.R Society of Cultural Relations with For Countries contains under the heading "Scien

Life" an account of measures recently adopted for encouraging intellectual activity. The title "merited" has been established, to be conferred for distinguished service by scientific and technical workers. Money premiums are to be given for inventions and suggestions, even though they may not directly result in the saving of expenditure. Instances of pensions for prominent services in science are also mentioned Under "International Cultural Relations" are reports of visits to Russia by Profs. Erlander of Stockholm, Wiegond and Rodenwald of Berlin, and Tenier of Strasbourg, and visits to Egypt by the Rector of the Russian Hydrological Institute to take part in the International Navigation Congress at Cairo, and to the Balkan countries and Italy by N P Sycher of the Russian Academy of History of Material Culture.

WE have received from Messrs. Stafford, Allen and Sons, Ltd., Cowper Street, Finsbury, London, E C.2, a sample of 'Sira' immersion oil and of 'Sira' mountant Originally produced as a result of researches conducted at the British Scientific Instrument Research Association, these products are now prepared by the manufacturers in accordance with the directions of the Association. The refractive index of the immersion oil (1·524 at 20°) is adjusted to suit modern high-power object glasses, condensers, and micro cover glasses. An important feature of the oil is its freedom from corrosive action on metals or on optical glass. 'Sira' mountant, being quite neutral, may be advantageously used in place of Canada balsam, the acidic properties of which are known to affect certain stains and other substances when mounted in it. These 'Sira' products, which may be obtained from all scientific instrument makers and dealers, should prove of considerable value to microscopists whose work demands critical observation, in assisting them to obtain the best possible results from their microscope and its accessories.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A pathologist for the City of Nottingham—The Town Clerk, Guildhall, Nottingham (October 18) A junior inspector of mines for North Wales (Lancashire and North Wales Division)—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (October 25). A mycologist under the Ceylon Rubber Research Scheme—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S W.1 (January 1). A lecturer in physics in the University of Otago, New Zealand—The High Commissioner for New Zealand, 415 Strand, W C.2 A junior technical officer at an Admiralty Experimental Establishment, with good theoretical and practical manufacturing knowledge of the design of electrical apparatus—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. A lecturer in mechanical engineering at the School of Science and Art, Newark-on-Trent—The Secretary, Old Magnus Buildings, Appleton Gate, Newark-on-Trent A junior mathematical mistress—subsidiary subjects geography and botany—at the Southport High School for Girls—Application forms from the Director of Education, Education Office, Southport, but returnable to the Headmistress.

Our Astronomical Column.

MINOR PLANETS.—Vol. 9, No 9 of the *Journal des Observateurs*, contains a study of the orbit of No 117 Lomia by M. Henri Blondel This covers the period from 1913 to 1925, and includes the perturbations by Jupiter and Saturn. A good agreement with observation is obtained It is noted that observations over a period of some four months are required to obtain a good orbit from a single opposition. It is suggested that ephemerides should be extended over a longer range than is usually done.

This is a favourable time for observing the interesting planet 132 Aethra, which was recovered a few years ago after being lost for half a century. It is in high north declination and of magnitude 11. Ephemeris for 0^h by H. Hartog (*Astr. Nach.* 5464):

	R.A.	N Decl.
Oct 16	$3^h\ 33^m\ 16^s$	41° 16′
,, 28	3 23 36	40 30

ANOTHER DETONATING FIREBALL.—Mr. W. F. Denning writes that a very large meteor was visible on the evening of Saturday, October 2, at $19^h\ 25^m$ G.M.T. As observed at Bristol, its path was from 330° – 7° to 34° + 14°. A considerable number of observations have been received, and a comparison of these shows that the object passed from over the English Channel (45 miles south of Brighton), northwards over the western suburbs of London, and on to the northern region of Hertfordshire, where it exploded at a height of about 11 miles. The radiant point was in Capricornus at 305° – 13°. The velocity of the fireball was about 13 miles per second along a real course of about 125 miles. The nucleus was green, followed by red sparks. The weather being generally clear in the south of England, the phenomenon was pretty generally witnessed, though observers differ materially in their impressions concerning it. The radiant of the fireball agrees with that of a well-known shower in July and August.

C. SCHOCH'S RESEARCHES ON ANCIENT ECLIPSES.—Allusion has already been made in these columns to Schoch's conclusions on the eclipse of the Odyssey, which he identified as that of April 16, B.C. 1178. He has now discussed a still more ancient eclipse, that in the tenth year of the Hittite king Mursilis II. He identifies this as the annular eclipse of B C 1335, March 13, which was central in the region of the Azzi (about Erzeroum). The total eclipse of Jan. 8, 1340, is excluded, since military operations would not take place so early in the year in that elevated region. Schoch notes that the region is the same as that afterwards traversed in the retreat of the Ten Thousand. He has also identified various eclipses mentioned by Greek poets:

Poet.	Date B.C.
Mimnermos, same as eclipse of Thales	May 28, 585
Stesichoros and Kydias. . .	May 19, 557.
Agathokles eclipse, concluded position of Agathokles in Straits of Messina	Aug 15, 310.

Research Items.

The Origin of the Masai and the Wild Tribes of Borneo.—In the *Journal of the East Africa and Uganda Natural History Society*, No. 26, August 1925, Mr. C. Cardale Luck puts forward a theory that the Masai and related tribes of East Africa are the ancient Israelites, while the wild tribes of Borneo, the Kenyah, Kayan, Punam, etc., are the ancient Edomites. Merker's theory of the Semitic origin of the Masai, it is pointed out, might have been extended to identify them with the ancient Israelites, had it not been conditioned by the view that if their route of migration was through the Nile valley, it must have taken place in the prehistoric period before the Egyptian settlement. The historical evidence, however, points to the possibility of a movement of Asiatic peoples in the required direction in Egyptian historic times in the influx of Semitic peoples after the Hyksos period, the transference of captives after the Egyptian conquests, the flight of such of the Israelites as were not carried off into Assyria before the victorious armies of that power, and the desertion into Ethiopia of mercenaries, presumed to be Asiatic, under Psamtek and Tanutamen of the Nubian dynasty. Looking at the evidence afforded by the Masai and kindred tribes, distribution of language clearly suggests a north to south movement. The religion of the Masai, a trinity of Engai, a feminine supreme deity, and two inferior deities, a black or good god and a red or evil god, points to an original mother goddess worship, ultimately of Asiatic origin. The Canaanites in passing through Egypt confused her with Hathor, the minor gods of the Masai being Osiris and Set. Tribal names of the Masai also point to Canaan, Ma-a-sae, L'Aiser and Gidon being equated with Ma-na-say, Je-ezer, and Gideon. Similar equivalences are found in the Bornean religion, belief, and nomenclature and pointing to a Canaanitish origin.

Sickness, Death and Burial among the Maori.—Notes from a native source in the original and in translation relating to the ritual of death and burial among the Maori of New Zealand are given by Mr. Elsdon Best in the *Journal of the Polynesian Society*, Vol. 35, No. 1, which contain certain data not hitherto recorded, and some interesting formulæ. In former times there was little ritual pertaining to burial, and indeed the ceremonies performed over a sick person were more elaborate, possibly owing to the fact that the custom of exhumation and final disposal of the remains was looked upon as the real burial. There were several ritualistic performances by which the shamanistic adepts diagnosed the cause of illness. This was usually either black magic or infringement of the laws of *tapu*. The ceremony here quoted, for a chief seized with severe illness, involved the use of formulæ absolving a person from the polluting effect of all immoral or wrongful acts committed from childhood up to that time. The dead were usually disposed of by inhumation, but sometimes they were merely placed in a cave. The body was flexed before it was cold, the knees being drawn up to touch the trunk and bound with a cord. In a few cases it was exposed to a rude drying process. The exhumation took place some years, sometimes so many as eight, after the first burial, although, as a number of exhumations took place at one time, there must have been considerable variation. The function was one of remarkable *tapu*; it involved the employment of adepts and was carried out with an elaborate ritual; the final destination of the remains was a cave, fissure, or hollow tree. Great care and skill were exercised in removing the bones, especially in recovering the small bones. Articles placed with the dead such as weapons and ornaments, both at the primary and secondary burials, were sometimes recovered for the relatives by a priestly adept, with the performance of certain ceremonial observances.

Alien Plants in the Isle of Wight.—The bulk of vol. 1, part 5 of the *Proceedings of the Isle of Wight Natural History Society* for 1924 is occupied by a list of the alien plants of Hampshire and the Isle of Wight, by John F. Rayner. The list is a very long one and has obviously been in compilation for some years, the author being helped by a number of local botanists, as well as by veteran systematists, as Dr. Claridge Druce.

An Antarctic Flora.—The Australasian Antarctic Expedition, 1911–14, has recently published as vol. 7, part 5, some beautiful photographs of the very characteristic flora of Macquarie Island, which were not available when the late Mr. F. T. Cheeseman prepared his report on the vascular flora of Macquarie Island, owing to the disturbance of personnel and records of the expedition brought about by the War. The photographs of *Pleurophyllum Hookeri*, of *Stilbocarpa polaris*, and of such cushion plants as *Azorella selago*, are of great ecological value, some photographs giving detail of individual plants beautifully, whilst others show in a striking manner their characteristic distribution on this wind-swept antarctic island. All the conspicuous members of the flora are represented photographically in these 19 plates, while Mr. Harold Hamilton supplies brief notes on the ecology.

Pentosans and Cold Resistance in Plants.—Of recent years, American workers, especially J. T. Rosa and Victor R. Boswell, have tried to establish a connexion between the pentosan content of certain plants and their resistance to frost damage. The underlying assumption has been that the water-imbibing properties of the colloidal pentosans have enabled these plants to retain the water in this form and thus resist the tendency to ice-formation and consequent protoplasmic disorganisation. Arguing further that the retention of water by imbibition by the pentosans should be effective against force of dehydration, Rosa compared the transpiration rates and rates of drying of cold resistant and non-resistant plants. Both Rosa and Boswell agree that the hardened plants lose water more slowly under comparable conditions, and suggest in fact that this property provides a simple test, in horticultural practice, of the relative hardiness of a plant. This attractive theory comes out very badly from a thorough investigation by Prof. Doyle and Miss Phyllis Clinch, of the Department of Botany, University College, Dublin, who have tested its application to evergreens, and particularly conifers. In conifers they conclude (*Scientific Proceedings of Royal Dublin Society*, vol. 18 (N.S.) No. 21, 1926) that no relation, seasonal or otherwise, can be established between hardiness and pentosan content. Furthermore (same *Journal*, No. 24, 1926), they show that the rates of drying show no relation to pentosan content, and on physico-chemical grounds there seems little reason to expect any other result, whilst until Rosa and Boswell have repeated their drying experiments with chopped-up tissues, there is little or no reason to assume that pentosan content has any connexion with the differences in drying shown by hardy and non-hardy varieties.

Minerals from the Ruby Mine District of Burma.—A notable contribution to the mineralogy of Burma is published by F. D. Adams and R. P. D. Graham in the *Trans Roy Soc Canada*, Section 4, 1926, p. 113 Between the Irawadi and Mogok the exposures show alternating bands of gneiss and coarsely crystalline limestones which recall the sections through the Grenville series of the Canadian Shield. Half way along the road to Mogok a large intrusive body of granite occurs with an enormous pegmatite dyke near its eastern border The dyke is made up mainly of kaolinised orthoclase and quartz, the latter being often in large transparent crystals Lepidolite crystals up to six inches across are described, and muscovite, topaz and cassiterite. An interesting nepheline-sodalite rock occurs at Mogok, the sodalite from which has a beautiful deep lilac colour. The colour fades on exposure to light, and disappears immediately when the mineral is slightly warmed, this being a characteristic of all pink sodalite. A nepheline-ægerine-augite rock (urtite) was found at Sinkwa, 13 miles from Mogok. Both nepheline rocks resemble very closely varieties occurring in the Bancroft district of Ontario, and afford additional examples of the common association with crystalline limestones Other minerals described are chrysoberyl, sillimanite and forsterite from Mogok. A more detailed description of the geology of this part of Burma, together with an account of the methods adopted in working the deposits for rubies, was given by Prof. Adams in the *Bull. Canadian Inst. Min. Met*, 29, Feb. 1926.

Platinum in South Africa.—In *Economic Geology*, Nos. 2 and 3, 1926, Dr. P. A Wagner gives a very full account of the occurrence of platinum in the Transvaal and Southern Rhodesia As the chief deposits have already been noticed in Nature, attention is here directed to the genetic considerations with which Dr Wagner concludes his study. Concentrations of platinum are more widely distributed in South Africa than in any other part of the world, and the platinum-bearing rocks have been produced in practically all the periods of igneous activity from the earliest Archæan onwards From the Vaal River to the Zambezi the principal deposits are confined to a narrow meridional belt that cuts indiscriminately across all the other structural features. Some deeply underlying region must therefore have contributed the ores, suggesting that the *sima* or peridotite zone beneath South Africa is, or has been, unusually richly endowed with platinum. J E. Spurr has already advocated the idea of great *ore canals*, stable throughout geological time, from which igneous magmas have abstracted ores and, ascending in the crust, have concentrated the metals nearer the surface. Dr Wagner similarly conceives the presence below the platinum belt of a great platinum-rich canal which has provided the material transferred towards the surface by successive igneous intrusions It is also pointed out that there is an equally remarkable gold province in south-east Africa which may well have drawn its gold from the same canal. It is worthy of notice that if the hypothesis be true in the form in which it is advocated by Spurr and Wagner, it raises a most serious objection to the migration of continents over the substratum that has been envisaged by Wegener, and somewhat differently by Joly On the other hand, the conception itself is in accord with the inference drawn by Holmes (from the atomic weight of lead) that lead ores must have had some source independent of any later concentration from the magmas of igneous rocks Another point is that no ore deposits are found in oceanic islands, suggesting that the continental rocks are more probably the original home of most ores rather than the underlying *sima*. If this be so, then the ore canals may represent concentrations produced in and near the bases of the continents at the time of their origin. If, then, the continents moved laterally in later ages, the canals would be carried with them, and not left beneath and behind as they would otherwise be.

Tides and Sea Seiches.—Tidal features of local coastal origin and sea seiches are discussed by Prof J Proudman in a recent *Geophysical Supplement* (vol. 1, No. 6, 1925) of the *Monthly Notices of the Royal Astronomical Society*. The paper is illustrated with many diagrams of cotidal lines relating either to actual regions or typical ideal cases (curved and rectangular capes and bays, circular and elliptic islands, and a passage between two seas). Deductions as to the deformation of the cotidal lines by such local features are made on a mathematical basis, and actual cases of the phenomena are instanced, on the British or Irish coasts. The effect of the neighbouring coast-line on sea-seiches in a narrow bay is also considered.

Irrigation in India.—A review of irrigation in British India during 1924–25 has been published by the Public Works Branch of the Department of Industries and Labour. During the year the monsoon, after beginning weak, was practically normal in total rainfall, and there was appreciable defect only in Orissa and Kashmir, with excess in the western United Provinces, the North-West Frontier, Rajputana, and Malabar. The total area irrigated by works of all kinds was 27·2 million acres, which was about a million acres less than in the record year 1922–23. It is of interest to note that 12·4 per cent. of the total cropped area was irrigated by Government works The review gives full details of the financial side of irrigation and drainage works during the year.

Pressure and Winds over the China Sea.—A large-scale atlas of twelve maps showing the mean atmospheric pressure and wind direction and force over the China Sea for each month of the year has been published under the authority of the Governor of Hong-Kong. There is a short introduction by the Director of the Royal Observatory, Hong-Kong. The observations were collected during the years 1900–1912 from ships calling at Hong-Kong, the stations of the Chinese Maritime Customs, and various observatories in the Far East The observations were originally tabulated in one-degree squares, but this grouping being found unjustifiable except on the main sea routes, they were collected into two-degree squares Pressures are shown in inches, wind forces are given on the Beaufort scale, and within the wind roses are given the number of barometric observations on which each has been determined and the percentage of calms. The maps extend to lat. 34° N, 8° S., and long. 130° E. They are clearly printed, with land outlines in blue and isobars in red.

X-Ray Examination of Long-Chain Compounds.—In the *Annales de Physique* for July-August, M. Trillat contributes an important paper on the X-ray examination of long-chain compounds, and he gives values for the spacings of fatty acids containing as many as 32 carbon atoms. With the new data at his disposal he shows that the rate of increase in chain length with increase in the number of carbon atoms is slightly different for acids containing odd and even numbers of carbon atoms, although it is uniform in both cases. He also finds that by mounting a thin layer of a fatty acid on a strip of metal, a very fine film of soap is usually formed immediately in contact with the metal surface. This film is amply sufficient for the purposes of X-ray examination by the reflection method, so that it is unnecessary, in general, to prepare a soap separately for X-ray examination. By examining the changes in the X-ray spectra of oleic, linoleic and linolenic acids in the course of drying in air, Trillat is the first to follow directly a complex chemical reaction by means of X-rays. Attention is directed to the importance of these long-chain compounds in the investigation of very soft X-rays.

The Physical Properties of Glasses.—A large amount of information on the above subject is to be found in Prof. W. E. S. Turner's lecture on the relationship of the physical properties of glasses to chemical composition and mode of preparation, delivered before the Chemical Society on April 29, and published in the Society's *Journal* for August last. The preparation of commercial glass involves the fusion of a number of oxides or metallic salts, which may number as many as twelve or more, and the proportions of the constituents largely determine the physical properties. The most important properties are the transmission and absorption of light, the refractive index, the viscosity, the annealing temperature, electrical conductivity, and resistance to the action of water (which is partly a chemical process), thermal expansion and density. In many cases simple relationships are found which make it possible to prepare glasses of approximately known properties by fusing suitable oxides in the requisite proportions. A compromise is necessary in the manufacture of glass for chemical purposes, since the presence of alkaline oxides reduces the resistance to the action of acids. Modern chemical glass ware contains a high percentage of silica, with boric oxide and alumina, and only sufficient alkaline oxides to enable melting to take place fairly readily. The use of a high percentage of silica lowers the resistance of the glass towards alkalies, but the danger of breakage from sudden temperature changes is eliminated on account of its low thermal expansion.

The Uses of Tellurium.—On account of its many industrial applications, tellurium is rapidly becoming of technical importance. Some notes on its uses are contained in a short article in the *Chemical Trade Journal* for September 10, and among the most important are: as a colouring agent in the glass and porcelain industry, in the preparation of organic dyestuffs, in the manufacture of electrical equipment, high resistance alloys and ultramarine, in the colouring of lithophone and the staining of silver, as a delicate test of sterilisation in bacteriology, and as a toning agent in photography. A compound of tellurium has been patented as an anti-knock constituent of motor fuels, and its use is said to lead to greater efficiency. Remarkable properties are shown by the alloys of tellurium; the tin alloys are extremely hard and have very great tensile strength, the aluminium alloys are very ductile, while the silver alloys have recently been used. The poisonous properties of the element, and its fairly ready absorption (*e.g.* from gold dental stoppings), are not mentioned in the article, but should not be overlooked.

Low Temperature Carbonisation.—The firm of Salermo Ltd., 17 Kingsway, London, W.C.2, has issued a brochure entitled "Low Temperature Carbonisation and the Salermo Process." It contains mainly a survey, sound in substance and temperately worded, of the processes hitherto proposed. The Salermo retort, which is new to Great Britain although tried already in the Sarre mines, is described. It consists of a series of troughs fixed adjacently and parallel and heated from below. The coal, pre-dried by waste heat, is mechanically propelled from one trough to the other, and the product is delivered in a semi-pulverised condition. High throughput is said to be associated with low capital and running costs. The product is, unfortunately, not fit for immediate domestic consumption, but might be suitable for steam boilers.

Projection of Explosive Flames.—In a paper published by the Safety in Mines Research Board (No. 27) Mr. M. J. Burgess has described experiments on the distance over which a methane-air mixture, when exploded in a tube, projects its flame into the air filling a second tube attached to the explosion-tube. When the two tubes were 9 cm. in diameter the projection of flame into the air may be more than five times the length of the original column of explosive mixture. When the aperture between the two tubes is gradually reduced by an adjustable diaphragm, the first effect is an increase in the length of the projected flame—especially with mixtures containing an excess of methane. The experiments show to what a great distance flame may be projected along a gallery when a fire-damp explosion occurs in a mine.

Smokeless Fuel for Power.—At the Conference on Smoke Abatement held at Birmingham recently, Mr A. S. E. Ackermann read a paper on the "Engineering Aspects of the Smokeless Production of Power," a copy of which we have received. The various methods of generating power without smoke production are surveyed briefly. Pulverised fuel firing of steam boilers is favoured on account of high thermal efficiency and absence of smoke. The common view that water-power resources of Great Britain are negligible is contested. It is calculated that 500,000 H.P. might be developed by the erection of efficient installations. The combination of public hot-water supply with power stations is a means of increasing the thermal return of electricity generation. The waste heat from gas retort settings might be utilised to generate current in large quantities. Mention was made of the application to marine and locomotive work of the Still (internal combustion steam) engine, which now is the most efficient prime-mover available.

Coal Treatment in the United States.—In the September number of the *Journal of the Franklin Institute* appears a series of papers on low temperature carbonisation, read at the "Oil and Gas Power Week" Conference at Philadelphia in April last. They reflect the growing concern as to the uncertainty of adequate supplies of mineral oil across the Atlantic. H. W. Brooks gave a general summary of European and American processes, and although unable to point to successful commercial achievement anywhere, he closed on a note of confidence that we are nearing the "Age of Coal Processing." W. H. Blauvelt read another general paper emphasising the desirability of subjecting coal to a process of fractionation and refinement analogous to that of the mineral oil industry. Perhaps the most interesting contribution technically was made by V. Z. Caracristi, who gave an account of experiences with the ingenious lead-bath carbonisation process which has aroused so much interest. This has been given trial by Henry Ford at his motor-works, where no expense has been spared in grappling with the problem of this pioneering effort. To those who speak lightly of the scientific treatment of coal, it may be a revelation to learn that already several million dollars have been spent on experiments on this one process. It is not clear whether commercial success is claimed, but it is stated that the practicability of the lead-bath as a medium for the transfer of heat has been fully demonstrated.

Forthcoming Books of Science.

Agriculture, Forestry, and Horticulture.

Ernest Benn, Ltd—The Growth, Cultivation, Manufacture and Marketing of Sugar Beet, R N. Dowling. *Thornton Butterworth, Ltd*—The Fruit Garden, A. J Macself. *Cambridge University Press.*—The Physiology of Reproduction in the Cow, J. Hammond. *Chapman and Hall, Ltd.*—Manures and Manuring, F E. Corrie *G. Duckworth and Co, Ltd*—The Scientific Feeding of Animals, Prof O. Kellner, translated by Dr. W. Goodwin, new edition. *Gurney and Jackson.*—The Stockfeeder's Companion, J. Porter *His Majesty's Stationery Office.*—Recent Progress in Agricultural and Horticultural Science in the United Kingdom, V. E. Wilkins. *Longmans, Green and Co., Ltd.*—Shorthorns: their Origin and Development, 1780–1890, W. Graham; Soil Conditions and Plant Growth, Sir E. John Russell and Members of the Biological Staff of the Rothamsted Experimental Station, new edition. *McGraw-Hill Publishing Co., Ltd.*—Breeding and Improvement of Farm Animals, Rice; Manual of Plant Diseases, Heald. *Oxford University Press.*—The Rural Industries of England and Wales. A Report of a Survey made on behalf of the Agricultural Economics Research Institute, Oxford. 1: Wood Industries and some Village Workshops, H. E. FitzRandolph and M. D Hay; The Financial Return from the Cultivation of Scots and Corsican Pines, W. E. Hiley; The Economics of the Production of Grade A (Tuberculin Tested) Milk, V. Liversage. *Sir Isaac Pitman and Sons, Ltd*—Fertilisers, H. Cave. *L. Reeve and Co, Ltd.*—Trees and Timber, A Popular Glossary of Terms, F. Tiffany. *Sheldon Press.*—A Simple Guide to Rock Gardening, Sir James L. Cotter.

Anthropology and Archæology.

Thornton Butterworth, Ltd.—A History of the Pharaohs, A. Weigall, vol 2: The 12th to the 18th Dynasties. *Cambridge University Press.*—Our Early Ancestors, M. C. Burkitt; Sardis. Publications of the American Society for the Excavation of Sardis, vol. 10, Terra-cottas, Part 1, Architectural Terra-cottas, T. L. Shear; A Comparative Study of the Melanesian Island Languages, S. H Ray. *G. Duckworth and Co, Ltd*—Ancient Cities and Modern Tribes: Exploration and Adventure in Maya Lands, Dr T. Gann *G. G. Harrap and Co, Ltd.*—A History of Hebrew Civilisation, Prof. A. Bertholet, translated by Rev. A. K. Dallas; The Primitive Races of Mankind, Prof. Max Schmidt, translated by Rev. A. K. Dallas, The Culture of Ancient Greece and Rome, Profs. F Poland, E. Reisinger, and R. Wagner, translated by J. H. Freese. *W. Heinemann, Ltd*—The City of the Sacred Well, T A. Willard. *Macmillan and Co., Ltd*—People of the Veil, being an Account of the Habits, Organisation, and History of the Wandering Tuareg Tribes which inhabit the mountains of Air or Asben in the Central Sahara, F. Rennell Rodd; Natural Man: A Record from Borneo, Dr. C Hose. With a Preface by Prof. G. Elliot Smith; A Short History of Marriage, Prof E. Westermarck *Methuen and Co., Ltd.*—Primitive Culture in Italy, Prof. H. J Rose; The Mystic Rose: a Study of Primitive Marriage and of Primitive Thought in its bearing on Marriage, E. Crawley, new edition, revised and much enlarged by T Besterman, 2 vols. *Oxford University Press*—A History of the Ancient World, vol. 1: The Orient and Greece, M. Rostovtzeff, translated by J. D. Duff; Apes and Men, H Peake and Prof. H. J Fleure; Religion and Art in Ashanti, R. S. Rattray, with chapters by G. T. Bennett, V. Blake, H. Dudley Buxton, R R. Marett, and Prof C. G. Seligman *Kegan Paul and Co., Ltd.*—The Civilisation of the South American Indians, with special reference to their Magic and Religion, R Karsten With preface by Prof E. Westermarck, Sex and Repression in Savage Society, Dr. B. Malinowski, The Father in Primitive Psychology, Dr. B. Malinowski; Myth in Primitive Psychology, Dr B. Malinowski. *Charles Scribner's Sons*—The Pulse of Progress, with a Sketch of Jewish History, E. Huntington.

Biology.

G Allen and Unwin, Ltd—Animal Mind, F Pitt; Birds and Beasts of the Roman Zoo, Dr. T. Knottnerus-Meyer, translated by B Miall. *Edward Arnold and Co.*—Elementary Botany. An Introduction to the Study of Plant Life, Dr. W. Watson. *Baillière, Tindall and Cox*—Anatomy of the Wood Rat. Comparative Anatomy of the Subgenera of the American Wood Rat (Genus Neotoma), A. B. Howell. *Ernest Benn, Ltd.*—The Story of Plant Life. *A. and C. Black, Ltd.*—Elementary Science Note-books, G. N. Pingriff, No. 3. Plant Food and Plant Growth. *Thornton Butterworth, Ltd.*—Marvels of Pond Life, R. Palmer. *Cambridge University Press*—Forest, Steppe and Tundra: Studies in Animal Environment, Maud D. Haviland (Mrs. H. H. Brindley). *Chapman and Hall, Ltd.*—Evolution, B. Gruenberg, Microscopic Fresh Water Life, F. J. W. Plaskitt. *Chatto and Windus*—Essays in Popular Science. *G G. Harrap and Co, Ltd.*—Reptiles and Amphibians, T. Barbour; The Wild Animals of Australasia, A. S. Le Souef and H. Burrell, with a section on the Bats of Australia and New Guinea by E Le G. Troughton. *Longmans, Green and Co., Ltd.*—British Birds, A. Thorburn, new edition in four volumes, vol. 4. *Oliver and Boyd*—Biological Monographs and Manuals, No. 7. The Composition and Distribution of the Protozoan Fauna of the Soil, H. Sandon. *Oxford University Press*—Functional Biology, Prof. W J. Dakin; Microbiology of Cellulose, Hemicelluloses, Pectin, and Gums, A Thaysen and H. J. Bunker; Worms in Furniture and Structural Timber, John Girdwood. *Kegan Paul and Co., Ltd.*—Insect Life and the Management of a Trout Fishery, M E. Moseley. *University of London Press, Ltd.*—Economic Biology for Students of Social Science, Dr Philippa C. Esdaile, 2 parts *University Press of Liverpool, Ltd*—The Marine Plankton: a Handbook for Students and Amateur Workers, with an Introduction by Sir William Herdman, Prof. J. Johnstone, A. Scott, and H. C. Chadwick.

Chemistry.

Edward Arnold and Co.—Physico-Chemical Periodicity, Dr. J. E. Myers and Dr E. S. Hedges; Ancient Egyptian Materials, A Lucas. *G Bell and Sons, Ltd.*—Elementary Practical Chemistry, E J. Holmyard. *Ernest Benn, Ltd*—Dictionary of Organic Substances; Dictionary of Inorganic Substances; Dictionary of Intermediates; British Chemicals: their Manufacturers and Uses, 1927 edition; The Manufacture of Ammonium Products, P. Parrish; Industrial Catalysis, S. Green; The Chemistry, Manufacture and Application of Artificial Fertilisers, vol. 1: Phosphatic Fertilisers, A Ogilvie and P. Parrish; Electrolytic Alkali, C. Elliott, The Chemistry, Manufacture and Uses of Aluminium, W. A. C. Newman, The Chemistry of Essential Oils, H. Finnemore; The Chemistry and Manufacture of Pigments and Paints, C. A. Klein and W. G Aston; The Problems of Paint and Varnish Films, Dr H. H. Morgan, The Analysis of Pigments, Paints and Varnishes, Dr. J. J. Fox and T H. Bowles; A Handbook of Ceramic Manufacture, Dr. H N. White, Encyclopædia of the Ceramic Industries, A. B. Searle, 2 vols *Chapman and Hall, Ltd.*—The Scientific Principles of Petroleum Technology, Prof. L. Gurwitsch. *J. and A. Churchill*—Oils, Fats and Fatty Foods, E R. Bolton, with a chapter on Vitamins by Dr J. C Drummond, new edition. *Constable and Co., Ltd.*—Chemistry of the Oil Industries, J. E. Southcombe, new edition; Photography: its Principles and Applications, A. Watkins, new edition, The Oil Industry: Production, Transportation, Resources, Refining and Marketing, Dr E. R. Lilley; The Theory and Use of Indicators. An Account of the Chemical Equilibria of Acids, Alkaloids and Indicators in Aqueous Solution, with Applications, Dr E. B. R Prideaux, new edition. *Gurney and Jackson.*—The Chemistry of Dyeing, Dr K. J Wood, new edition. *J B. Lippincott Co*—Pharmaceutical and Medical Chemistry, J. Hostmann and F. Stroup. *Longmans, Green and*

Co., Ltd.—Lecithin and Allied Substances: The Lipins, Prof. H. Maclean, new edition; A Student's Manual of Organic Chemical Analysis, Qualitative and Quantitative, Prof. J. F. Thorpe and Dr. Martha Annie Whiteley, re-issue, with an Appendix on New Methods for the Estimation of Elements in Organic Compounds by Prof H Ter Meulen. *McGraw-Hill Publishing Co., Ltd.*—International Critical Tables, vol 2; Kinetic Theory of Gases, Loeb; Hydrous Oxides, Weiser; Chemistry of Cellulose and Wood, Schorger. *Methuen and Co, Ltd.*—Practical Colloid Chemistry, Prof. W. Ostwald, with the collaboration of W. P. Wolski and Dr. A Kuhn, translated by Dr J. N. Kugelmass and T. K. Cleveland; New Conceptions in Colloidal Chemistry, Prof. H, Freundlich. *Sir Isaac Pitman and Sons, Ltd*—Photographic Chemicals, T. L J. Bentley and J. Southworth.

Engineering.

Edward Arnold and Co—Engineering Science, A First Year's Course in Mechanics and Heat Engines, W. Ward; Electric Trains, R E. Dickinson. *Ernest Benn, Ltd.*—Electric Switch and Controlling Gear, Dr. C. C. Garrard, new edition; Insulated Electric Cables, Part 2, Manufacture and Installation, C. J. Beaver; Electro-Farming, or The Applications of Electricity to Agriculture, R. B. Matthews; Electric Insulation, W. S. Flight; The Electrification of Railways, R. Smith; Electric Winders, H. H Broughton; Electrical Measuring Instruments: 3, Steady Current Laboratory Instruments, Dr. C. V. Drysdale and A C. Jolley; Electrical Measuring Instruments: 4, Alternating Current Laboratory Instruments, Dr. C. V. Drysdale and A. C. Jolley; Motive Power and the Modern Steam Turbine, Hon. Sir Charles Parsons and R. Dawson; Rotary Convertors, F. P. Whitaker; Wireless Telegraphy and Telephony, Prof W. H. Eccles, new edition, Modern By-Product Coking Practice, E Bury and S. J. Morgan; Industrial Gaseous Firing, W. N. Booth, Modern Coal Washing Practice, R. C. R Minikin; The Design and Construction of Docks, Wharves and Piers, F. M Du Plat Taylor; Concrete Construction, E. S Andrews; The General Principles of Chemical Engineering, Prof S. G. M. Ure; Evaporating, Condensing and Cooling Apparatus, E Hausbrand, new edition, The Principles and Practice of Tower Filling, P. Parrish and F. C. Snelling; Colloid Mills, Dr. S. P. Schotz; Modern Muffle Furnaces, C. M. Walter; Laboratories and Laboratory Furnishing, C. Hollins; Power Generation and Transmission on Works, H. Seymour; Principles of Filtration Plant, E. A. Alliott. *Chapman and Hall, Ltd*—Alternating Current Rectification and Allied Problems, L. B. W. Jolley, new edition; Electrical Engineering Practice, J. W Meares and R. E. Neale, vol. 2; Rotary Converters: the Principles, Construction and Operation, E P Hill, Polyphase Induction Motors, R. D. Archibald. *Concrete Publications, Ltd*—Design and Construction of Formwork for Concrete Structures, A E. Wynn. *Constable and Co., Ltd*—The Efficiency of Pumps and Ejectors, E. C. Bowden-Smith. *Crosby Lockwood and Son*—Largest Ships of the World, V S. F. Wilson; Rotary and Motor Converters, E F. Smith; Marine Works: A Practical Treatise for Maritime Engineers, Landowners, Public Authorities, E Latham, with a Preface by C. Le Maistre, new edition; The Calender Effect and the Shrinking Effect of Unvulcanised Rubber, Dr W. De Visser, translated by E S. Allsop; Water-Power Practice: The Principles, Practice and Development of Water Power, F Johnstone-Taylor, Electric Lighting, Starting and Ignition for Motor Cars, featuring British Productions, H. H. U. Cross, new edition; Centrifugal Pumps. Their Design, Operation, and Testing, G. Higgins; Sewage Works, F. C. Temple; Gas Meters: Their Construction, Use, Fixing, Inspection, and Maintenance, A. T. Gilbert, new edition; Motor Car Mechanism and Management Simplified, with a Complete Section on Overhauling, E. C. M. Shepherd, new edition; Dredging and Dredging Appliances, P. M. Dekker, with an Introduction by Sir Robert Hadfield. *Longmans, Green and Co, Ltd*—Civil Engineering Specifications, Dr. G S. Coleman and G. M. Flood. *McGraw-Hill Publishing Co., Ltd*—Engineering Problems, Woodward; Engineering Metallurgy, Stoughton and Butts; Concrete Practice, Hool; Steam and Gas Turbines, Stodola; Mine Ventilation, Weeks; Repair Shop Diagrams and Connecting Tables, Braymer and Roe. *Oliver and Boyd.*—Materials and Design in Turbo-Generator Plant, third enlarged and revised edition, W. Kieser, English edition by Prof. A L Mellanby and W. R. Cooper. *Oxford University Press.*—Elements of Radio Communication, O F Brown. *Sir Isaac Pitman and Sons, Ltd.*—Road Making and Road Using, Major T Salkield; Theory of Machines, L. Toft and A. T. J Kersey; Performance and Design of D C. Machines, Dr A. E. Clayton; Poole's Telephone Handbook, J. Poole, new edition; The Director System of Automatic Telephony, W. E. Hudson; Electrical Condensers, P. R Coursey, Motive Power Engineering, H. C. Harris, Radio Year Book, 1927. *Radio Press, Ltd*—History of Radio Telegraphy and Telephony, G G. Blake, Illustrated Wireless Dictionary, Dr. E. H. Chapman. *University Press of Liverpool, Ltd*—Stability and Seaworthiness of Ships, Prof. T. B. Abell.

Geography and Travel.

Edward Arnold and Co—The Epic of Mount Everest, Sir Francis Younghusband; Among the Kara-Korum Glaciers, P. C Visser and Mrs. Visser. *A. and C Black, Ltd.*—My Flight to Australia and Back, Sir Alan Cobham *Cambridge University Press*—A Year amongst the Persians, E. G Browne (new edition), with a Memoir by Sir E Denison Ross. *Constable and Co, Ltd.*—The Valley of Arno: Its Geography, History and Works of Art, E Hutton. *G. Duckworth and Co, Ltd*—Big Game Fishing Adventures in Primitive Wilds, F. A Mitchell Hedges, Through Liberia, Lady Dorothy Mills. *W. Heinemann, Ltd.*—My Journey to Lhasa, Madame Alexandra David-Neel. *Sir Isaac Pitman and Sons, Ltd*—Geography: the Scientific Study of Human Settlement Book 3, Africa and Australasia, R. E. Parry. *Charles Scribner's Sons.*—East of the Sun and West of the Moon, Theodore and Kermit Roosevelt. *Seeley, Service and Co, Ltd.*—In Himalayan Tibet, Drs. Reeve Heber and Kathleen M. Heber, Sport and Service in Africa, Lieut.-Col A. H. W. Haywood *University of London Press, Ltd*—A First Reader in Economic Geography, V. C. Spary *University Press of Liverpool, Ltd.*—A Geographical Study of Coal and Iron in China, W. Smith, with an Introductory note by Prof. P. Roxby. *T. Fisher Unwin, Ltd.*—Peoples and Problems of the Pacific, Prof. J. Macmillan Brown *H F and G. Witherby*—By-ways of the Tropic Seas: Wanderings among the Solomons and in the Malay Archipelago, H. Norden; The *Arcturus* Adventure, W. Beebe, East Africa: A New Dominion, Major A. G. Church.

Geology, Mineralogy, and Mining.

Baillière, Tindall and Cox.—Leached Outcrops as a Guide to Copper Ores, A. Locke. *Ernest Benn, Ltd*—The Story of Geology, The Working of Non-Stratified Mineral Deposits, G. J. Young; The Working of Stratified Mineral Deposits, H. F Bulman; Mineral Deposits, Prof. H. Louis; Haulage and Winding, H. M Morgans, The Mechanical Principles of Mining Appliances, Prof. H Louis and Dr. J Morrow; Sinking Shafts and Driving Adits, E O F. Brown. *Chapman and Hall, Ltd.*—Stones in Stone, W T. Lee. *Methuen and Co, Ltd*—The Principles of Petrology: An Introduction to the Science of Rocks, Dr G. W Tyrrell *Oliver and Boyd*—The Geology of South Africa, Dr. A L. du Toit.

Mathematical and Physical Sciences.

Edward Arnold and Co—The Evolution and Development of the Quantum Theory, N. M. Bligh. With a Foreword by Prof Planck. *Baillière, Tindall and Cox.*—Interpolation, Dr J. F. Steffensen. *G. Bell and Sons, Ltd*—The Structure of the Atom, Dr. E. N da C Andrade, new edition *Ernest Benn, Ltd.*—The Ether of Space, Sir Oliver Lodge, Rays and X-rays, V E Pullin and W. J Willshire; Applied Magnetism, Dr. T. F. Wall, The Structure of the Atom, Dr E N da C. Andrade; First Principles of ~~Electricity and Magnetism, H. W~~ Phear. *A. and C. Black, Ltd*—Stage A Geometry, R W. M Gibbs. *Blackie and Son, Ltd.*—The Absolute Differential Calculus, Prof T Levi-Civita, translated by Miss M. Long, Space and Time, Prof. É. Borel, translated by Dr. A. S. Rappoport and J. Dougall *Cambridge University Press.*—The Internal Constitution of the Stars, Prof A S Eddington, The Scientific Papers of Sir James Dewar, Edited by J. D. H Dickson, H. M Ross, and E. C S. Dickson, 2 vols; The Theory of Electricity, Prof. G. H. Livens, new edition; A Treatise on the Mathematical Theory of Elasticity, Prof. A. E. H. Love, new edition, Principia Mathematica, Prof. A. N. Whitehead and Hon. B Russell, vol. 2, new edition. *Constable and Co., Ltd.*—Field Astronomy for Engineers and Surveyors, Prof. D. Clark; Television, T. Thorne Baker. *W. Heffer and Sons, Ltd.*—The Elements of the Theory of Real Functions, J. E. Littlewood; Gyromagnetic Electrons, and a Classical Theory of Atomic Structure and Radiation, Prof. L. V. King. *C. and E Layton*—Frequency-Curves and Correlation, W Palin Elderton, new and enlarged edition *Crosby Lockwood and Son*—Colour-Music: The Art of Light, Major A. B. Klein. *Longmans, Green and Co, Ltd.*—Practical Physics, T. G. Bedford. *McGraw-Hill Publishing Co., Ltd*—Circuit Theory and Operational Calculus, Carson; Compound Interest and Annuity Tables, Kent. *Methuen and Co, Ltd*—Three Lectures on Atomic Physics, Prof A. Sommerfeld, translated by Dr H. L. Brose; The Theory of the Brownian Movement, Prof. A. Einstein, translated by A. D Cowper. *Open Court Company.*—Mathematical Statistics, Prof. H L. Rietz (Carus Mathematical Monographs), Knowledge and Error, Prof E. Mach; Principles of the Theory of Heat, Prof. E. Mach; Civilisation and Mechanics, Prof. E. Mach; Non-Euclidean Geometry, G. Riemann, Relation of Space and Time to Experience, N. Weiner; Motive Power of Heat, S. Carnot *Oxford University Press.*—Matter and Gravity in Newton's Physical Philosophy: A Study in the Natural Philosophy of Newton's Time, A. J. Snow; Modern Astronomy. Its Rise and Progress, H. Macpherson; Advanced Constructive Geometry, J. F Dowsett, Physics in Industry, vol. 4; Containing two Lectures: Physics in the Rubber Industry, Dr. W. Makower; The Physicist in Agriculture, Dr. B. A. Keen. *Sir Isaac Pitman and Sons, Ltd.*—Primary Physical Science, W. R Bower. *Charles Scribner's Sons.*—Beyond the Milky Way, Dr. G. E Hale.

Medical Science.

Baillière, Tindall and Cox.—Diseases of the Intestines, Dr. A. P. Cawadias; Rongten Rays in Dermatology, Arzt and Fuhs, translated by Dr. C. K. O'Malley, Clinical Applications of Sunlight and Artificial Radiations, Dr. E. Mayer; Gastroscopy, Dr. J Rachet, translated by Dr. F. F. Imianitoff; Local Immunisation, Dr. A. Besredka, translated by Dr. H. Plotz; Enzymes, Their Properties, Distribution, Methods and Applications, Dr S. A. Waksman and Dr. W. C. Dacison; Hydrogen Ion Concentration, Its Significance in the Biological Sciences and Methods for its Determination, Dr. L. Michaelis, translated by Dr. W. A. Perlweig. In three volumes; Hydrogen Ion Concentration of the Blood in Health and Disease, Prof. J. H. Austin and G. E. Cullen; The Biological Relations of Optically Isomeric Substances, late Prof A. R. Cushny; Tuberculosis of the Lungs, Dr. H. H. Thomson and A. P. Ford; Intestinal Tuberculosis, Its Importance, Diagnosis, and Treatment, Dr. L. Brown and H. L. Sampson; The Natural Processes of Healing in Pulmonary Tuberculosis, Dr. M. Jaquerod, translated by Dr J. D. Sinclair, Advising the Tuberculous about Employment, W. I. Hamilton and T. B. Kidner; Muscular Contraction and the Reflex Control of Movement, J F. Fulton; Psychology of Reasoning, Dr. M. F. Dunn, Diastatic Activity of the Blood Serum in Mental Disorders, J. R. Rauth, Variations in the Form of the Jaws, Dr J S. Wallace; Notes for Diabetics, W. R. Campbell and Marie T. Porter, The Meaning of Disease, Dr. W. A. White, Problems of Human Reproduction, P. Popenoe; De Lamar Lectures, 1925–26: being a series of popular lectures in the field of personal hygiene and public health given each year at School of Hygiene and Public Health, Johns Hopkins University. *G. Bell and Sons, Ltd*—Finlayson's Clinical Manual for the Study of Medical Cases. Edited by Drs. C. H. Browning, E. P. Cathcart, and L. Findlay; Readable Physiology and Hygiene, Dr. J. A. Campbell *Cassell and Co., Ltd.*—X-ray Diagnosis, J. M. Redding, Essentials of Medical Diagnosis, Sir Thomas Horder, Bart, and Dr. A. E. Gow, Surgical Applied Anatomy, Prof. C. C. Choyce; The Life of Sir Patrick Manson, Lieut-Col. A. W. Alcock and Dr P. H. Manson-Bahr. *Chapman and Hall, Ltd*—The Theory and Practice of Radiology. With a Synopsis of Radiography and Radiotherapy, B J. Leggett *J B. Lippincott Co.*—Normal Histology, Dr. W H F Addison; Harvey Society Lectures, 1924–25; Factors affecting the Distribution of Electrolytes, Water and Gases in the Animal Body, Dr. D. D. van Slyke. *E and S. Livingstone*—Outlines of Dental Science: by various authors; First five volumes on Anæsthetics, Bacteriology, Materia Medica, Prosthetics, and Radiography, Atlas of Pathogenic Bacteria, arranged by R Muir; Practical Methods in the Diagnosis and Treatment of Venereal Diseases, Dr. D. Lees; The Heart, its Anatomy and Physiology, and the Diagnosis and Treatment of Disease, Dr. C. W. Chapman, Catechism Series: Works on Tuberculosis and Diseases of Children, and new editions of Hewat's Examination of the Urine and other Clinical Sideroom Methods; Wheeler and Jack's Handbook of Medicine; M'Kendrick and Whittaker's X-ray Atlas of the Normal and Abnormal Structures of the Body; Russell's Ultra-Violet Radiation and Actinotherapy. *McGraw-Hill Publishing Co, Ltd.*—Basic Material for a Pharmaceutical Curriculum, Charters, Text-book of Comparative Physiology, Rogers. *Kegan Paul and Co., Ltd*—The History of Medicine, from the time of the Pharaohs to the end of the Eighteenth Century, Dr. C G. Cumston, with foreword by Dr. F. G Crookshank; Types of Mind and Body, Dr E. Miller; Rheumatic Diseases, Dr. M. B. Ray.

Metallurgy.

Edward Arnold and Co—Metal-Work, H M. Adam and J. H. Evans, new edition *Ernest Benn, Ltd.*—Blast Furnace Practice, F. Clements, 3 vols., The Technology of Iron, P Oberhoffer, revised and edited by W. Austin; Chemistry of the Non-Ferrous Metals, C C. Smith. *Chapman and Hall, Ltd*—The Metallurgist's Manual, T. G. Bamford and H. Harris. With a Foreword by Prof. T. Turner *McGraw-Hill Publishing Co., Ltd*—Metallographic Researches, Benedict.

Meteorology.

Baillière, Tindall and Cox,—Fogs and Clouds, W. J. Humphreys; Rain-making and Other Weather Vagaries, W. J. Humphreys *Cambridge University Press.*—Manual of Meteorology, vol. 1: Meteorology in History, Sir Napier Shaw, with the assistance of E. Elaine Austin.

Miscellaneous.

G Bell and Sons, Ltd—Old Trades and New Knowledge, Sir William Bragg. *W Collins, Sons and Co, Ltd.*—Aspects of Science, J. W N. Sullivan, second series. *G. G. Harrap and Co., Ltd.*—The Story of Reckoning in the Middle Ages, F A Yeldham With an Introduction by Dr. C. Singer. *His Majesty's Stationery Office.*—Temperature Conditions in Refrigerated Holds carrying Apples, "Bitter Pit" in Apples, Temperature Conditions in small Cold Storage Chambers containing Fruit (Reports of the Food Investigation Board) Methods of Analysis of Coal (Fuel Research Board Paper). The Terminology of Illumination and Vision, The Transmission Factor of Commercial Window Glasses, Light Distribution from Industrial Reflector Fittings; Surface Brightness of Diffusing Glassware for Illumination; The Relation between Illumination and Efficiency in Fine Work (Composing Rooms), Joint Report by the Industrial

Fatigue Research Board and the Illumination Research Committee. *Longmans, Green and Co, Ltd.*—The Groundwork of Modern Science. A Two-year Course of Experimental General Science, J. M. Moir. *Macmillan and Co, Ltd*—Official Papers of Alfred Marshall. Reprinted from Parliamentary Papers; First Essay on Population (1798), T. R. Malthus, with Explanatory Notes by Dr. J. Bonar; Industrial Fluctuations, Prof. A. C Pigou *McGraw-Hill Publishing Co, Ltd.*—The Sewage Problem, Fuller; Handbook for Prospectors, Von Bernewitz *Methuen and Co, Ltd.*—History of Sciences in Greco-Roman Antiquity, Prof A. Reymond, translated by Ruth Gheury de Bray. *Kegan Paul and Co., Ltd.*—Science and Poetry, I. A Richards, Over-Population: Theory and Statistics, P. S Florence, Fee, Fi, Fo, Fum: the Giants of England, H. J. Massingham. *Seeley, Service and Co, Ltd*—The Romance of Our Wonderful World, P. J. Risdon *University of London Press, Ltd.*—University College, London, 1825–1925, H. H. Bellot; The Uses of Libraries, edited by Dr. E. A. Baker. *University Press of Liverpool, Ltd*—The Theory of Architecture, Prof L. B. Budden.

Philosophy and Psychology.

G. Allen and Unwin, Ltd.—Science and Philosophy, and other Essays, the late B. Bosanquet, with Preface by Prof J. H Muirhead; Indian Philosophy, Prof. S. Radhakrishnan, vol. 2. *Baillière, Tindall and Cox*—Psychology Studies, T. Lipps, translated by H. Sanborn. *Cambridge University Press.*—Psychology applied to Education, the late Dr J. Ward, edited by Prof. G. Dawes Hicks; Religion in the Making, Dr. A. N. Whitehead. *Macmillan and Co, Ltd*—Mind in Evolution, Prof. L. T. Hobhouse, new edition *Methuen and Co., Ltd.*—Plato: The Man and His Work, Prof. A. E. Taylor; Lectures on Ethics, Immanuel Kant, with an Introduction by Dr. P. Menzer, translated by Dr. W. M. McGovern, A First Laboratory Guide in Psychology, Dr. Mary Collins and Dr. J. Drever, An Adventure in Moral Philosophy, Prof W. Fite *Open Court Company.*—The Aims of Scientific Method and other Philosophical Essays, Prof. T. Percy Nunn. *Oxford University Press.*—Lectures on Kant's Philosophy of Religion, C. C. J. Webb; Benedetto Croce: an Autobiography, translated by R. G. Collingwood, with a Prefatory Note by J. A. Smith. *Kegan Paul and Co., Ltd.*—The Language and Thought of the Child, Prof. J. Piaget, with Preface by Prof. E. Claparède; Thought and the Brain, Prof. H. Piéron; Man not a Machine, Prof. E Rignano. *Sheldon Press*—Psychoanalysis Explained and Criticised, A. E. Baker. *University of London Press, Ltd.*—The Nature of Personality, Dr. W. Brown. *Williams and Norgate, Ltd*—Evolution in Religion, W. Stuart.

Technology.

Ernest Benn, Ltd.—The Dyeing of Textile Fibres, R. S Horsfall and L. G. Lawrie, Grammar of Textile Design, H. Nisbet, new edition, Cotton Spinning (Intermediate, or Grade II.), T. Thornley, new edition; The Dyeing of Cotton Fabrics, F. Beech, new edition; Textile Colour Mixing, D. Paterson, new edition. *His Majesty's Stationery Office.*—Third Report on the Cleaning and Restoration of Museum Exhibits; The Consistence of Cement Pastes, Mortars, and Concrete. *Crosby Lockwood and Son*—Standard Manual of Brewing and Malting and Laboratory Companion, being a thoroughly revised and considerably augmented work, based on "A Handy Book for Brewers," by H. E. Wright, embracing the Conclusions of Modern Research, by J. Ross-Mackenzie; Mechanical Dentistry: a Practical Treatise on the Construction of the Various Kinds of Artificial Dentures, C. Hunter, new edition; Testing Milk and its Products, G Thomson. *Macmillan and Co, Ltd.*—Lens Computing, Col. J W. Gifford, with a foreword by Prof. F Cheshire. *Oxford University Press.*—Preservation of Fruit and Vegetables, Margaret J. M. Watson. *Sir Isaac Pitman and Sons, Ltd.*—Scientific Pattern Construction, B. W. Poole; Introduction to Textiles, A. E. Lewis. *Scott, Greenwood and Son.*—The Manufacture of Enamel Paints, D. Wait.

University and Educational Intelligence.

The twenty-fifth session of the work of the Sir John Cass Technical Institute was inaugurated on October 4, when an address was delivered by Alderman Sir Charles Wakefield, Bart Before calling upon Sir Charles to deliver the inaugural address, the chairman of the Governors, the Rev. J. F. Marr, referred to the resignation of Dr. Keane, who had been principal for almost a quarter of a century, the appointment of Mr. Geo. Patchin as his successor, the generous support given to the work by the important companies connected with the fermentation and petroleum industries, and the gratifying record of university successes; one student has been awarded a D.Sc. for a thesis on research work carried out in the department of chemistry. Further facilities for study are being provided during the session, including a more advanced course of lectures in colloids and an advanced course of lectures on petroleum technology.

One of the papers read at the recent conference at Balliol College, Oxford, of the Association of Special Libraries and Information Bureaux was entitled "Instruction in Bibliographical Technique for University Students," by Mr. Harold E. Potts, chairman of Convocation of the University of Liverpool. He urges that all students should be given some instruction in the art of using a library intelligently. It is not intended that they should spend the time when they should be working in the laboratories in reading in the library, but that they should acquire the habit of looking for the original sources of the information given in lectures and text-books. This matter is largely in the hands of the professors, who would do well, from time to time, to recommend their pupils to read certain original papers as an example of how discoveries are made. The habit of looking at original papers instead of at text-books and abstracts is one that cannot be acquired too early. The student will be astonished to find that some mis-statements have been quoted from text-book to text-book throughout long periods before the error was discovered. At the same time it must be confessed that a student may easily spend too much time in this way to the neglect of experimental work.

While the universities and university colleges in Great Britain usually possess good libraries, the technical institutes and colleges are, as a rule, very poorly supplied. In most cases the sums allowed for the upkeep of their libraries are very small. Principal J. F. Hudson, of the Huddersfield Technical College, in a paper contributed to the recent Conference of Special Libraries and Information Bureaux at Balliol College, Oxford, argues that the provision of a suitable supply of literature should be regarded as an essential part of the equipment of every scientific and technical department of a college. Most local colleges specialise in one or more departments, such as woollen textiles, rubber technology, or pottery. These schools should develop special libraries of peculiar value which should be made accessible to all who are interested in these subjects. Principal Hudson suggests that at least 1 per cent. of the annual expenditure on a technical institute should be assigned to the support of the library. He refers to a letter in Nature for May 22, 1926, in which a correspondent asks what he can do with old scientific books which he no longer needs. As will be seen from Mr. Headicar's letter in our issue of July 3, the Universities' Library for Central Europe has taken up this problem and has arranged to act as a clearing house for the disposal of scientific periodicals.

Contemporary Birthdays.

October 15, 1884. Prof. Lewis Knudson.
October 16, 1859. Prof. James Playfair McMurrich
October 17, 1872. Sir Cyril Reginald S. Kirkpatrick.
October 19, 1856. Prof. Edmund B. Wilson, For. Mem. R.S.
October 20, 1862. Prof. Thomas Hastie Bryce, F.R.S.
October 22, 1876. Prof. Harold Hilton.

Prof. Knudson, who occupies the chair of botany at Cornell University, was born at Milwaukee, Wisconsin, U.S.A. His informative lectures on plant physiology have been particularly welcomed in recent years by Spanish men of science, notably at such centres as Madrid and Barcelona. His botanical studies comprise researches in fermentation, the organic nutrition of plants, germination of orchid seeds, and the diseases of the banana.

Prof McMurrich was educated at Upper Canada College, Toronto, at the University of the city, and at Johns Hopkins University, Baltimore. He has occupied posts in several universities of the United States, but since 1907 he has been professor of anatomy at Toronto In 1922 Prof. McMurrich was president of the Royal Society of Canada.

Sir Cyril Kirkpatrick was educated at Repton His engineering studies were conducted, in the first instance, at the Crystal Palace School of Engineering; afterwards he entered the service of the old London and North-Western Railway Sir Cyril was chief engineer of the Port of London Authority from 1913 until 1924.

Prof. E. B Wilson, distinguished as a zoologist, was born at Geneva, Illinois, U.S A, and educated at Yale University, New Haven, and Johns Hopkins University, Baltimore. In 1883 he was a lecturer in biology at Williams College, fulfilling afterwards various important duties elsewhere until 1891, when he was appointed professor of zoology in Columbia University. Prof. Wilson is a foreign member of the Royal Society of London, and of the Linnean Society. In 1914 he delivered the Croonian lecture before the former body, taking as his subject "The Bearing of Cytological Research on Heredity." A member of the National Academy of Sciences, Washington, and of several English societies, he is Hon. Sc.D., Cambridge Prof. Wilson is the author of a standard work, "The Cell in Development and Heredity"; originally issued in 1896, it passed recently into a third edition.

Prof Bryce was educated at Edinburgh Collegiate School. He graduated later at the University of Edinburgh. Lecturer on anatomy in the University of Glasgow from 1892 until 1909, he was then appointed to the chair of anatomy The Royal Society of Edinburgh awarded Prof. Bryce its Keith prize in 1906 for his memoirs on the histology of the blood of the larva of *Lepidosiren paradoxa*. He is the author of vol. 1 of "Quain's Anatomy" and joint author of a work on the development of the human ovum.

Prof. Hilton, an old pupil of Lancing College, graduated at Hertford College, Oxford. Sometime assistant lecturer in mathematics in the University of Bangor, he afterwards joined the teaching staff of Bedford College. Since 1912 he has been professor of mathematics in the University of London. Prof. Hilton is the author of many papers in crystallography, especially the theory of crystalline structures.

Societies and Academies.

Sydney.

Linnean Society of New South Wales, July 28.—**C. T. White**: On a small collection of plants from the Rigo district, Papua. Two species, one of Plectronia and one Jasminum, are described as new.—**C. P. Alexander**: The Trichoceridæ (Diptera) of Australia. One genus and four species are described as new. A key is given for the determination of the genera.—**R. H. Cambage**: Notes on the native flora of New South Wales. Part xi. Moree to Mungindi and Moonie R., with a description of a new species of Eucalyptus The paper contains notes on the early exploration, topography, etc, and a list of the plants noticed A comparison of this flora is made with that of Tasmania, in view of the dominating influence of climate on plant distribution.—**G H. Cunningham**: Gasteromycetes of Australasia (v) The genus Calvatia. The genus may be separated from Lycoperdon by the method of dehiscence, which is effected in Calvatia by the irregular falling away of the apical portion of the peridium; whereas in Lycoperdon dehiscence is effected by means of a definite apical stoma The genus contains about eight species, of which four are present in Australia and New Zealand.—**G D. Osborne**: Stratigraphical and structural geology of the Carboniferous rocks in the Mt. Mirannie and Mt Dyrring districts, near Singleton, N.S W. There are two volcanic series with associated clastic rocks, and separating these series is a set of sediments called the Main Clastic Zone. The major volcanic series comprises andesites, dacites, rhyolites and keratophyres, while the lavas in the other group are chiefly toscanitic and dellenitic. The only glacial beds occur near the top of the Kuttung Series, and Rhacopteris-bearing strata are found on two horizons. The chief tectonic feature is the great Bridgeman Fault which separates the Kuttung Series from the Permian or Permo-Carboniferous Series. This is probably an overthrust. In addition there are many normal faults connected with the late Palæozoic diastrophism which folded the area and produced two basin-structures.

Washington, D.C.

National Academy of Sciences (Proc. vol. 12, No. 8, August).—**R. J. Havighurst**. The absorption of X-rays in crystalline compounds The mass absorption coefficient in a compound is the sum of the mass absorption coefficients of the individual atoms and has been calculated from various empirical formulæ. Measurements upon crystalline compounds are subject to large experimental error on account of "selective absorption" due to reflection of the primary ray from certain atomic planes Compressed slabs of powders (and also Wingardh's data from solutions) give results in good accord with the calculated absorptions for sodium chloride and fluoride and calcium fluoride and carbonate.—**Carl Barus**: (1) Acoustic pressures in case of soap bubbles. A series of soap bubbles were attached to the telephonic apparatus and pinhole probe. Pressure as measured by the fringe displacement of the interferometer always corresponded with the radius of the bubble. (2) Acoustic pressure promoted by co-operating quill tubes without pinholes.—**Edwin H. Hall**: Note on the temperature relations of photo-electric emission and thermionic emission of electrons. Hall's theory of "associated" and "free" electrons in metallic conduction indicates a slight increase with temperature in the work done in detaching completely an associated electron; this accords with the fact that the lowest frequency producing photo-electric emission is nearly independent of temperature. Also the work done in detaching completely a free electron within the metal should diminish with rise of temperature; this has not been disproved.—R. de L **Kronig**: The dielectric constant of diatomic dipole-gases on the new quantum mechanics.—F. L. **Mohler**: A photo-ionisation experiment with hydrogen. Using a double thermionic tube, one unit of which produced a discharge while the other detected photo-ionisation excited by the radiation from the discharge, no evidence was obtained that hydrogen emits radiation which can ionise the normal molecule.—Otto **Laporte**: Series and ionisation potentials in the iron spectrum.—Carleton C. **Murdock**: The location of the electromotive force in a photo-active cell containing a fluorescent electrolyte Semi-transparent platinum films sputtered on opposite sides of a glass test-tube serve as electrodes. The electrolyte can be illuminated before it reaches the electrode, through it, or after leaving it, and is made to flow along the surface of the electrode. The photo-active electromotive force is due, in part, to the action of light on the fluorescent electrolyte.—Richard C **Tolman** and Sinclair **Smith**: Remarks on Professor Lewis's note on the path of light quanta in an interference field.—L. R. **Maxwell**: The mean free path of electrons in mercury vapour. An electron stream passes through a chamber the end of which is a long Faraday cage. The electron current was measured with and without the presence of mercury vapour at a pressure of 3·12 bars in the chamber. The distance traversed by the electrons was varied by raising and lowering the cage. The mean free path is calculated for accelerating potentials up to 3000 volts; at 1120 volts and 3050 volts it is 73 cm. and 144 cm. respectively.—Edward A. **Birge** and Chancey **Juday**: The organic content of lake water. Large samples from Wisconsin lakes were examined. The quantity of organic material present is much greater than, and that of the inorganic salts is far less than, that found in sea water The dissolved organic matter forms a potential food supply several times as large as that offered by the plankton.—Thomas Wayland **Vaughan**: (1) The stratigraphic horizon of the beds containing *Lepidocyclina chaperi* on Haut Chagres, Panama. The horizon is upper Eocene, virtually the same as that of the Ocala limestone of Florida and Georgia. (2) Foraminifera from the upper Eocene deposits of the coast of Ecuador. The horizon is about the same as that at Haut Chagres; the finds indicate that the same fauna existed on both sides of America during Eocene times.—T. J. **Webb**: On the free energy of hydration of ions. The energy of hydration depends on the dielectric properties of the solvent, as well as upon the charge and effective radius of the ion.—Curt **Stern**: An effect of temperature and age on crossing-over in the first chromosome of *Drosophila melanogaster*. Susceptibility is connected in some way with the localisation of the spindle fibre attachment.

Official Publications Received.

BRITISH AND COLONIAL.

Aeronautical Research Committee: Reports and Memoranda. No 989 (Ae. 200): An Investigation of the Flow of Air around an Aerofoil of Infinite Span. By L. W. Bryant and D. H. Williams; with an Appendix by G. I. Taylor. (A 8 a. Aerofoils, General, 182.—T. 1686.) Pp. 44. 1s 9d. net. No. 995: The Behaviour of Single Crystals of Aluminium under Static and Repeated Stresses, Parts 1, 2 and 3. By H. J. Gough, Dr. D. Hanson and S. J. Wright. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (B. 1. a. Metals, 40, a and b—T 1963, a and b) Pp. 54+35 plates. 3s. 6d. net. No. 1015 (Ae. 218): On the Drag of an Aerofoil for Two-dimensional Flow. By A Fage and L. J. Jones. (A. 3, A Aerofoils-General, 154.—T. 2135.) Pp. 14. 7d. net. (London: H.M. Stationery Office)

Leicester Museum, Art Gallery and Library. Bulletin No 10. Pp. 12. (Leicester.)

County Borough of Warrington: Museum Committee. Report of the Director for the Two Years ending 30th June 1926; with a List of the Principal Additions to the Museum Collections. Pp. 21. (Warrington.)

Transactions of the Royal Society of Edinburgh Vol. 54, Part 2, No. 14: Magnetic Quality in Crystals. Part i: Discrimination of, and Stability in, Magnetic Lattices; Part ii: Stability of Magnetic Lattices; Part iii: Twinning in Crystals. By Dr. J. Forrest Pp 601-701. (Edinburgh: Robert Grant and Son, London: Williams and Norgate, Ltd) 12s. 6d.

Union of South Africa: Department of Agriculture. Science Bulletin No. 45: Physiological Studies of the Grape. By Dr. Francois Jean de Villiers. Pp. 97. (Pretoria. Government Printing and Stationery Office) 1s. 6d.

Northampton Polytechnic Institute, St. John Street, London, E.C.1. Announcements, Educational and Social, for the Session 1926–1927. Pp. 176. (London.)

Decennial Index of *The Analyst*: the Journal of the Society of Public Analysts and other Analytical Chemists Vols. 41-50 (1916–1925). Compiled by M. B. Elliott. Pp. 358. (Cambridge: W. Heffer and Sons, Ltd.) Paper, 21s. net; cloth, 25s. net

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 3, No. 16: On the Development of the Cranial Muscles in Protopterus and Lepidosiren. By Prof. F H. Edgeworth. Pp. 719-784+9 plates. 5s. 6d. Vol. 54, Part 3, No. 19 The Petrography of Jan Mayen. By Dr. G. W. Tyrrell. Pp. 747-765. 2s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol 56, 1926, January to June. Pp. 206+15 plates. (London.) 15s net

Aeronautical Research Committee: Reports and Memoranda. No. 1029 (E. 20): Hydrogen as an Auxiliary Fuel for a Solid Injection Oil Engine. By G. F Mucklow. (I.C.E. 520.) Pp 16+17 plates 1s. net. No 1032 (Ae. 224): Wind Tunnel Tests on a Wing covered with Monel Metal Gauze. By F. B. Bradfield (A. 3. a Aerofoils-General, 162—T. 2230) Pp 2+1 plate. 4d. net. (London. H.M. Stationery Office)

Report by the Hon. W. G A. Ormsby-Gore, M.P (Parliamentary Under-Secretary of State for the Colonies), on his Visit to West Africa during the Year 1926. (Cmd 2744) Pp. 188. (London H.M. Stationery Office.) 3s 6d. net.

British Honduras. Annual Report of the Forest Trust for the Year ended 31st March 1926. Pp. 24 (Belize, British Honduras.)

FOREIGN.

Proceedings of the Imperial Academy. Vol. 2, No. 7, July. Pp. xxi-xxii+299-350. (Ueno Park, Tokyo.)

Ministero dell' Aeronautica, Aviazione Civile e Traffico Aereo: Ufficio Presagi. Le condizioni meteorologiche dell' Umbria nel mese di Settembre. Pp. 12+8 tavole. (Roma)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Technical Bulletin No. 76: Concentration of Materials and Rates of Application in the Control of Apple Scab. By W. C. Dutton. Pp. 18. (East Lansing, Mich.)

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Entomological Series, Bulletin No. 18: Contributions to our Knowledge of South American Fulgoroidea (Homoptera). Part 1.: The Family Delphacidae By F. Muir. Pp. iii+51. (Honolulu, Hawaii.)

Museums of the Brooklyn Institute of Arts and Sciences Report upon the Condition and Progress of the Museums for the Year ending December 31, 1925. By William Henry Fox. Pp. 75+8 plates. (Brooklyn, N.Y.)

Department of the Interior: U.S Geological Survey. Bulletin 768: Geology and Oil Resources of the Puente Hills Region, Southern California. By Walter A. English. With a Section on the Chemical Character of the Oil, by Paul W. Prutzman. Pp. v+110+14 plates. 40 cents Bulletin 776: The Mesozoic Stratigraphy of Alaska. By George C. Martin. Pp. xii+493. 75 cents. Bulletin 785-B: Potash Investigations in 1924. By Walter B Lang. (Contributions to Economic Geology, 1926, Part 1) Pp. ii+29-43. 5 cents. Water-Supply Paper 558: Preliminary Index to River Surveys made by the United States Geological Survey and other Agencies By Benjamin E. Jones and Randolph O. Helland. Pp. iv+108+2 plates. Professional Paper 143: Paleontology and Stratigraphy of the Castle Hayne and Trent Marls in North Carolina By Lewis Burnett Kellum. Pp iii+56+11 plates. 30 cents. Professional Paper 145: Geology and Oil and Coal Resources of the Oregon Basin, Meeteetse, and Grass Creek Basin Quadrangles, Wyoming. By D. F. Hewett. Pp. iv+111+33 plates. 1 dollar. (Washington, D.C.: Government Printing Office.)

Publications of the United States Naval Observatory. Second Series, Volume 10. In 2 parts. Part 1: Observations made with the Prime Vertical Transit Instrument, 1893–1912, by George A. Hill; Part 2: Total Solar Eclipses of August 30, 1905, and June 8, 1918, with Aviators' Notes on the Total Solar Eclipse of September 10, 1923. Pp. A cccviii+A 362+9 plates+B 416+40 plates. (Washington, D.C.: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No 68: An Account of Experiments carried out to Determine the Experimental Error of Field Trials with Cotton in Egypt By M. A. Bailey and T. Trought Pp. ii+29+23 plates. (Cairo: Government Publications Office.) 10 P.T.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 18. Eye shaped end of Bar investigated by Photo-elastic Method. By Kango Takemura and Yahei Hosokawa Pp. 127-143. 0.40 yen. No. 19 On the Distribution of Shearing Stresses in Beams of certain Cross-sections. By Tuneo Inokuty. Pp. 145-204. 1.05 yen. (Tôkyô)

List D: Wavelength Spectrometers, Monochromators, and Specialised Spectroscopes. Pp. 21 List E: Spectrographs. Pp. 24. List L: Micrometers, etc. Pp. 5. Water Jacketed Tubes. Pp 2. (London Adam Hilger, Ltd)

Diary of Societies.

SATURDAY, October 16.

North of England Institute of Mining and Mechanical Engineers (Associates and Students Section) (at Neville Hall, Newcastle-upon-Tyne), at 3.—P. F. Hope: Steam and Electric Locomotives for Colliery Purposes.

British Psychological Society (at University College), at 3.—W. J. Messer: Conative Control.—R. J. Bartlett: Does the Psychogalvanic Phenomenon indicate Emotion?

Physiological Society (in Department of Physiology, Guy's Hospital), at 4.—Demonstrations on A Substitute for Blood Fibrin in Work on Digestion, by W. M. Clifford, and Peculiar Substance in the Central Nervous System of Cats kept on Autoclaved Meat, by C. Da Fano.—A. E. Clark-Kennedy and T. Owen: The Effect of Variation of Oxygen Pressure on the Respiratory Exchange during Exercise.—T. Lewis and Y. Zotterman: Reactions of the Skin to Ultra-violet Light.—T. Lewis and L. M. Harmer: The Release of Vasodilator Bodies in Response to Mechanical Stimulation of the Skin (preliminary communication).—W. Cramer: The Transplantation of Spleen.—W. W. Payne and E. P. Poulton: The Law of the Intestines as applied to the Œsophagus.—V. de Burgh Daly: The Effect of a Negative Pressure on the Heart-Lung Preparation.—A. D. Macdonald and W. Schlapp: Adrenaline Vaso-dilatation.—K. Furusawa and R. M. T. Kerridge:—The Buffering Powers of Cardiac and Skeletal Muscles of the Cat.—A. Levin: Fatigue, Retention of Action Current, and Recovery, in Nerves of the Spider Crab.—R. S. Creed and Sybil Cooper: A Reflex in the Knee Extensors caused by Active Contraction of the Flexors.—J. de B. Daly and E. B. Verney: The Site of the Receptors engaged in the Reflex Regulation of the Heart Rate.—E. B. Verney: Some Quantitative Experiments on the Secretion of Pituitrin in Mammals.—E. D. Adrian: Action Currents in the Optic Nerve.—E. T. Conybeare, M. Maizels and M. S. Pembrey: Influence of Anæsthesia on Metabolism.—M. Maizels and A. C. Hampson: The Effects of Variations in PH on the Volume of the Red Cells (preliminary communication).

MONDAY, October 18.

Royal College of Physicians of London, at 4.—Sir John Rose Bradford: Harveian Oration.

Royal College of Surgeons of England, at 5.—C. H. Shattock: Demonstration of Surgical Conditions of Lymphatic Gland.

Royal Society of Medicine (Social Evening), at 9.30.—Sir Arthur Keith: John Bull: a Study in Anthropology.

Institution of the Rubber Industry (London Section) (at Engineers' Club, Coventry Street).—W. H. Harford: Advertising.

TUESDAY, October 19.

Royal Society of Medicine, at 5.30.

Institute of Transport (at Institution of Electrical Engineers), at 5.30.—Capt. F. L. Barnard: Commercial Flying.

Zoological Society of London, at 5.30.—The Secretary: Report on the Additions to the Society's Menagerie during the months of June, July, August, and September 1926.—Dr. P. A. Buxton: Exhibition of Apparatus for the Measurement of Radiant Heat in the Tropics.—Miss Joan B. Procter: Exhibition of a White Example of the English Grass-Snake.—Prof. J. S. Huxley: Studies in Heterogonic Growth: the Annual Increment of the Antlers of the Red Deer (*Cervus elaphus*).—Dr. J. Waterson: On the Crop Contents of certain Mallophaga (Insecta).—J. R. Norman: A Synopsis of the Rays of the Family Rhinobatidæ, with a Revision of the Genus Rhinobatus.—Prof. D. M. Fedotov: The Plan of Structure and Systematic Status of Ophiocista (Echinodermata).—Dr. R. Anthony and G. M. Iliesco: Étude sur les Cavités nasales des Carnassiers.

Royal Photographic Society (Scientific and Technical Group), at 7.—T. Thorne Baker: The Use of Light-Sensitive Cells in Photometry, Wireless Picture Telegraphy and Television.

WEDNESDAY, October 20.

Society of Glass Technology (at Leeds University), at 2.30.—General Discussion on Annealing and Lehrs.—E. A. Coad-Pryor: The Economics of the Annealing Process.—Dr. J. W. French: Glass Annealing.—Dr. S. English and Prof. W. E. S. Turner: The Relationship between Chemical Composition and the Upper Critical Annealing Temperature of Glasses.

Electrical Association for Women, at 3.—Visit to London Electric Wire Co., and Smith's Ltd., Leyton.

Royal Institute of Public Health, at 4.—Dr. W. J. O'Donovan: The Prevention and Treatment of Eczematous Conditions of the Skin of Occupational Origin.

Royal Society of Medicine (History of Medicine Section), at 5.—W. G. Spencer: Review of the 'Proceedings' of the Section.—Dr. Le Roy Crummer: The Anatomical Plates for the work of Geminus.

Newcomen Society for the Study of the History of Engineering and Technology (at Iron and Steel Institute), at 5.30.—R. Jenkins: The Rise and Progress of Manufacturing Industry in England (Presidential Address).

Institution of Automobile Engineers (Birmingham Graduates' Section) (at Chamber of Commerce, Birmingham), at 7.30.—W. Evans: Engine Lubrication.

Society of Chemical Industry (Nottingham Section) (at University College, Nottingham), at 7.30.—F. H. Carr: The Manufacture of Organic Medicinal Chemicals.

Merseyside Aquarium Society (at 1 Falkland Road, Egremont), at 7.30.—W. Mallinson and A. G. This: The Construction of a Simple Aquarium.

Institute of Chemistry (London Section), at 8.

C.B.C. Society for Constructive Birth Control and Racial Progress (at Essex Hall, Strand), at 8.—Dr. C. W. Saleeby: The Expectant Mother.

Royal Microscopical Society, at 8.—Prof. E. Ghosh: A New Classification of Ciliata.—Dr. J. E. McCartney: The Filterable Viruses.—B. K. Mullick: Notes on some Rotifers from India.—Dr. A. Piney: A Method of Silver Impregnation of Zenker-fixed Paraffin Sections.

Royal Society of Medicine (Surgery Section), at 8.30.—W. Low: Surgery and the Workmen's Compensation Act (Presidential Address).

THURSDAY, October 21.

Child-Study Society (at Royal Sanitary Institute), at 6.—Miss Margaret Morris: Dancing as Physical Culture.

Institution of Electrical Engineers, at 6.—Dr. W. H. Eccles: Inaugural Address.

Royal Aeronautical Society (at Royal Society of Arts), at 6.30.—W. R. D. Jones: Notes on Magnesium and some of its Alloys.

Chemical Society, at 8.—Prof. H. V. A. Briscoe, P. L. Robinson, and H. C. Smith: The Density of Boron Trichloride, and the Suspected Variation in the Atomic Weight of Boron.—W. H. J. Vernon: The Formation of Protective Oxide Films on Copper and Brass by Exposure to Air at Various Temperatures.—W. H. Gray: The Action of Antimony Trichloride upon some Diazotised Diamines.—H. H. Farmer and J. Ross: The Formation and Stability of Associated Alicyclic Systems. Part III. The Change from 'Meta-' to 'Para-' bridged Rings.

Royal Society of Tropical Medicine and Hygiene, at 8.15.—Prof. N. H. Fairley: Studies in the Chemotherapy and Immunity Reactions of Schistosomiasis.

Royal Aeronautical Society (Coventry Branch) (at Coventry).—Major F. M. Green: The History of the Aeroplane.

FRIDAY, October 22.

Royal College of Surgeons of England, at 5.—Sir Arthur Keith: Demonstration of the Anatomy of the Sacro-iliac Region and its Application to Practice.

Institution of Mechanical Engineers, at 6.—W. Reavell: Presidential Address.

Junior Institution of Engineers, at 7.30.—R. H. Kenyon: Boiler Accidents.

Institute of Metals (Sheffield Local Section) (at Sheffield University), at 7.30.—Prof. H. C. H. Carpenter: Sorby Lecture.

Royal Sanitary Institute (at Town Hall, Dover), at 7.30.—Discussion on Diphtheria Immunisation.

Oil and Colour Chemists' Association.

PUBLIC LECTURES.

SATURDAY, October 16.

Horniman Museum (Forest Hill), at 3.30.—Mrs. H. M. Dunn: Kashmir, the Country and its People.

SUNDAY, October 17.

Guildhouse (Eccleston Square), at 3.30.—Air Vice-Marshal Sir Sefton Brancker: The Scientific Problems of Commercial Aviation.

TUESDAY, October 19.

Royal Society of Medicine, at 5.—Prof. Abel: The Development and Present State of Public Health in Germany (Chadwick Lecture).

School of Oriental Studies (London Institution), at 5.—Dr. L. D. Barnett: An Introduction to Indian Philosophy. (Succeeding Lectures on November 2, 16, 30; December 7; January 18; February 1, 15; March 1 and 15.)

King's College, at 5.30.—Prof. C. Lloyd Morgan: The Place of Mind in an Organic Theory of Nature. (Succeeding Lectures on October 26 and November 2.)

University College, at 5.30.—K. Lansma: The Drainage of the Zuyder Zee.

WEDNESDAY, October 20.

Institution of Electrical Engineers, at 5.30.—Prof. J. A. Fleming: The Interaction of Pure Scientific Research and Electrical Engineering Practice. (Succeeding Lectures on October 22, 27, 29; November 10, 12, 17, and 19.)

Royal Society of Medicine, at 8.—Prof. Abel: The Development and Present State of Public Health in Germany (Chadwick Lecture).

THURSDAY, October 21.

Fulham Central Public Library, at 8.—H. T. Davidge: The Earth we Live on.

SATURDAY, October 23.

Horniman Museum (Forest Hill), at 3.30.—V. Gordon Childe: The Dawn of Civilisation in Europe.

SUNDAY, October 24.

Guildhouse (Eccleston Square), at 3.30.—Prof. W. A. Bone: The Economic Aspects of Coal.

CONGRESSES.

October 18 to 26.

German Society for the Study of Diseases of Digestion and Metabolism (at Berlin).

October 20 to 22.

Textile Institute (at Town Hall, Buxton).—Sir William Bragg (Mather Lecture).—J. A. Robertson: Centralised Electricity Production.—P. Bean: Sizing of Artificial Silk Yarns, and Comparison with Sizing of Cotton Yarns.

October 21.

Coke Oven Managers' Association (at Midland Hotel, Manchester).—Annual General Meeting.

October 25 to 28.

Italian Congress of Surgery (at Padua).

SATURDAY, OCTOBER 23, 1926.

CONTENTS.

PAGE
Science and Religion 577
The Evolution of Voles and Lemmings . . . 579
Modern Photometry. By L. C. M. 581
Philosophy of Emergence of New Qualities. By G. C. Field 582
Our Bookshelf 583
Letters to the Editor:
  Early History of Gaseous Adsorption.—Sir Joseph Larmor, F.R.S. 586
  The Structure of the Continents.—Prof. Arthur Holmes 586
  Science and Psychical Research. — Dr. R. J. Tillyard, F.R.S.; W. W. L.; Dr. James Weir French. 587
  Transmission of Stimuli in Plants.—Prof. Nigel G. Ball 589
  Electric Television.—A. A. Campbell Swinton, F.R.S. 590
  Active Nitrogen.—Dr. E. B. Ludlam and L. H. Easson 590
  Copper at Low Temperatures. — George James Alexander 590
  The Reaction to Flea Bites.—Prof. A. E. Boycott, F R.S. 591
  Zoological Nomenclature: Hubner's (1806) 'Tentamen.'—Dr. C. W. Stiles 591
  The Problem of the Origin of Species as it appeared to Darwin in 1859 and as it appears to us To-day. —Prof Henry Fairfield Osborn, For. Mem. R.S. 591
  The Spectrum of Zinc.—D. M. Smith. . . . 592
  Observed Relative Intensities of Stark Components in Hydrogen.—Dr. J. Stuart Foster and Miss M. Laura Chalk 592
  Absorption Spectrum of the Hydrogen Molecule.—Prof. J. J. Hopfield and G. H. Dieke . . 592
  Sterility in the Vegetable Marrow.—Miss Eleonora Armitage 592
The Analysis of Line Spectra. By Prof. A. Fowler, F.R S. 593
Scientific and Industrial Research in Australia and New Zealand 597
News and Views 599
Our Astronomical Column 603
Research Items 604
International Congress of Psychology. By Ll. W. J. 606
Coal Blending. By Dr. A. Parker 607
Physical Phenomena and Molecular Orientation at Interfaces. By E. K. R. 607
The Wellcome Historical Medical Museum . . 608
University and Educational Intelligence . . . 609
Contemporary Birthdays 610
Societies and Academies. 610
Official Publications Received 611
Diary of Societies and Public Lectures . . . 612

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Science and Religion.

AT the recent Church Congress held at Southport, several papers dealt with the relations between science and religion. This is a subject of the deepest interest to students of natural science, for the ultimate objects of religious study and of scientific research are the same. This was finely expressed by no less a person than Sir Ray Lankester, whom no one will accuse of a bias in favour of theology, when he was president of the British Association at the York meeting in 1906. In his presidential address he claimed the sympathy of the Church for the scientific student, saying that the churchman and the student agreed in this: both had turned aside their gaze from the fleeting and temporal and had fixed it on the enduring and eternal; both, in a word, sought for the absolute and everlasting beneath the never-ending flux of things.

There are, it is true, many students of science, and especially of biology, who consider religion to be a name for a mass of outworn and discredited superstitions, and think that the best hope for the progress of mankind lies in getting rid of such beliefs entirely. This, however, is a view which biologists of wider outlook find it impossible to accept. For they recognise, on one hand, that the progressive evolution of man is bound up with the evolution of society, and, on the other, that every society is, and always has been, held together by religious sanctions, even when those sanctions are submerged in the subconscious stratum of our existence. Hence the conclusion is inevitable that religious belief performs an important biological function, and that it will endure so long as society itself endures. But religion can only exercise its proper influence so long as it is believed in sincerely; and hence the importance of reconciling, if possible, such beliefs with the scientific view of the universe.

The functions of religion and science are, in fact, correlative: one strives to hold fast and preserve the flashes of insight into the real nature of things which have been granted to mankind in the past; the other is ever seeking to gain new light on Nature. The reverence of religion for what is old is justified, because great discoveries of truth, or, as our fathers preferred to call them, 'revelations,' come but very rarely, and between them are interposed many generations of ordinary men to whom no new light is vouchsafed.

Every 'revelation,' however, is necessarily framed in a background of the current beliefs of its time about the universe; and as this background changes the 'revelation' comes to be expressed in obsolete language. The reconciliation consists in finding appropriate modern language in which to express it, and in the search for this expression the modernist school of Anglican theology will have the sympathy of every student who reflects deeply on the ultimate mysteries which he encounters in his study of science.

Amongst the papers read at the congress, none excited more interest than that from the pen of the late Dr. Adami on "The Eternal Spirit in Nature." Many of our readers and contributors to our columns were friends of Dr. Adami, and sadly miss his bright cheery optimism and his infectious scientific enthusiasm. It will surprise many of them to learn that Dr. Adami, whose interests they had imagined to be confined to the technicalities of science, had reflected so deeply on the ultimate nature of things. His paper attempted the stupendous task of trying to prove from a consideration of scientific facts that there was one God Who was the author of the universe, that the nature of God was good, and was ultimately expressed in the character and teaching of the Founder of Christianity, and that the human soul was immortal. Dr. Adami's method was not that of the *a priori* philosopher: like all true scientific men he was a pragmatist, and he felt that these beliefs were justified, because when applied to the phenomena they yielded satisfactory results.

If, indeed, Dr. Adami had been successful in his attempt, then the complete reconciliation of science and religion would have been achieved: we fear, however, that we are unable to go the whole way with him. His argument for the existence of God is the presence of order and law in Nature: this order must have its ground in one grand unifying Will. Was it not Huxley himself who said that "Law, order, and abiding Force are more stupendous miracles than any to be found in our mythologies," and who ridiculed that heterodoxy which regarded the world as "a mud-pie made by two blind children, matter and force." The argument really comes to this: the human intellect, through the action of which alone religion, science, or any other kind of knowledge is possible, recognises amidst phenomena an order and regularity which it feels to be akin to its own deepest nature. Either that recognition is valid or it is illusory. If it is valid, then the ultimate nature of everything must be a Mind in some ways akin to the human mind. If it is illusory, then we are thrown back on a total agnosticism, and conclude that we learn from phenomena nothing of the real nature of things, and that our intellect, as Bergson has maintained, is only a tool-making and food-getting mechanism.

Although it is persistently ignored by shallow thinkers amongst 'practical' scientific men, there is a subjective element in all knowledge which cannot be neglected. We do not begin with 'matter,' which is an abstraction, but with 'something presented to my mind,' and the 'mind' to which it is presented is as fundamental as the 'something.' The qualities with which we endow matter are all mental, and can be expressed only in terms of perception, which is a mental function. Surely no one imagines that 'redness,' 'hardness,' and 'sweetness,' for example, exist outside of and independently of us. To describe the mind as the mere result of molecular movement is to commit an error beside which the wildest Irish bull must sound like common sense.

Dr. Adami's argument that God must be good is that the evolutionary process has led to the production of human nature, the highest aspect of which is goodness. This, again, is the old argument that the stream cannot rise higher than the fountain. "He that planted the ear, shall He not hear? Shall not the judge of all the earth do right?"

Against this argument, however, there are ranged the terrible facts of the struggle for existence and the slaughter of the unfit. If God be the author of Nature, how is this condition to be accounted for? If with Dr. Adami we reply that there is some end to be gained by this which we cannot understand, then the objector justly rejoins that every conscious-suffering individual is an end in itself, and has rights which it is wrong to sacrifice even for the well-being of another.

If, indeed, not only the human soul, but also the soul of all that suffers, survives bodily dissolution, then the ultimate satisfaction of the individual may be enhanced by suffering in some of the preliminary phases of existence. We fail completely, however, to see how Dr. Adami can prove the immortality of the soul from the facts of natural science; the utmost that can be said is that the vitalistic conception of biology leaves the possibility open. It seems to us that the essence of religious faith is the hope that God may turn out to be good, and the resolve to order our lives on this assumption. We hope, but we do not and cannot know. Dr. Adami's assertion that the highest expression of the nature of God is to be discovered in the Founder of Christianity leads us into the realm of special theology, which it is outside the province of this journal to discuss. This much, however, all will admit; that so far no finer conception of God has been presented to the human intellect than that embodied in the sayings of Christ and of some of His early followers. In the field of natural science, it may not be necessary to postulate God; but in religion, as in science, the workings of an evolutionary process are now recognised. It is through the acceptance of the idea of evolution in the spirit as well as in the body of man that the partition which formerly separated religion and science is being dissolved.

The Evolution of Voles and Lemmings.

Monograph of the Voles and Lemmings (Microtinæ), Living and Extinct. By Martin A. C. Hinton. Vol. 1. Pp. xvi + 488 + 15 plates. (London: British Museum (Natural History), 1926.) 30s.

THERE is no group of mammals so likely to throw light on the manner in which new species arise as the Microtinæ, a subfamily of rodents represented by voles and lemmings, and there is certainly no one so well qualified as Mr. Martin A. C. Hinton, of the Zoological Department of the British Museum (Natural History), to bring together and to systematise all that is known concerning the distribution in space and time, the structure and habit, of this highly specialised group. It may be said at once that Mr. Hinton is producing a monograph—for the volume noted here is only the first part—of the very highest order, one which will serve the needs of systematic zoologists for many years to come. In the present volume 14 genera, including 120 species, are defined and described, a score of the species having been discovered and named by the author. Great and abiding as is the service which Mr. Hinton is thus rendering to systematic zoologists, he is doing even more for the student of evolution, and it is to this aspect of his inquiries which we desire to direct attention now.

In the common water vole, Mr. Hinton finds that although sexual maturity is attained at a comparatively early age, yet growth never ceases; growth changes are continued so long as the individual lives, so that aged animals may have the appearance of being specifically distinct from younger adults. There is, in particular, a continual transformation of all those parts of the skull which are concerned in mastication. In the water vole there is a tendency for the growth discs of long bones to remain open. More remarkable still are the growth changes in the teeth. As is well known, the development of a tooth begins with the formation of a crown and ends with the production of a root. The incisor or gnawing teeth of rodents remain perpetually young; they never proceed to the formation of a root but go on producing crown as long as the animal lives. This retention of an infantile stage in the growth of incisor teeth took place at an early stage in the evolution of rodent mammals. In the course of time this tendency spread from the incisor to the cheek or molar teeth of rodents. Mr. Hinton has demonstrated that a tendency to a delay in the formation of roots and an inclination to continue the growth of crowns has appeared in the molar teeth of various members of the Microtinæ, and at different horizons of the geological record. The molar teeth of the water vole never cease growing. Mr. Hinton also emphasises the fact that in the production of new specific forms the whole apparatus of mastication and of digestion—teeth, jaws, skull, temporal and masseter muscles, great bowel and cæcum—undergo a simultaneous and co-ordinated hypertrophy.

Now, changes of an exactly similar kind to those which Mr. Hinton has noted in the evolutionary history of voles and their allies have come under the observation of medical men. In acromegaly—a disorder of growth which occasionally overtakes men and women—jaws, muscles of mastication, skull and skeleton, and the various parts of the alimentary canal undergo just such changes as those which occur normally in adult water voles. Such growth changes in the human body are always accompanied by a disordered enlargement and action of the anterior lobe of the pituitary gland. Medical men also meet with cases in which the growth lines of bones tend to remain open, and although they cannot identify the exact part of the growth mechanism which is at fault, yet the evidence already collected leaves no doubt that the defect lies in the hormone system which regulates growth. These growth changes, with which medical men are familiar, have nothing to do with 'use and wont,' but are disordered manifestations of a growth mechanism which is resident in all living tissues.

Nowhere does Mr. Hinton mention the name of Lamarck, yet from statements he makes it is clear he must be placed amongst the followers of that great naturalist.

> "Every mammal," he writes, "is the product of two distinct and sometimes conflicting forces; a compound of relatively essential characters, fixed for the time being in each group by inheritance, and of more or less plastic characters which yield like potter's clay to the thumb of stern necessity. It is the special use which an animal makes of its various organs that results eventually in a more or less perfect adaptation of form and structure to particular functions, no matter whether the special use is called into being by tempting opportunity or by the compelling stress of circumstances. Use and habit, and all that goes to make environment in its widest sense, have thus made species what they are." (p. 4.)

In this extract Mr. Hinton leaves his readers in no doubt as to the factors which he conceives as being the most important in bringing about the evolution of new species. We may take one of his remarkable examples of adaptation in order that we may probe more deeply into what his beliefs imply. In a Greenland lemming (Dicrostonyx) the fur becomes very thick as winter sets in and at the same time the claws

> "of the third and fourth manual digits become highly modified for digging and subject to a remarkable and unique seasonal change; with the approach of winter these two claws grow to an extraordinary size and

develop a peculiar supplementary ventral portion which sometimes surpasses the main part of the claw in length; but with the return of spring this ventral portion is shed and the main part of the claw is then worn down to normal length. The bones of the fore-arm, particularly the ulna, are greatly strengthened for the attachment of the powerful muscles which move the fossorial hand."

Now the utility of all these changes, which permit Dicrostonyx to burrow in a frost-bound soil, is very apparent, but how 'use and wont' can bring about such a series of growth changes is not at all clear. The more we come to know of the machinery of growth, the less likely does it seem that 'use and wont' can effect any direct change on structure; use and habit can bring out of the claws of the Greenland lemming just such growth responses as are already resident in them. If these responses are lacking, no matter how the lemming burrows or how hard the soil may be, its efforts will only wear the claws away. Here again we may fall back on observations made in the human body. If a hundred young recruits are submitted to the same course of hard physical training, a certain number will respond readily and fully, their muscles taking on a quite Herculean contour; others scarcely respond to the trainer's efforts. Between these extremes all intermediate stages occur. The environment has been the same for all; the response has depended on the degree to which the muscles and bones, heart and lungs, of the recruits have been endowed with the machinery which underlies the processes of growth. What is true of men is likely to hold for lemmings and voles. Environment can select, but there is no evidence that it can produce new forms.

Especially valuable is the contribution which Mr. Hinton makes to our knowledge of the evolution of the cheek teeth of the various members of the Microtinæ, for it is the characters of these teeth which give a clue to the identification of fossil species and to the evolutionary lines of their descent. The splendid series of drawings of skulls, jaws, and teeth by Mr. Terzi, and figures of the chewing surfaces of the teeth made by Mr. Hinton, render the reader's task easy. In interpreting the nature of the dental changes, Mr. Hinton has been influenced by the teaching of the late Dr. Forsyth Major, but most of his inferences are based on a first-hand study of extensive series of molar teeth. As to the accuracy of the facts observed by Mr. Hinton in the cheek or molar teeth of voles, lemmings, and their allies, there cannot be any doubt, but whether or not his interpretation of these facts will hold good, one may legitimately doubt. Indeed, Mr. Hinton has anticipated such a criticism, for in a footnote to p. 34 he states: "As long ago as 1914 Winge and I were comparing our views on this subject and he told me that I had got everything upside down. No doubt others will be of the same opinion to-day."

Voles and lemmings have three molar teeth on each side of their jaws; the middle molar is sheltered, and, in the opinion of the majority of students of dental evolution, would be regarded, on the evidence produced by Mr. Hinton, as the most conservative and primitive of the three. Mr. Hinton is of an opposite opinion. What he has demonstrated is that the free ends of the dental series, the front end of the first molars and the hind end of the last molars, are the plastic points of the dental series. One cannot see how an appeal to a multi-tuberculate theory of dental origin can explain the remarkable additions which have been made at the terminal points of the molar series of voles; the anterior 'loop' of the first lower molars and the hinder ends of the last upper appear to have in them the germinal properties possessed by the terminal sprout of a growing tree. From time immemorial crowns of teeth have been fully formed before they come into use. It is difficult to see how the manner of chewing or the degree of force exerted in this act can have brought about the changes noted by Mr. Hinton in the evolution of the molars of the Microtinæ.

We have reserved for a final paragraph a mention of the important contributions which Mr. Hinton has made, and is making, to our knowledge of the recent geological history of Britain. For the past twenty-five years he has searched the later geological deposits of England for fossil traces of the less conspicuous and smaller mammals. In the late pliocene deposits of East Anglia he has identified 13 species belonging to 4 genera of Microtinæ, the genus Mimomys being the oldest and Microtus the most recent of the pliocene forms. The high terrace of the Thames valley is evidently of the same age as the later Cromerian deposits, for in it Mr. Hinton has identified three of the genera of Microtinæ found in the late pliocene deposits of East Anglia. In the deeper or older deposits of the middle terrace of the Thames valley, fossil remains of three microtine genera occur, two of them—Evotomys and Microtus—being continued from the Cromerian horizon, while one—the genus Arvicola, to which the modern water vole belongs—appears for the first time. Mr. Hinton regards this genus as having arisen by modification from the pliocene genus Mimomys. In the upper or later deposits of the middle terrace an altogether different microtine fauna is found—one associated with a cold climate. Two forms of lemming make their appearance, and three forms of vole belonging to the genus Microtus, one being the snow vole.

No doubt this change in fauna corresponds with the maximum phase of glaciation; nowhere else in the recent geological deposits of Britain does Mr. Hinton find any sudden faunistic change—only in the later deposits of the middle terrace and of deposits of the same age, such as those found at Ightham in Kent, and in the deposits of caves in the centre and west of England. In the lowest or third terrace of the Thames valley the microtine fauna of the cold period is continued. Traces of the modern water vole appear for the first time in quite recent deposits, but it is clearly closely related to a late pleistocene vole, distinguished by Mr. Hinton as *Arvicola præceptor*, which in turn is closely related to the late pliocene genus—Mimomys. Already the water vole of Britain is showing signs of breaking up into several local varieties—the first phase in the production of new species. Clearly Mr. Hinton is justified in regarding the Microtinæ as being in a state of evolutionary plasticity, and he has also demonstrated that the fossil remains of this inoffensive and unobtrusive group of mammals supply geologists with trustworthy data on which to assign recent deposits to their proper horizons in time. The Microtinæ in their evolutionary history serve as geological clocks. Beyond a doubt the Trustees of the British Museum were well advised when they undertook the publication of Mr. Hinton's monograph.

Modern Photometry.

Photometry. By John W. T. Walsh. Pp. xxvii + 505. (London: Constable and Co., Ltd., 1926.) 40*s.* net.

In his delightful book "With Nature and a Camera" Mr. Richard Kearton wrote (a few years ago): "It is wonderful to think that within the confines of the British Isles, on the eve of the twentieth century, it is still possible to find a man sitting on Friday night in a rude semi-underground house lighted only by the primitive stone lamp of his fore-fathers of prehistoric times." He was referring to the primitive customs of Borrera in the Outer Hebrides. It is only yesterday that *light* of any sort, however feeble, was a great achievement. Then come demands for *more light*, and for *enough light*. Finally, the request is for *enough light of the right quality* which, by its approach to the properties of daylight, will show objects not only in form but also in their true colours.

In our modern world these questions of illumination are of the highest importance, and the relative illumination necessary for various purposes has been studied, so that in building a factory, say, it will be equipped with lamps so arranged as to yield the necessary light in the right quantity. The factory owner does not, of course, purchase light directly; he must pay for energy delivered by gas or electricity. Nevertheless, the study of the most economical production and distribution of the light calls for the development of accurate methods of measuring light quantities.

The human eye is, fortunately, a very accommodating organ. It will function more or less satisfactorily over a wide range of brightnesses. Hence the question of high precision in photometry is not likely to be of very much concern to the ordinary user, who will not experience much effect from a four or five per cent. variation of illumination unless he is trying to work with nearly the minimum of light. The demand for precision comes rather from the requirements of industrial competition in lamp manufacture; in testing various lamps for efficiency and the effects of ageing; in the investigation of the various reflectors and screens. Precision spectro-photometry is, however, of considerable importance to the user who requires light of daylight quality, and also it is important from many scientific and industrial points of view.

Photometry is by no means a purely physical operation. Although the modern tendency appears to be towards the elimination of visual methods, this can only be done by a thorough study of human vision. After all, the sensation of light is a purely subjective phenomenon, and it is not to be confounded with the radiation capable of evoking it.

Mr. Walsh's latest work on photometry reflects the enormous growth of the subject during the last few decades. In his capacities of senior assistant in the Photometry Division of the National Physical Laboratory, and of general secretary of the International Commission on Illumination, he has had unequalled opportunity of becoming acquainted with all sides of the subject; his treatise is in many respects the most complete and thorough-going which is at present in existence. The chapters include discussions of all the usual principles of photometry in addition to historical notes, the eye and vision, heterochromatic photometry, colour, physical photometry, and stellar photometry. Each chapter is concluded by a large and complete bibliography furnishing references to many original papers and books dealing with the subjects under discussion. Without doubt it will be of the greatest value as a work of reference for those who have to carry out photometric operations. The text is concisely and clearly written; the reader may place confidence in its accuracy. In addition, the diagrams are numerous and well drawn.

An adequate criticism of the book is extremely difficult to give on short acquaintance. The scope is probably wide enough to cover all the interests of a photometric laboratory, but it seems also to make a bid for the interest of the physicist and astronomer. These will, however, find the treatment of photographic photometry somewhat disappointing and brief.

R I

One of the problems of greatest interest in modern spectroscopy is the measurement of the relative intensities of the lines in line spectra, and a fuller discussion of the photographic methods would have been very acceptable. On the other hand, the book includes many paragraphs which are quite out of place; such as those giving a highly condensed version of the derivation of Maxwell's electromagnetic equations, the thermodynamic discussion of radiation laws, and so on. Nobody turns to a book on photometry for matters of this kind, especially when they are discussed with the aid of complex equations written in the ordinary lines of text, where they are hard enough to see, let alone to understand.

The reader must not object to change. Spectrum diagrams are all plotted to wave-number; in some cases the wave-length diagrams are given as well. There are obvious advantages for some physical discussions in using the 'wave-number,' but for many of the present purposes the familiar 'wave-length' is entirely suitable and adequate; there seems no obvious reason for the change from the familiar to the less familiar.

This is not the place to discuss fully the vexed question of nomenclature. The reader will, of course, find the terminology adopted by the International Commission, but in the writer's view the British section made a great mistake in translating the French 'intensité' by the English 'intensity.' In scientific English the word 'intensity' always connotes something analogous to 'energy per unit area,' but we are now asked to exchange the easily understandable phrase 'candle power' (as applied to a source) for the words 'luminous intensity.' Another recent innovation is the term 'luminous flux,' to be substituted for the term 'light.' Surely it would have been better simply to be more careful and definite regarding the use of the word 'light' rather than to introduce terms which, in the judgment of the present writer, show small signs of being generally adopted by the English-speaking scientific world, whatever is the case amongst photometric workers. Time and experience must decide, but evolution is preferable to revolution, even in this connexion. Cannot our specialists be a little more Fabian?

We may speculate in conclusion that the author of such a text-book has at the present time a very difficult task. He has a vast accumulation of material, very heterogeneous in composition, and a necessarily limited personal experience. Although some things stand out as secure and stable, there are many methods and ideas which are ephemeral and unsound. One plan is to include all the information possible, and leave it to the reader to take his choice; another is to adopt a severely critical attitude and reject all that is apparently non-essential. Mr. Walsh has at the present time avoided both extremes, but it may be hoped that the whole subject will henceforth gain in coherence and simplicity, and that this may be reflected in books of the future. The present book will, we feel sure, contribute materially to the healthy development of photometric theory and practice.

L. C. M.

Philosophy of Emergence of New Qualities.

Life, Mind and Spirit: being the Second Course of the Gifford Lectures delivered in the University of St. Andrews in the year 1923 under the general title of "Emergent Evolution." By Prof. C. Lloyd Morgan. Pp. xix+316. (London: Williams and Norgate, Ltd., 1926.) 15*s*. net.

THIS is the second course of Gifford Lectures delivered by Prof Lloyd Morgan, and continues the first volume published under the title of "Emergent Evolution." It should be read in conjunction with the earlier volume, otherwise there are parts of the argument which might be found difficult to follow. Indeed, even with this aid, it is, it must be confessed, by no means easy reading. But the difficulty arises, in the main, from the difficulty of the subject and the profundity of the thought; and those who will make the effort to master the argument will find themselves amply rewarded. They will be encouraged in this task by the appeal that the tone and style of the writing must make to all readers, for the book, as a whole, is marked to an impressive degree by the dignity and urbanity of ripened wisdom.

Both books deal with that question of the emergence of new qualities which is so much in the centre of philosophical discussion at the present time. There are significant differences in Prof. Lloyd Morgan's treatment of the subject from that with which we are familiar in other writers, such as Prof. Alexander. We may, to begin with, get the impression that Prof. Lloyd Morgan recognises many more cases of real emergence than most writers. Even within the inorganic world he finds several stages. There are distinctively new modes of action in the behaviour of the molecule as compared with that of the atom, and again in the crystal as compared with the molecule. The novelty that occurs on the emergence of life is no different in principle from these cases Then within the living organism we have the emergence of cognitive and reflective reference—we must not say mind—and, finally, the emergence of the spiritual or religious attitude, which consists in the acknowledgment of the working of Divine Purpose in the universe. The differences in detail of these different levels are worked out with all the wealth of knowledge and reflection that we expect of the author.

If we continue our comparison with other writers we find that, for Prof. Lloyd Morgan, if there are more emergents, they are less emergent. What emerges in general appears to be rather a new pattern of what is already there than any positively new entity. We see this when we consider what is said about the place of mind in the process. Prof. Lloyd Morgan will not allow that mind emerges at any point in the evolution of life. On the contrary, mind is there from the beginning. He maintains the doctrine of "the unrestricted concomitance of life and mind," and will only allow the emergence of new types of action of mind and new relations between the mental and physiological sides of the vital process. Mind, by which he implies more particularly the enjoyment, apparently the conscious enjoyment, of the activity of the organism, is there at the lowest stages of life. But it is not there as a separate entity, with a substantial existence of its own, coming in, as it were, from outside and introducing new forms of energy. That is the animistic or 'hormic' theory, to which Prof. Lloyd Morgan is most resolutely opposed. As against it, he maintains that mind and body are merely two aspects of the same process, "two stories," as he phrases it, about the same series of events. This, in its turn, throws some light on what happens in the passage from the inorganic to the organic. It must be confessed that on this point we should like a good deal more information about Prof. Lloyd Morgan's point of view. But it is at least clear that there is, for him, no new entity or new form of energy which emerges.

The novelty of Prof. Lloyd Morgan's theory of emergence is seen most clearly when we come to deal with his view of the object of the religious consciousness. For Prof. Alexander and his followers, Deity is a new quality that emerges beyond the human level. For Prof. Lloyd Morgan, Deity does not emerge—though human acknowledgment of it does—but pervades the whole from beginning to end. Divine Purpose *is* "the rational order of the cosmos." There is no supernatural and transcendent Being who intervenes at certain times or stages. But there is a purpose which is present in all that happens in the universe, and is none other than the "rational order" of the whole. Similarly, there is no particular point at which a naturalistic or scientific account becomes inadequate. That is always one way of looking at the facts. But, equally, there is always the other way of looking at the facts, which we call spiritual, and when we reach this point of view we have reached religion. We cannot pursue further the subtle, but difficult, argument in which Prof. Lloyd Morgan attempts to explain the sense in which he ascribes objective reality to the object of religious worship. Nor can we discuss here the degree to which his point of view is susceptible of being brought into accord with the ordinary assumptions of the religious consciousness.

The significance of the whole book is very great. To the philosopher it will, perhaps, lie mainly in the tendency which it shows not to remain contented with the simple acceptance of emergence as a mere brute fact, but to try to explain what is involved in it. Some might think that the explaining of it here comes very near to explaining it away. At any rate the main purport of the argument appears to be to reconcile the acceptance of some form of emergence with the monistic doctrine of the substantial identity of all that is, in which Prof. Lloyd Morgan is such a convinced believer.

G. C. FIELD.

Our Bookshelf

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 10, 1925. Pp. 725. (London: Society of Chemical Industry, 1926.) n.p.

THE main impression conveyed by this compendious work is the enormous activity that is being displayed in applying chemistry and physics to the whole gamut of the arts and crafts. There may be signs here and there of radical advances, but, generally speaking, elaboration or *Ausarbeitung*, as the Germans say, seems to be the main feature of present-day work. The few who make a business of studying and card-indexing abstracts of technical literature may not require reports of this kind—for in the main they are little more than collated summaries of abstracts and patents—but the great majority of chemists who desire to keep abreast of the times will find them very valuable.

The present volume covers twenty-three of the somewhat arbitrary but necessary sections into which applied chemistry has been classified by the Society of Chemical Industry; reports on sanitation and water-purification and explosives are omitted, but the section on non-ferrous metals which was absent last year has been restored to its place in this year's volume. A considerable number of changes has been made in the authorship of sections, one of the most important being the collective contribution on paints, pigments, varnishes, and resins, by members of the Oil and Colour Chemists' Association. This innovation has much to commend it, and might usefully be extended to other sections of an omnibus character; but care must be taken that such contributions do not become inordinately long. The fact that every year sees an extension in bulk prompts the suggestion that it would be worth while to make the experiment of asking authors to deal more generally with their subjects: to lay aside their abstracts as they write, but refer to them for filling in gaps and necessary figures after writing. In this way, it is thought, the contributions would be more readable and savour more of original thought and treatment than of paraphrasing the abstract literature.

The book under review contains many contributions of high merit, and the general effect is undoubtedly good, though, as usual, there are minor points that evoke criticism. In altering the title of the first chapter by inserting the word 'General' before 'Plant and Machinery,' an attempt has been made to justify the inclusion in this section of information on beet-sugar and artificial silk production and on nitrogen-fixation, topics that are also treated in their appropriate chapters. If this report were labelled 'Chemical Engineering,' and the material of it were supplied by members of the Chemical Engineering Group, its value would be greatly improved, especially if line-diagrams were used to clarify, or obviate, verbal descriptions of plant. Unnecessary errors in spelling and hyphenation are less numerous than in previous reports, but the inclusion of such eccentricities as 'steam-line filter' (p. 12), 'electroultrafiltration' (p. 18), 'Pittsburg' for Pittsburgh (p. 14), and 'Haüsser' for Häusser (p. 189) show the need of better editorial supervision. The opinion (p. 87) that synthetic methyl alcohol "will solve the motor spirit from coal problem" appears to betray ignorance of the fact that methyl alcohol is a very poor motor-fuel; and the following statement (p. 59) bears witness to confusion of thought and style: "The decrease in the amount of tar now being distilled in the country may be gathered from the fact that the 1923 and 1924 quantities were approximately 326 and 353 million gallons respectively." In conclusion, we suggest that each volume should contain a list of the errors in its predecessor, and also the full titles of many, if not all, of the technical journals referred to in the text. How many chemists, for example, could decipher the abbreviations: S. & I. P., R., and J. Inf. Dis.?

Le magnétisme. Par Prof. Pierre Weiss et Gabriel Foex. (Collection Armand Colin: Section de physique, No. 71.) Pp. viii+215. (Paris: Armand Colin, 1926.) 8·40 francs.

ALL who are interested in the important subject of magnetism must feel that they owe a debt of gratitude to the authors of this little book. They are both distinguished for the researches which they have carried out on the subject, and as their work shows, combine skill in exposition with the imaginative faculty which belongs to the successful investigator. In this volume they have aimed at putting the reader in touch with recent researches which for the most part are to be found only in the original memoirs. Consequently they have confined themselves to a rapid summary of the definitions and fundamental laws of magnetism, though even here the careful reader will find much to repay study. Questions, such as the experimental technique and industrial applications, which have been discussed in previous works, have been left on one side.

To present the results of research in a coherent form is no easy task when they cover such a wide domain, but the authors have been successful in a high degree, and have shown how the experiments are to be interpreted by means of thermodynamics, statistical mechanics, and the anisotropy of crystals. A study of the magnetic properties of matter leads inevitably to the problem of the constitution of the atom, and thus is related to the most fundamental questions of present-day physics. To a certain extent the phenomena of magnetism are in good agreement with the atomic models which are demanded by the facts of radioactivity and radiation, but there are still unsolved problems. The theory of quanta leads to an elementary magnetic moment which is almost exactly five times the magneton deduced by Weiss from the experimental results. As the volume under notice bears the date 1926, we might have expected some account of the recent work of Sommerfeld and others, which serves to throw some light on the discrepancy. The final chapter does, however, contain a description of the quantisation of orbits in three dimensions and the confirmatory experiments of Gerlach and Stern. Though most students of physics are able to read scientific works in French, an English translation, if accompanied by some additional matter, would probably be welcome.

Kalkfrage, Bodenreaktion und Pflanzenwachstum. Von O. Arrhenius. Pp. vii+148. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 8 gold marks.

A LIST of those who have set forth their views on some aspect or other of the reaction between lime and soil would be an almost complete list of the world's soil chemists. It is not only—perhaps not chiefly—because of the economic importance of the liming of soils that so much scientific work and thought have been given to the matter. Economic considerations undoubtedly brought about the inception of the work (and still remain in some quarters the diplomatic excuse for its pursuit), but the enormous development of the work is in large measure the result of the sheer fascination of an elusive problem, which seems to be more complicated with each step taken towards its solution.

In his survey of the problem, Dr. Arrhenius gives a brief and somewhat critical review of the opinions held by soil chemists and ecologists on the relation between plant growth and soil acidity, and of the multiplicity of experimental methods which have been invoked in the study of the subject. We recognise the difficulty of giving an account of a subject with so many aspects, particularly when there is great divergence of opinion about the relative significance of those aspects, but it is not easy to understand the omission from the book of an account of the work of Hissink and of Gedroiz on the relation of exchangeable calcium in the soil to the liming problem. The conceptions which have arisen from this work are well known to be playing a prominent part both in the scientific study of the liming question and in the solution of economic problems of farming. It is to be hoped that in a future edition some account of this aspect of the work will be given and the appropriate additions made to the otherwise valuable and extensive bibliography.

A feature of the book is a concise account of the work—to which the author has himself made important contributions—of the observed relation between the weight of crop and the hydrogen ion concentration of the soil. Not all soil chemists and ecologists are able to agree with Dr. Arrhenius about the significance of this work and the validity of the conclusions drawn therefrom, but this account will be valuable both to its exponents and its critics. N. M. COMBER.

Colloid Chemistry: Theoretical and Applied. By Selected International Contributors. Collected and edited by Jerome Alexander. Vol. 1: Theory and Methods. Pp. 974. (New York: The Chemical Catalog Co., Inc., 1926.) 14.50 dollars.

MR. ALEXANDER, with the aid of sixty contributors of a dozen different nationalities, has made a gallant attempt to produce a comprehensive treatise on colloid chemistry in English. His success may be measured by the mass of useful material which is here presented, though the arrangement does not always make it readily available. The more general papers, for example, Harkins on surface energy, Hardy on lubrication, Freundlich on adsorption, Gibbs on aerosols, and Hatschek on viscosity, are models which might with advantage have been followed by some of the less eminent authors. The detailed discussion of any particular piece of experimental work is only permissible in a book of this kind when some very general principle is thereby illustrated, and on these grounds some half-dozen of the papers here printed should be relegated to the ordinary journals; their inclusion tends to produce the atmosphere of a *Festschrift*. Again, the actual matter of some of the articles is already available elsewhere; for example, that of Millikan on measuring the electrons, and the unduly long account given by Von Weimarn of his theory of the colloidal state. It is to be hoped that in the two volumes to follow the editor will be less merciful, even though his contributors write without hope of reward.

The ingenuity with which this mosaic of essays covers the field of theory and method is remarkable, but it is curious to find that the fundamental process of dialysis receives only a casual mention in two places. Recent developments in the use of electrodialysis are also neglected. No pains have been spared to provide adequate bibliographies, diagrams, and indexes, and with some patience in use this volume will form a valuable addition to the shelves of the colloid chemist.

P. C. L. THORNE.

Pflanzen als Gesteinsbildner. Von Julius Pia. Pp. viii + 355. (Berlin: Gebrüder Borntraeger, 1926.) 19·50 gold marks.

THIS book, which is founded in part on lectures delivered at the University of Vienna, aims at providing a comprehensive treatise on plants as rock-builders. It is intended both for geologists and botanists, but the whole mode of treatment is botanical rather than geological. The account of the Bacteria and Algæ, with which the book opens, will be useful to many students, though the amount of botanical detail included seems scarcely relevant to the main purpose of the book. Indeed, before the Cormophyta are reached, the reader can scarcely fail to become aware of a certain lack of proportion in the scheme of the work; nearly half the volume is devoted to the Bacteria and Algæ, while about the same amount of space is deemed sufficient for the higher plants from Bryophyta to Angiosperms. Even within the latter section of the book, the space assigned to different topics seems to have been allotted with little regard to their relative importance. Less than a dozen pages, for example, are assigned to the Coal-measure flora, whereas more than forty are devoted to marsh and moorland plants of the present day, which are included on the strength of their function as peat-formers.

The book is lavishly illustrated, the figures being mostly taken from well-known sources, which are cited. It may seem ungrateful to quarrel with such a wealth of excellent drawings in a book which has, to a certain extent, a popular aim, but one cannot but regret the space consumed by figures of some fifty flowering plants of the present day. The student, whether of geology or botany, would willingly have dispensed with some of these pretty pictures in favour of fuller bibliographies, especially in connexion with the chapter dealing with coal and its origin.

The Psychology of Social Institutions. By Prof. C. H. Judd. Pp. ix + 346. (New York: The Macmillan Co., 1926.) 8*s.* 6*d.* net.

"THE purpose of this book is to concentrate attention on the fact that social influences are of the highest importance in determining the character of human thought and conduct." To instincts and other inborn traits the author attributes little importance. This point of view now meets with widespread approval, and it is not proposed to quarrel with it here. There can be little doubt that the older social psychology, founding itself upon observation of the individual, over-emphasised the rôle of the so-called instincts of gregariousness and acquisition and the like. Whatever may have been the case with regard to the origin of institutions in respect to the part played by instinct, there is no question but that the vast accumulation represented in our social heritage now predominates in determining social conduct in general. Prof. Judd's book is to be welcomed in that it provides for the student an examination of certain social institutions at some length, during the course of which this point of view is kept continuously to the fore. But it cannot be said that the book contributes anything definite towards the solution of the numerous problems connected with the whole subject. It may be replied that this was not its purpose, and if this is so, then it has certainly fulfilled its limited object in driving home this one important lesson.

A. M. C.-S.

British Birds. Written and Illustrated by Archibald Thorburn. New edition. In 4 vols. Vol. 3. Pp. x + 168 + 48 plates. (London: Longmans, Green and Co., Ltd., 1926.) 16*s.* net.

THE third of the four volumes of Mr. Thorburn's new book on "British Birds" has now appeared, and fully comes up to the standard of its predecessors. It contains a further series of coloured plates of high merit, although a few, such as that of the lapwing, are decidedly less happy than the majority. We are glad to see that the female plumage is portrayed in very many cases, as is certainly necessary with such birds as ducks and game-birds, two of the principal groups dealt with on this occasion. Both sexes of the ptarmigan are shown in each of their three seasonal plumages. We could wish, however, that the nestlings also had more often been included in the plates, as has here been so successfully done in the case of the ringed and golden plovers.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Early History of Gaseous Adsorption.

THE publication in a recent part of *Proc. Roy. Soc.* (A, Sept. 1) of excerpts from the memoir of 1863 by Dr. R. Angus Smith of Manchester, on "The Absorption of Gases by Charcoal—(i)," by the initiative of Mr. S. Lenher, calls to mind Angus Smith's service in collecting, with the help of James Young of Kelly, the scattered scientific papers of his friend Thomas Graham, in 1876. No more attractive account of the history and philosophy of the atomic theory exists than the short introduction which he prefixed to that volume Physical chemistry was then being born, and the relevant ideas about atoms and the aether were in the foreground.

The John Hunter whose paper (*Journ. Chem. Soc.*, 1865) is referred to by Mr. Lenher was, I doubt not, the assistant trained to this kind of work by Thomas Andrews at Belfast, who died young In Andrews' address to the Chemical Section of the British Association in 1871 ("Scientific Papers," ed Tait and Crum Brown, p. 348), which was a survey of the main recent advances, he devotes a paragraph to the work of his assistant.

"Hunter has given a great extension to the earlier experiments of Saussure on the absorptive power of charcoal for gases. Cocoanut-charcoal, according to Hunter's experiments, exceeds all other varieties of wood-charcoal in absorptive power, taking up at ordinary pressures 170 volumes of ammonia and 69 of carbonic acid. Methylic alcohol is more largely absorbed than any other vapour from 90° to 127°: but at 159° the absorption of ordinary alcohol exceeds it. Cocoanut-charcoal absorbs forty-four times its volume of the vapour of water at 127°. The absorptive power is increased by pressure."

One recalls that the late Sir James Dewar, who presented to science the technique of charcoal absorption at low temperatures, spent his earlier years at Edinburgh, where the work of Andrews would be familiar through his friends Crum Brown and Tait

JOSEPH LARMOR

Cambridge, October 1.

The Structure of the Continents.

IN his letter on this subject published in NATURE of September 25, Dr. Harold Jeffreys cautiously favours the possibility that "the basaltic layer below the granite may be in a glassy state, as Daly has suggested," and he goes on to add that the underlying layer may well be dunite. The evidence in favour of this view is based on:

(*a*) Earthquake records which show that compressional waves are transmitted through the upper layer with a velocity of 5·6 km./sec.; through the lower layer with a velocity of 7·8 km /sec., and through an intermediate layer with a velocity (measurable in one case only) of 6·2 km./sec.

(*b*) The work of L. H. Adams and R E. Gibson (*Proc. Nat Acad Sci*, May 1926, p. 275), which gives the velocities calculated from the observed compressibilities and densities, at pressures corresponding to depths of about 30 km., as 6·45 km./sec. for tachylyte (basaltic glass) and 8·2 km /sec. for dunite (peridotite composed mainly of olivine). As these results refer to ordinary temperatures, those corresponding to the temperatures below the granitic crust would be a little less.

The possibility of a layer of basaltic glass between granite and dunite—both crystalline rocks—seems improbable on general grounds. If the basaltic layer be glassy, then one would expect the dunite also to be glassy, in which case the velocity of compressional waves would probably be less, instead of greater, than that within the lower layer of the continents. On the other hand, if the dunite be crystalline, then the basaltic layer should also be crystalline, particularly as its existence is referred to differentiation due to the crystallisation and sinking of olivine; for if olivine could crystallise it is difficult to imagine conditions which would inhibit the crystallisation of pyroxenes and felspars (or a high-pressure equivalent). But in this case the velocity of compressional waves would be 6·9 km./sec. or more. Evidently all that can be safely deduced from the evidence is that the basaltic layer is not mainly composed of gabbro.

There is, however, an alternative interpretation of the intermediate velocity recorded by Jeffreys which should not be overlooked L. H. Adams and E. D. Williamson (*Journ. Franklin Inst.*, April 1923, p 520) have calculated the corresponding velocities in syenite and granodiorite at 6·2 km /sec, and in diorite at 6·4 km /sec. If, therefore, the granite of the upper levels of the continents passes down into diorite, a reasonable explanation of the intermediate layer is forthcoming. In a recent paper (*Geol Mag.*, July 1926, p 317) I presented chemical and petrological evidence supporting the hypothesis that the continents were originally of granodiorite composition, and that as a result of igneous processes, mainly in pre-Cambrian time, the upper levels have become more granitic, leaving a complementary differentiate of diorite in depth. This hypothesis is in accordance with the great abundance of diorites and andesites in zones of later mountain folding, and with the absence of any widespread intrusions of post-Cambrian granites comparable in their regional extent with those that preceded them in pre-Cambrian time.

If the intermediate layer of Jeffreys be identified with diorite instead of with basaltic glass, then the basaltic layer should exist in the high-pressure crystalline facies of eclogite. Unfortunately, the compressibilities of garnets or eclogites at different pressures have not yet been determined, but it seems probable that the velocity of compressional waves in eclogite would not differ seriously from that in dunite. A layer of eclogite passing gradually down into dunite at some unknown depth would then satisfy the seismic, petrological, and isostatic evidence. In view of the great importance of testing this interpretation in the most direct possible way, I have expressed to Dr. L. H. Adams and his colleagues my hope that they will add to their work on basaltic glass and dunite a similar investigation of the elastic properties of eclogite.

A further objection to the identification of the intermediate layer with basaltic material, whether glassy or otherwise, arises from its shallowness in the crust If, as Jeffreys suggests, it extends from a depth of 10 or 15 km. to a depth of 20 or 30 km, then it is difficult to understand how it could ever be raised to the high temperatures implied by the great extrusions of plateau basalts which from time to time in geological history have overwhelmed enormous areas in different parts of the world This difficulty is relieved by the conception of an eclogite layer extending downwards from a depth of 20 or 30 km. into a region where the temperature is higher and heat of radioactive origin can be accumulated.

ARTHUR HOLMES.

The University, Durham, September 25.

Science and Psychical Research.

As I shall be shortly leaving for New Zealand, perhaps a little space may be granted me to reply to a number of letters which have appeared in the recent issues of Nature, from the pens of Sir Bryan Donkin, Mr. Campbell Swinton (3), and Mr. E. J. Dingwall.

Some of the confused thinking represented in these letters may perhaps be stopped if I explain the genesis of the original article which has provoked the discussion The editor of Nature asked me to write a review of Sir Arthur Conan Doyle's book *from a scientific viewpoint*, and I said I would try to do it. After reading through the two volumes very carefully, I concluded that there was nothing scientific about the book. I do not care for merely destructive criticism, as I think that a badly written book is its own worst condemnation. Also I am not yet so far removed from youthfulness as to have forgotten what I owe to the talented author, for giving us, long ago, "The White Company" and the adventures of the immortal Sherlock Holmes. So I told the editor that I had decided not to undertake the task. He then suggested to me that I should write an "essay review"; that is, using the book as a peg, I should hang upon it a dissertation on a cognate subject of scientific interest, namely, psychical research I accepted this offer, and chose the subject which has started the present discussion Apparently it sufficed for some minds to draw the conclusion that, because my essay was hung upon a spiritualistic peg, therefore psychical research is the same thing as spiritualism! No doubt, if I had written an essay review on the subject of evolution, hanging it upon a book on neo-Lamarckism, let us say, as a peg, the same type of mind would deduce that this indicated that evolution was the same thing as neo-Lamarckism!

That psychical research and spiritualism are not at all the same thing can be easily demonstrated, I think, if we take the cases of two famous exponents of psychical research already more or less discussed in these letters. I refer to Lodge and Richet. Both are admittedly psychical researchers of the first rank. Lodge is also a spiritualist, having come to the conclusion that survival is proved from his interpretation of the facts of psychical research. Richet, admitting the truth of the same set of facts, but interpreting them from a very different viewpoint, is still a kind of 'super-materialist,' absolutely and irrevocably opposed to the spiritistic hypothesis, which he holds is disproved by some of the very facts of psychical research! Could anything be plainer, then, than that psychical research and spiritualism are two entirely different things? What should we say of the mentality that confused biology with neo-Darwinism or with neo-Lamarckism? What are we to think of those who confuse a line of experimental research with one of the hypothetical conclusions which, in the opinion of only a portion of the researchers, arises out of it?

Let me now reply more particularly to Mr. Campbell Swinton, who has been a fair and, on the whole, courteous opponent, though sadly tempted at times, I fear, to let out and say what he really feels. Perhaps I may be ready to meet him half-way in his criticism that the medium is not absolutely comparable with the microscope or the chemical balance; I ought perhaps to have used a closer simile and likened the medium rather to the catalytic agent, the presence of which is essential to the production of the phenomena in certain types of chemical change. What I wanted to bring out, and what I still maintain, is that a genuine medium is not *actively* a participant in the experiments; the phenomena are produced *through some extended action of his subconscious mind*, but not by active volition on his part.

Mr. Campbell Swinton ought to know that a set of negative results in an experiment does not prove anything when confronted with even a single well-authenticated positive result from the same experiment. How many times have we, who have taught chemistry in schools, seen some of the most carefully prepared experiments fail to succeed, to the great delight of the assembled class? Yet, once the positive result is obtained, the acute mind of the boy knows at once that the negative results are cancelled, and one good demonstration is enough for him. It is only muddled thinking of the adult mind which persists in quoting a series of negative results as decisive.

As regards psychic photography, the decisive positive result, in my opinion, has never yet been obtained. So, in this particular case, I entirely agree with Mr. Swinton that there is *a high probability* that there is nothing in it. Many psychical researchers think the same; but spiritualists, on the whole, believe the opposite. The question could be settled once for all, to everybody's satisfaction, if one of the alleged photographic mediums would consent to experiment under absolute test conditions in which he would not be allowed to handle the plates or to have access to them at any stage of the proceedings. But I venture to think that it will be a very long time before any such thing as this is likely to happen.

I think it is rather hard that all my critics should waste so many words on trying to prove that I am a spiritualist and that spiritualism is a delusion If any of them had come to the National Laboratory of Psychical Research last week they would have heard my address on this very subject, in which I took the stand that the spiritistic hypothesis does *not* fit in with all the known facts of the case, and pleaded for a more thorough and scientific study of the phenomena, with the view of finding a general theory "which should harmonise all the discoverable facts in the same way that Darwin's great theory of Evolution harmonised all the known facts of biology." Surely Mr. Swinton, at any rate, will concede that I have never diverged from that view in the whole of this long discussion?

I am sorry that Mr. Swinton departed a little from the high level of his debate in the last paragraph of his letter in Nature of September 25. The words *suggestio falsi* sound, to my ears, somewhat offensive, especially as the idea behind them has been derived from the second-hand information of mischief-makers, and has not been verified by Mr. Swinton himself There are more than six hundred firms, associations, and companies in the London Telephone Directory having names beginning with the word 'national'. I think I need say no more than that we can justly claim to be quite as national in our organisation and outlook as most of them But as an excuse for refusing my invitation the objection to the word is surely puerile Why does not Mr. Swinton say that he has never in his life been to a séance and never intends to go to one? I would have preferred this direct statement to the somewhat unkind and unworthy innuendo which he makes instead. But, in any event, Mr. Swinton stands self-confessed as an illustration of the type of scientific man about whom I wrote my article, namely, the man who presents "an unscientific attitude to the subject of psychical research." I claim that the letters written by him and my other correspondents fully prove my point.

Mr. Swinton's remarks in his last letter, published in Nature of October 9, are entirely correct and in agreement with my own views, except for his last paragraph. I never classed Richet with Crookes and Lodge "as a spiritualist" but only as a psychical researcher. To do so would be "most misleading" if I had been dealing with spiritualism, but I was not. The title of my essay was "Science and Psychical Research," not "Science and Spiritualism." My plea to men of science is for a more scientific attitude of mind *towards psychical research*, not towards spiritualism.

Sir Bryan Donkin has gratuitously given his own interpretation to the words "supernormal phenomena," thereby ruling out all those manifestations which I consider to be the key to the whole situation. I have more than once stated that I do not know the difference between trance and sleep. If Sir Bryan does, will he please tell us? If he does not, why does he take up an attitude which will forever prevent the problem being solved? If some of our leading medical men would spare a little time, even though they be, as I am, hard-worked to the very limit, we should soon know something about this mediumistic state. But I have seen excellent supernormal phenomena produced with the medium wide awake and absolutely controlled and immobilised in good light, so the question as to what trance may or may not be does not touch the essentials of my argument. Sir Bryan cannot have it both ways. If he is opposed to the scientific examination of the trance state, then he takes an unscientific attitude towards this phenomenon and is another of those to whom my article was addressed. But if he thinks it ought to be studied, then he should range himself on my side in this discussion.

Mr. Dingwall, I can surely claim, agrees with me, for he uses my very words in his last paragraph. He says, "There is a good case for the scientific study of what are called supernormal phenomena." That is exactly what I said too! But the rest of his letter shows clearly what he wanted to imply, namely, that Dr. Tillyard had not seen enough supernormal phenomena to enable him to judge rightly. I concede readily that I have not seen anything like so much as Mr. Dingwall; if he were logical, he would *a fortiori* exclude Mr. Swinton and most other men of science from this discussion, as they have not even seen as much as I have seen. Why pick me out and leave them in?

Mr. Dingwall asks, very pertinently, "Can Dr. Tillyard tell us of any single medium who can produce some simple raps, under conditions which render their normal reproduction impossible?" Yes, I can. Stella C. has repeatedly, both in my presence and in that of many others, produced such raps inside a close Pugh Table at a distance from herself. Mr. Dingwall will doubtless criticise this experiment, as he has done to me personally, on the ground that, as the box is closed, nobody could really see what was going on inside it. Yet, in his report on the Margery mediumship he says that he particularly requested that the phenomena should be done inside a closed box, and, when this request was refused, he regarded it as highly suspicious. In other words, Mr. Dingwall is always ready with an argument *against* any particular experiment, even though his objections mutually destroy one another.

I would like to assure Mr. Dingwall that it is not the number of séances that a man attends, but his capacity to draw definite conclusions, which really matters. Mr. Dingwall has attended hundreds, but he is still in a mental fog, just like the schoolboy whom we all know, who may be given an experiment to do many times over, but can never make a clear deduction from it. I am quite content with the eight séances which I have attended. In two of them, undoubted evidence of fraud was easily discoverable. In one other there was no analysable result. In the other five, with three different mediums, definite supernormal results followed under strict test conditions. In other words, I have obtained, *five times over*, a definite proof that supernormal phenomena do undoubtedly occur, and so I join the ranks of those who, like Lodge and Richet, are convinced of this fact. No amount of negative evidence can outweigh these positive results. Let me also assure Mr. Dingwall that I am not very likely to add largely to my psychic experiences, not being a hunter after sensations. I have seen Sir Ernest Rutherford's experiment on the bombardment of the atom demonstrated twice. It is enough. I accept the fact that the atom can be broken up, and no longer desire to go on attending lectures which keep on proving the same thing. I have seen supernormal phenomena in abundance produced at five controlled séances. It is also enough to convince me that they occur. What is the true explanation of them remains still to me at least a partial mystery; according as the evidence may unfold itself in the future, I may yet find myself with either Sir Oliver Lodge or Prof. Richet.

Finally, let me again plead for a more scientific attitude of mind on the part of men of science towards psychical research. Perhaps I may live to see it, if I succeed in attaining the allotted span.

R. J. TILLYARD.

REFERRING to the discussion on this subject in previous issues of NATURE, might one ask: Is there not confusion regarding the aims of science and of psychical research, which at present are fundamentally dissimilar? We know that the object of experimental science, as distinct from philosophy and mathematics, is to obtain control over the energies of Nature by learning the laws inherent in matter; that science has never set a limit to the varieties of matter; that, consistent with its purpose, it accepts facts as it finds them; and that its function, *qua* science, has never been to prove *a priori* conceptions. Some of us forget, however, that the elementary conditions essential for the pursuit of its object are not compatible with the objects and conditions of psychical research. By way of contrast a simple statement of scientific requirements might be made as follows:

1. The first two indispensable and interdependent factors in any scientific problem are the trained research worker and *something to be examined*. The thing to be examined may not have been contacted by all the physical senses, as, for example, electricity; but it must have been experienced by means of one sense-faculty, at least, before it will come to the attention of human beings or within the range of scientific research. (Scientific instruments are merely the extension of our physical senses.) It was not necessary to prove the existence of electricity; the problem was first, how to induce, and second, how to control or direct it.

2. It is essential for real scientific research that the matter investigated be, to some extent at least, under the control of the investigator, and this is possible only through his knowledge of the laws which describe the action of energy under certain specified conditions.

3. Science has advanced each step in its progress on the knowledge of laws already ascertained. Much was known concerning the chemical elements and conductive materials before electro-chemical phenomena could be investigated. Every factor in an experiment cannot be new.

4. Science requires for each advance a working hypothesis or theory about what is next to be discovered. The theory may be proved wrong, but nothing at all can be attempted in fresh fields without

a tentative supposition, a temporary theory which suggests a particular line of investigation, or some reason for doing one thing rather than another.

Now, the phenomena described as 'psychic' cannot come within the purvey of science if we accept the conditions given above. Men of science cannot examine something non-existent to them, and of which, consequently, no data exist, for there is then no basis for a beginning It is impossible to undertake to 'test' that about which we know absolutely nothing. Thus a Gilbertian situation arises when it is proposed to examine 'psychic phenomena' scientifically (1) The matter to be tested has as yet no existence; therefore (2) we know no laws by which its action could be induced; (3) we have no theory regarding its nature, laws, or cause; (4) we cannot control its production, (5) we do not know the nature of the medium through which it is proposed to attempt to induce the phenomena; and (6) the investigator cannot control or direct the energies which supposedly must operate to produce results.

Before science can enter this field there would have to be (1) an acknowledgment, derived from experience, of the reality of psychic phenomena; (2) the formulation of a scientific theory or working hypothesis of the possible laws inherent in the matter of the phenomena, and (3) some means found by which the experimenter could control the operations of the experiment. One does not by this preclude the possibility of prediction by mathematical science of the existence of a kind of matter hitherto unknown, a hypothetical state of organic matter, acting under electro-magnetic laws, analogous to inorganic states of invisible electro-chemical matter Such a prediction could arise only from a more exact knowledge of physiological and psychological activities, but the first step in a true scientific investigation of 'psychic phenomena' cannot be taken until some deduction or other is attempted. It is necessary, therefore, for serious investigators of this phenomena, who affirm its existence, to state a case, to enunciate a working hypothesis not contradictory of the fundamental principles of exact science. The collection of instances and theories thereon, or hit-and-miss experiments in the vague expectation that something will be discovered, have never, and could never, in themselves, evolve a science Terms used should be defined in such a way as to conform to the 'uniformity of Nature,' which is the one great deductive theorem of science. We know, however, that, although man is included in Nature in the largest sense of that term, science has as yet gained control only of energies latent in the mineral forms of existence and of *states preceding mineral precipitation*. The energies of the forms that *succeed*, *i e.* of plants, animals, and man, have not been made subject to exact science. We have no practical knowledge of the laws that originate organic forms and govern their growth. Further, no man of science can alter the temperament or constitution of a human being, nor can he *isolate sensations, emotions, or thoughts from exterior influence and regulate them according to prescribed formulæ* Hence, scientific attempts to isolate a 'medium' are childish. Equally puerile are 'tests' by measuring instruments. The *vacuum tube* preceded the measurements of the phenomena of modern physics. What is to be the vacuum tube for psychical investigation?

W. W. L.

How can the methods of scientific research be applied to the subject of the spirit world, which is of such post-vital interest to us all? To do so under existing conditions is generally impossible and always difficult. Faraday wrote to a friend: "I have been busy turning the tables on the table-turners." That statement was based on the results of definite experiments carried out under his own conditions.

In present circumstances, to follow Faraday's example and apply science to psychics is not easy. Would any manager of importance take his medium to the Royal Institution and submit without reserve to laboratory conditions?

Cannot the difficulty, if it does exist, be overcome by the use of scientifically trained mediums? Suppose, for example, prominent spiritists were engaged, in the first instance, to examine the staffs of colleges and scientific institutions throughout the country. It is probable that from such plentiful material a sufficient number of mediums of even moderate power could be obtained, when it is remembered that from one family alone a father, two daughters, and a son-in-law were all able to practise successfully as mediums. It would be desirable to exclude all who already have committed themselves intensely, those whose interest is mercenary, writers of imaginative articles for profit, those who seek prominence, and those imbued with the spirit of mischief.

Given the willing medium whose sole interest is science, and given suitable laboratory conditions, it should be possible to test the scientific basis of the claims of spiritists. It might even be possible to entice a ghost between crossed Nicols

JAMES WEIR FRENCH.

Anniesland, Glasgow, W 2,
October 6.

Transmission of Stimuli in Plants.

THE transmission of stimulation past a discontinuity has been demonstrated in Mimosa by Prof. Ricca and confirmed by Mr. Snow and others. On the other hand, Sir J. C Bose has stated (NATURE, vol 115, Jan. 10 and March 28, 1925, and also *Proc R. S.*, Series B, 98, p 290) that he was unable to obtain this result.

I have for some time past been engaged in work on the transmission of stimulation in *Mimosa pudica*. Apart from my main line of work, and more as a matter of interest than from any doubt as to its validity, I have attempted to repeat this experiment The method used was that described by Mr. Snow (*Proc. R. S.*, Series B, 96, p. 349) in which the two parts of the shoot are connected together by a piece of water-filled rubber tubing.

The directions given by Mr Snow were followed carefully, but for a long time I was not successful in obtaining the transport of the stimulus past the cut, although the experiment was repeated on a number of different occasions. The cause of the failures was finally found to be due to minute bubbles of air which emerged from the pith as the tension in the water increased. These bubbles collected in the space between the cut surfaces and interrupted the continuity of the water separating the two portions of the shoot. In Mr Snow's experiments this effect does not seem to have been encountered, but possibly Sir J. C. Bose's failures are to be attributed to this cause. It may be of interest to describe a method which I have found successful in avoiding this difficulty.

A shoot was cut into two halves under water and the portions placed in a beaker of water in such a way that the two freshly cut surfaces were completely submerged The beaker was then put into a large empty desiccator from which the air was exhausted by means of a vacuum pump. In this way air was removed from the intercellular spaces of the pith of the cut internode and, when air was readmitted to the desiccator, these spaces became injected with water. The two portions of the shoot were removed and connected with water-filled rubber tubing in the usual way, the two cut surfaces being brought very close together. The whole shoot was then supported in air in a horizontal position, the basal end being immersed in water. After a resting period of two hours, to enable the shoot to recover its normal condition, it was stimulated by the application of a flame to a basal internode.

On the two occasions on which the experiment was tried, using the above-mentioned method, the stimulus affected, first of all, the leaves on the basal portion of the shoot, and then, after a pause of more than one minute, it traversed the water-gap and affected the leaves in the apical portion For example, in one case, the two leaves in the basal part moved after 4 sec. and 8 sec. respectively, while beyond the discontinuity the times at which the leaves moved were 1 m. 16 s., 1 m. 49 s., 2 m. 21 s., and 2 m. 29 s.

If Sir J C. Bose will repeat his experiments, using the precautions mentioned above, I am sure that he will be able to convince himself of the need of modifying his statements (NATURE, vol. 115, Jan. 10, 1925) "that the transpiration-current has nothing to do with the conduction of the excitatory impulse" and that "*the conduction is a phenomenon of propagation of protoplasmic excitation.*" There is no doubt that the stimulus can be carried across a discontinuity by means of the transpiration current, and that in this case, at any rate, the conduction has nothing to do with "the propagation of protoplasmic excitation."

It is somewhat surprising that Sir J. C. Bose (*Proc. R. S.*, Series B, 98) should have failed to obtain stimulation by applying extracts of the stem to the basal end of a cut shoot. This result, which was obtained originally by Prof. Ricca and amply confirmed by others, strongly favours the hormone theory. Personally, I have not found the least difficulty in obtaining stimulation in this way.

NIGEL G. BALL.

University College, Colombo,
August 18.

Electric Television.

INVENTION appears to be multiplying in regard to this interesting subject, and I hear that more than one inventor in Paris is employing, for receiving, the cathode ray arrangement that I believe I was the first to publish in a letter to NATURE of June 18, 1908. The ideas embodied in this arrangement had occurred to me several years prior to that date, indeed not long after the production of the Braun cathode ray oscillograph invented in 1897 I actually tried some rot very successful experiments in the matter of getting an electrical effect from the combined action of light and cathode rays incident upon a selenium-coated surface, in which I was assisted by the late Prof. G. M. Minchin, himself a great authority on electric cells sensitive to light, and also by Mr. J. C. M. Stanton. The transmitting apparatus consisted of a home-made Braun oscillograph in which a metal plate coated with selenium was substituted for the usual fluorescent screen, the image to be transmitted being thrown by a lens upon the selenium surface, and the end of the cathode ray beam being caused electromagnetically to traverse the projected image. Experiments were also tried in receiving with a Braun tube which I purchased in Germany, but in its then 'hard' form it proved very intractable.

My ideas in regard to this cathode ray arrangement for the production of television were further detailed and illustrated in an address I gave to the Röntgen Society on November 7, 1911; and still further elaborated and brought up-to-date, with wireless methods applied, in a paper I read before the Radio Society of Great Britain on March 26, 1924.

My idea, which was to use cathode rays as employed in the Braun oscillograph, instead of moving material parts, both in the transmitting and in the receiving instruments, is, as I understand, only at present being applied for receiving, mechanical apparatus being still used for transmitting. I desire, however, to point out that when the cathode ray is also applied to transmitting it will be possible to dispense entirely with all moving material parts, as the alternating or intermittent electric currents employed for moving the two cathode ray beams synchronously at the transmitting and receiving stations respectively can be supplied by oscillating thermionic valves supplied by batteries.

In this way it should prove possible to have electric television of a satisfactory fine-grain description without the employment of any mechanical motion of material parts whatever, as cathode rays are practically without weight and inertia, and can be deflected with perfect accuracy and synchronism at almost incredible speeds, while the accuracy of oscillating valves properly tuned is also wonderful.

A. A. CAMPBELL SWINTON.

October 9.

Active Nitrogen.

IN the "Research Items" in NATURE for September 18, reference is made to the paper by Willey and Rideal in the *Journal of the Chemical Society* for July, in which the energy of active nitrogen is found to be 42,500 cal. per gm. mol. Now Strutt's photographs of the glow produced when active nitrogen acts upon iodine show that the iodine line 2061 Å U. is produced, and this needs an amount of energy of at least 150,000 cal. It is unlikely that a series of successive impacts could give to the iodine a higher level of energy than that possessed by the nitrogen, or that simultaneous collisions of the iodine with more than one nitrogen molecule would suffice. The nitrogen glow is destroyed by iodine vapour in an exceedingly small fraction of a second, which indicates the probability of exchange of energy taking place directly between the active nitrogen molecule (if it *is* the molecule and not the atom) and the molecule of iodine.

E. B. LUDLAM.
L. H. EASSON.

University of Edinburgh,
October 5.

Copper at Low Temperatures.

IN the August issue of the *Proceedings of the Royal Society* (A 112 [1926], pp 136-151) a paper by Messrs. Lambert and Hartley on "An Investigation of the Effects of Variations in the Radiation Factor on the Efficiency of Dewar Vessels" records some interesting experiments which suggest that copper has unique radiating properties at about the temperature of liquid oxygen. In this connexion a peculiar phenomenon came to my notice some months ago, and it is possible that the two sets of observations may be related.

When present at a public lecture on 'Liquid Air,' delivered at the beginning of this year, I made the following observation during one of the lecture experiments A small solid copper cylinder was immersed in liquid air contained in an unsilvered glass Dewar vessel in order to cool it down prior to its immersion in water to demonstrate the formation of ice. During the cooling of the cylinder in the liquid air, the usual rapid evolution of gas occurred on immersion, which lasted for some time, after which the liquid air became quiescent and it appeared that temperature equilibrium had been reached. However, instead of remaining quiescent, as one would expect, after a few seconds a sudden re-evolution of gas took place, which was of short duration, and then a state of equilibrium was apparently attained.

I have recently confirmed this observation, and some experiments have been carried out to see whether this phenomenon is of general occurrence with metals, or whether it is specific for copper. It has only been possible, so far, to examine the following metals: lead, iron, tin, platinum and aluminium, and in these cases no such action was observed under similar conditions.

It appears from these experiments that either:

(1) Copper undergoes an allotropic change with heat evolution at a temperature slightly above that of liquid air. One is reminded of the phenomenon of recalescence in the case of iron at higher temperatures.

Or (2) a surface action peculiar to copper comes into play

Such an effect must cause a considerable loss in filling copper Dewar-vessels with liquid air.

I have so far been unable to trace any record of this peculiar behaviour of copper in the literature.

GEORGE JAMES ALEXANDER.

Rock Ferry, Cheshire

The Reaction to Flea Bites.

IT does not seem to be generally appreciated that the irritating wheals which may follow the bites of various insects are anaphylactic in origin. The first time that a person is bitten by a species of insect which has never bitten him before, nothing or next to nothing may happen, but when he has become sensitive to the proteid in the liquid which the insect injects in the process of biting, he develops the local irritable swelling which is familiar to most people.

Some years ago (*J. Path. Bact.*, 17 (1912), 110) I showed that my wife, who gave a violent reaction to the bite of the human flea (*Pulex irritans*), did not respond at all to bites of the rat flea (*Xenopsylla cheopis*) until they had been fed on her five times during six weeks, when she developed extensive wheals. We have recently got the same results with the rabbit flea (*Spilopsyllus cuniculi*) Single fleas were fed on June 6 and June 18, and four fleas on July 11, without any result; after feeding two on August 13 red papules developed seven days later; single fleas were fed on August 22 and September 1, and in each case a moderate reaction developed about 36 hours later. It is rather remarkable that the minute quantity of foreign proteid injected by the fleas in four bites should be enough to make a person sensitive. Lack of sensitisation is not, of course, the only reason why people do not react. Some persons who are extensively flea bitten seem to become immune. Others are naturally immune: however often I am bitten by them, I give no response to fleas of any kind, though midges and some mosquitoes irritate me extremely. At least that is so in Hertfordshire; from my only experience of Scotch midges, in which I was bitten very freely, I had no trouble; they were probably a different species.

The rabbit flea does not in my experience bite man very readily; in some trials I have quite failed to get them to do so even after several days' starvation. When they do, they take a long time to get their feed, and if undisturbed may remain attached for so long as an hour. Brumpt ("Précis de parasitologie," 3rd ed., 1922, p. 829) notices this peculiarity, which seems to apply to their feeding on rabbits as well as man.

A. E. BOYCOTT.

October 2.

Zoological Nomenclature: Hübner's (1806) 'Tentamen.'

THE secretary of the International Commission on Zoological Nomenclature has the honour to invite attention of the zoological profession to the fact that application has been made for the suspension of the International Rules, in the case of Hübner's (1806) 'Tentamen' in order to establish its nomenclatorial availability.

Briefly summarised: The formal nomenclatorial status of this document, involving about 100 names admitted by some authors as of generic rank, has been under controversy for many years, and opinion of specialists in Lepidoptera is still divided.

The arguments, as submitted, in favour of suspension of rules, maintain that: (1) there are sound reasons both for admitting and for denying recognition to the 'Tentamen' from the viewpoint of interpreting the Rules; (2) the evidence *pro* and *con* is not sufficiently conclusive to remove the question from debate; (3) the rejection of the 'Tentamen' will produce greater confusion than uniformity, will necessitate a vast amount of undesirable labour and economic loss of time and work; (4) if, on the ground of expediency, the rules can be suspended in this case, the nomenclature of the Lepidoptera, as used for the past thirty years, can be largely maintained.

The 'Tentamen' is one of the most important and most controversial cases ever submitted to the Commission. A discussion, with essential bibliographic references, will be found in *Smithsonian Misc. Coll.*, v. 73 (4) (now in press).

The Commission will delay announcement of vote, on the requested suspension, at least until September 1, 1927, in order to give interested authors, and especially entomological societies, opportunity to study the premises and to present to the Commission their views and arguments, *pro* or *con*, regarding the action requested.

In order to protect groups other than Lepidoptera, a prerequisite to suspension of rules would be that representative specialists in Lepidoptera agree upon and furnish to the Commission definite bibliographic references to the 107 names which they view as genotypes.

C. W. STILES,
Secretary to Commission.

U.S. Hygienic Laboratory,
Washington, D C,
August 21.

The Problem of the Origin of Species as it appeared to Darwin in 1859 and as it appears to us To-day.

I HAVE discovered two errors in my recent paper which appeared under this title in NATURE of August 21, 1926. These errors were due to the hurried assemblage of facts and citations under the heading "Geographic Isolation and Speciation"; they will be carefully corrected in a sequel to this paper which is now in preparation for the *American Naturalist*, to be published under the title "The Origin of Species, V.: Speciation and Mutation." Meanwhile, I desire to point out as inaccurate the following statement in my paper:

"As an example of wide isolation without speciation, the house wren of Florida, *T. aedon aedon*, exhibits the same characters as those of Tierra del Fuego, but in the intermediate regions another species, *T. musculus*, exhibits a large amount of subspeciation and several complete intergradations."

On the contrary, the house wren is not known to breed in Florida and does not occur in Tierra del

Fuego. The species occurs in Patagonia and in the southern United States, but the birds from these two areas are specifically distinct.

The second erroneous statement is in the final paragraph of the same section, where (2) and (4) contradict each other:

"(2) . . . a desert subspecies, *P. m. sonoriensis*, reared for eight years in a humid environment, is entirely unmodified in the direction of the humid subspecies *P. m. gambeli*.

(4) Similar results from transplantation of *P. m. rubidus* and *P. m. sonoriensis* are obtained: reared in an entirely new environment, they do not converge toward each other but toward local humid subspecies *P. m. gambeli*."

Here (4) should read.

"Similar results from transplantation of *P. m. rubidus* and *P. m. sonoriensis* are obtained: reared in an entirely new environment, they do not converge toward each other or toward the local humid subspecies *P. m. gambeli*."

I regret having made these erroneous statements in a zoological field outside my own, and I trust that this correction will prevent their wider circulation.

HENRY FAIRFIELD OSBORN.

American Museum of Natural History,
September 21.

The Spectrum of Zinc.

IN the course of an investigation for the British Non-Ferrous Metals Research Association, which it is hoped will prove successful in applying the spectroscope to the quantitative assay of the impurities in zinc, the following observations of more special scientific interest were noted.

A zinc line, which does not appear to have been measured, occurs at λ2147·36 I. Å. (±0·02) near the cadmium line at λ2144·39 Å. Close to the 'raie ultime' of cadmium λ2265·04 Å. is a zinc line the wavelength of which is λ2265·35 I. Å. (±0·02). This should be taken into account when searching the zinc spectrum for lines due to impurities, as with spectrographs of comparatively low dispersion, such as the Hilger quartz spectrograph size E. 31., the zinc and cadmium lines are indistinguishable. Hagenbach and Schumacher (*Z. wiss. Phot.*, 19, p. 129, 1919) give the following as zinc lines: λλ2265·08 (8) and 2265·40 (2), and it is highly probable that the former line is a cadmium line.

Spectrograms were taken on a Hilger quartz spectrograph size E. 1. and the zinc lines measured on a photo-measuring micrometer size L. 1. using various samples of zinc.

The samples of zinc supplied by the British Non-Ferrous Metals Research Association included one sample from the New Jersey Zinc Co, prepared by fractional distillation after electrolytic refining, and was considered to be spectroscopically pure.

D. M. SMITH.

Research Department, Adam Hilger, Ltd.,
September 15.

Observed Relative Intensities of Stark Components in Hydrogen.

ATTRACTED by the singularly large observed variations (*Astrophys. Jour.*, 62, 229, 1925) from estimated intensities of certain strong Stark components of H_β (H. A. Kramers, Copenhagen, 1919) we have recently made quantitative measurements from a suitable source by means of a neutral wedge. It is interesting to compare the results with the new theoretical calculations by Schrödinger (*Ann. d. Phys.*, 80, 437, 1926). Following are the observed, calculated, and estimated ratios of intensities of components having polarisations and displacements as indicated. The displacement Δ is expressed in the unit which appears in the quantum theory of the Stark-effect.

Components Compared.	Ratio of Intensities		
	Obs.	Calc	Est
p components of H_β, $\dfrac{\Delta=\pm 8}{\Delta=\pm 10}$	1·00	1·06	0·40
s components of H_β, $\dfrac{\Delta=\pm 4}{\Delta=\pm 6}$	1·59	1·55	0·54

The much weaker components, p, $\Delta=\pm 6$ and s, $\Delta=\pm 2$ appear somewhat stronger than the theory indicates This is possibly due in part to superimposed secondary spectrum lines, which could not be detected by the present method. Owing to the increased interest in this research, the measurements are now being extended to the weaker components and to H_γ and H_δ with such modification in method as to permit the detection of any seconday spectrum lines.

J. STUART FOSTER.
M. LAURA CHALK
(National Research Student)

McGill University, Montreal,
September 6.

Absorption Spectrum of the Hydrogen Molecule.

WITH the continuous spectrum described by Lyman (*Astrophysical Jour.*, 60, 1) as a background, and with hydrogen flowing through the receiver of the spectrograph, it was found possible to photograph the absorption spectrum of molecular hydrogen in the extreme ultra-violet. More than twenty absorption bands were observed between λλ1245 and 840. Most of the bands were clearly resolved and show the characteristic structure of the emission bands in the ultra-violet. The most striking feature of the spectrum is a progression of strong absorption bands beginning with λ1105. At least twelve bands of this progression were easily recognised. This adds a new electronic level to the three already obtained (Dieke and Hopfield, Oakland Meeting of the American Physical Society, June 1926) from the hydrogen emission spectrum A continuous absorption spectrum begins sharply at λ840. This continuous absorption corresponds to the dissociation of the molecule into a normal and an excited atom. The long wave-length limit of the continuous absorption compares well with the theoretical value 14·4 volts. Complete details will be published later.

J. J. HOPFIELD.
G. H. DIEKE.

University of California,
Berkeley, August 17.

Sterility in the Vegetable Marrow.

THE vegetable marrow appears to have been affected by a form of sterility this season I have been told of cases both in Gloucestershire and Surrey where the plants have produced an enormous number of male flowers and only one, or possibly two, female flowers. In the case of one marrow to a plant the resulting fruit has been a large one. Every plant was affected in the same way. No disbudding had been practised. In my own case I have had, as usual, an abundant crop, including about three dozen well-ripened fruits for winter use The season has been favourable for half-hardy plants. Can any reader suggest a reason for this occurrence in a monœcious plant?

ELEONORA ARMITAGE.

Dadnor, Herefordshire,
September 25.

The Analysis of Line Spectra.[1]

By Prof. A. FOWLER, F.R.S.

RATHER more than sixty years ago, when the spectroscope became an effective instrument of scientific research through the work of Kirchhoff and Bunsen, it was regarded essentially as providing a new and powerful method of chemical analysis. It soon had brilliant results to show in the discovery of a number of new elements, but this kind of discovery could not go on indefinitely, and the interest of chemists as a body in spectrum analysis would appear to have declined rather rapidly. Spectrum analysis, as was soon realised, was not so simple a matter as it first appeared, and called for so much study that its pursuit was mainly left in the hands of a small band of specialists.

Some of the most important developments of spectroscopy have been closely associated with attempts to interpret the spectra of celestial bodies. The introduction of photographic methods by Huggins led almost at once to the discovery of new lines apparently belonging to hydrogen in the spectra of Sirius and other white stars, which were afterwards of great value in the establishment of Balmer's law of the hydrogen spectrum. Perhaps the greatest contribution of early astrophysics to our stock of knowledge, however, was that which so clearly pointed to the essential identity of matter throughout the universe.

With the discovery that the spectra of certain elements were modified by varying the character of the exciting source, chemical analysis of the sun and stars was supplemented and eventually overshadowed by investigations of the physical conditions which prevail in those bodies. The sun and stars thus came to be regarded as natural experiments on generally similar masses of matter at various high temperatures—experiments ready prepared for observation and always in operation. Thus many laboratory researches were directly instigated by astrophysical observations. To take one example, the fragmentary observations by Lockyer and by Liveing and Dewar of what were afterwards called *enhanced lines* were extended and systematised through an attempt by Lockyer, in which I myself took part, to interpret the spectrum of the solar chromosphere as photographed during the total eclipses of the sun in 1893 and 1896. The immediate result was an important correlation of the changes in the laboratory spectra of the elements with the succession of types in stellar spectra,[2] from which it appeared that enhanced lines were especially characteristic of stars which, on other grounds, were believed to be hotter than the sun. These investigations laid the foundations for a true interpretation of the spectra of the hotter stars, and led to the more extended studies of enhanced lines which have proved of such great importance in the development of the theory of the origin of spectra and the structure of atoms.

The remarkable developments of spectroscopy in the direction of atomic physics have resulted from discoveries relating to regularities in spectra. In the representation of series spectra the wave-number of a line always appears as the difference of two *terms*, and a series of lines appears as a regular succession of differences between a limiting term and a sequence of terms, the limit itself being a term of another sequence.

Much of the early work on series regularities in spectra is summarised in the now well-known symbolic representation of a series system, namely:

Principal series . . .	$1\,S - mP_i$
Sharp series	$1\,P_i - mS$
Diffuse series . . .	$1\,P_i - mD_i$
Fundamental series . .	$2\,D_i - mF_i$

where 1 S, for example, represents an individual term, and mS a sequence of terms of S type. The S terms are always single, but the others are complex in all but singlet systems; so that $i = 1$ for singlets; 1, 2 for doublets; and 1, 2, 3 for triplets (in the older numeration). A sequence of terms may be represented by an approximate formula such as that of Hicks, in the form $R/[m+\mu+a/m]^2$, where R is the Rydberg constant, m a serial number, and μ and a constants (usually proper fractions) to be determined from the observed lines. The possible combinations of terms in the production of lines are restricted in accordance with selection rules which have since been extended to more complex spectra, as will appear later.

It should be understood that these studies of the structure of spectra were pursued with the clear conviction that they would ultimately reveal the secrets of atomic structure, and the analysis of spectra, as distinct from spectrum analysis, gradually became one of the principal objects of spectroscopic research.

With the advent of Bohr's theory of spectra in 1913, spectroscopy entered on a new phase of activity. The theory and its immediate explanation of the spectra of hydrogen and ionised helium are now so well known as to call for little more than mention. Adopting the Rutherford conception of a neutral atom, spectroscopic terms were translated by the theory into 'energy levels' of the atom, so that a spectrum line is considered to represent the energy emitted by an excited atom when it passes from a non-radiating state of a certain energy to another of lesser energy. The terms are, in fact, proportional to the energies of the corresponding 'stationary' states.

The theory in its first form also gave a definite significance to the enhanced lines occurring in the spectra of other elements besides helium, and predicted that such lines would form series systems for which the series constant would be 4 R, 9 R, 16 R, and so on for atoms at successive stages of ionisation.

Bohr's theory proved a great stimulus to experimental spectroscopy as well as to theoretical investigations. Among the first fruits was the experimental verification of the predicted 4 R value for the series constant in the spectra of ionised magnesium, calcium, and strontium.[3] Next, Sommerfeld's well-known extension of the theory of the hydrogen spectrum by taking account of the relativistic variation of the mass of the electron with its orbital velocity predicted a fine structure of the lines of hydrogen and of ionised helium which was almost immediately verified by Paschen's remarkable observations of the structure of ionised helium lines under very high resolving power.

---

[1] From the presidential address delivered to Section A (Mathematical and Physical Science) of the British Association at Oxford, on August 9.

[2] Lockyer, *Roy. Soc. Proc.*, vol. 60, p. 475 (1897).

[3] A. Fowler, *Phil. Trans.*, A, vol. 214, p. 225 (1914).
The verification of 9 R for doubly-ionised aluminium by Paschen (*Ann. d. Phys.*, vol. 71, p. 142, 1923), and of 16 R for trebly-ionised silicon by A. Fowler (*Roy. Soc. Proc.*, A, vol. 103, p. 413, 1923), followed in due course.

A general explanation of the existence of several types of series S, P, D . . . in the spectra of more complex atoms immediately followed, namely, that such types of series are to be attributed to the action on the series electron of a perturbing field due to the presence of other electrons in the atom, producing a precessional motion similar to that associated with the relativity effect, but of very much greater value.

Apart from the first two groups and the aluminium sub-group of the periodic table, the spectra of the elements, with few exceptions, are extremely complex and long defied analysis. It was not until 1922 that a key to the structure of complex spectra was furnished by the investigations of Catalán, who was then working at the Imperial College of Science. The essential feature of Catalán's work was the discovery that in the arc and spark spectra of manganese, and in the arc spectrum of chromium, there were terms of greater complexity than the triple terms which had previously been recognised. It was this discovery that opened a way to the analysis of complex spectra in general. It has been pursued with amazing success by Catalán himself, Walters, Laporte, Meggers, Sommer, and others, and the main features of the structure of many spectra as complicated as that of iron have been revealed.

It is not necessary to go into all the intricate details of the spectra, because the general results can now be very simply summarised in consequence of the theoretical developments which have gone hand in hand with the experimental investigations. Bohr and Sommerfeld had already established certain 'selection rules' for the combination of the terms of the simpler spectra on a quantum number basis, and immediately following the work of Catalán, Sommerfeld showed that the scheme of 'inner quantum numbers' which he had devised for the simpler spectra could be extended so as to fit the observations empirically. As other spectra came to be disentangled, an assignment of quantum numbers which appears to be adapted to all spectra was completed by Landé.

In accordance with the work of Bohr, Sommerfeld and Landé, a spectral term may be represented by four quantum numbers, written in the form $n_{k_j}^{r}$. Here n is the *principal* quantum number, increasing by unity for successive terms of the same sequence; k is the *asimuthal* quantum number and has the values 1, 2, 3, 4, 5 . . . . . . for the term types S, P, D, F, G . . . . ; j is the *inner* quantum number, having one or more values according as the term is single or multiple; r represents the *maximum multiplicity* of terms in the system to which the term belongs, so that $r=1$ for singlets, 2 for doublets, 3 for triplets, and so on.

The selection rules regulating the term combinations of most general occurrence are:

For different types of terms: $\Delta k = \pm 1$.

For individual component terms: $\Delta j = \pm 1$ or 0, with $j=0$ to $j=0$ forbidden.

For systems of terms: $\Delta r = \pm 2$ or 0.

Apparent exceptions to the first selection rule, $\Delta k = \pm 1$, are of very frequent occurrence. In the spectra of the alkaline earths there are several groups of lines—some of them of great intensity—which do not belong to the regular series, but are related to them through the characteristic separations of the respective triplet systems, as was first recognised by Rydberg more than thirty years ago. Groups of this type were further investigated by Popow and by Gotze, and their real structure was deduced from observations of Zeeman effects. It then appeared that such a group was derived from combinations of P terms of the regular series with another set of P terms, or of ordinary D terms with a second set of D terms. The additional types of terms, which are usually distinguished as 'anomalous terms' and designated by P′, D′ . . ., have the same inner quantum numbers and show the same Zeeman effects as ordinary terms of corresponding types; but in their combinations with the regular terms they mostly follow the rule $\Delta k = 0$, giving the combinations PP′, DD′ . . . . Among themselves, however, the anomalous terms combine in accordance with the ordinary selection rule, $\Delta k = \pm 1$, giving such combinations as P′D′, D′F′ . . . . Such terms are not restricted to the spectra of the alkaline earths, but have been found to be of very general occurrence in all but the simplest spectra.

In the actual analysis of a spectrum, the selection rules which have been indicated for the combination of terms are supplemented in a very practical way by Sommerfeld's 'intensity rule' and to a less degree by Landé's 'interval rule.'

The whole question of intensities in related groups of lines has recently been placed on a quantitative basis through photometric measurements initiated by Ornstein, Burger, and Dorgelo at Utrecht. It results that the intensities in such groups are in the ratio of integers, and it may accordingly be concluded that intensities, like frequencies, are determined by quantum considerations.

Unfortunately, the analysis of a spectrum does not always lead to a knowledge of the actual values of the terms, or energy levels. These can be determined for any of the relatively simple spectra, in which comparatively extended series can be traced and their limits calculated. In most of the complex spectra, only the relative values of the terms have been deduced, since extended sequences in these spectra are apparently of rare occurrence. Even for these, however, the term of highest numerical value, representing the lowest energy level, can often be identified, and this is of special value in view of its association with the normal state of the atom.

This completes the story of spectroscopic terms and their possible combinations on what might be called a purely numerical basis; that is, in so far as the analysis of a spectrum can at present be based merely on a table of wave-lengths and intensities. Especially as regards the more complex spectra, however, advantage has to be taken of every possible experimental aid to the classification of the lines—particularly, in the first instance, as a means of sorting out the lines characteristic of an element at different stages of ionisation.

Thanks to the industry of numerous workers, many of the complex spectra have now been partially analysed, and two of the principal generalisations foreshadowed some years ago have been greatly strengthened. The first of these is expressed by the so-called 'alternation law,' according to which the arc spectra of the elements are alternately of even and odd multiplicities in passing from the first to the higher groups of the periodic table. No exceptions to the rule have yet been found.

The second generalisation is expressed by the spectroscopic 'displacement law,' which states that the first spark (enhanced) spectrum of an element has a structure similar to that of the arc spectrum of the element which precedes it in the periodic table. To make this generally applicable, however, it is necessary to qualify the rule by restricting the meaning of similarity to a common odd or even multiplicity.

These rules have by no means been proved for all elements, but they are true for all spectra which have been disentangled up to the present time, and may safely be adopted as a starting-point in the analysis of further spectra. They have been almost completely verified for the elements of the two short periods Li (3) to Cl (17), but may be more effectively illustrated by the arc spectra of the elements K (19) to Ni (28) by the use of data collected by Catalán, which are given in Table I. The table includes references to the 'ground term,' *i.e.* the highest term or deepest energy level:

TABLE I.

TERM SYSTEMS IN ARC SPECTRA, K-Ni.

Group.	I	II	III	IV	V	VI	VII	VIII		
Element.	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni
Multiplicities	2	1 3	2 4	1 3 5	2 4 6	3 5 7	4 6 8	3 5 7	2 4 6	1 3 5
Ground term	^2S	^1S	^2D	^3F	^4F	^7S	^6S	^5D	^4F	^3F

A very striking relation, to which attention appears to have first been directed by Hund, is that, as regards the ground term, the spark spectrum of each of the elements Ca to Ni is more closely related to its own arc spectrum than to the arc spectrum of the preceding element. This may be shown as follows:

	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni
Arc . .	^1S	^2D	^3F	^4F	^7S	^6S	^5D	^4F	^3F
Spark . .	^2S	^3D	^4F	^5F	^6S	^7S	^6D	(^5F)	(^4F)

It is not improbable that such systematic relations will be of considerable assistance in the unravelling of the numerous complicated spectra which remain to be investigated.

The more recent results of the analysis of complex spectra have provided an ordered knowledge of a multitude of facts which have an important bearing upon the development of the theory of spectra and the arrangement of electrons in the outer parts of normal atoms. Theoretical workers have not been slow to utilise the new data, and have, indeed, frequently been able to forge ahead of experimental results.

The principal problems immediately resulting from the analysis of the more complex spectra resolve themselves into two—first, the distribution of the electrons among the various possible types of orbit; and, second, the deduction of spectroscopic terms from a given distribution of electrons.

In the consideration of the first problem we are not confined to the evidence afforded by optical spectra. Other data towards this end are furnished by X-ray spectra and by the variations of the chemical and physical properties of the elements according to their positions in the periodic classification. Bohr's well-known table of electron orbits (1922) was built up by taking account of these properties and considering the formation of atoms by the successive capture and binding of electrons. The orbits themselves were distinguished by the quantum numbers n_k $(k \leq n)$, and it was assumed that the orbits of the earlier bound electrons were essentially unchanged when another electron was introduced into the system.

These ideas of Bohr have been remarkably developed in recent years, especially through the work of Main Smith[4] and Stoner,[5] who independently arrived at similar conclusions, chiefly from the consideration of chemical and physical properties respectively. In the new scheme the inner sub-levels are completed at an earlier stage than in Bohr's arrangement, and there is a greater concentration of electrons in the outer sub-levels of each group. The nature of the modification will be sufficiently indicated by comparing the electron distribution among the sub-levels in helium, neon, argon, and krypton, according to the old and new arrangements (Table II.).

TABLE II.

ARRANGEMENT OF ELECTRONS IN RARE GASES.

Bohr.

	Atomic Number.	K 1_1	L 2_1 2_2	M 3_1 3_2 3_3	N 4_1 4_2 4_3 4_4
He	2	2			
Ne	10	2	4 4		
A	18	2	4 4	4 4	
Kr	36	2	4 4	6 6 6	4 4

Main Smith and Stoner.

	Atomic Number.	K 1_{11}	L 2_{11} 2_{21} 2_{22}	M 3_{11} 3_{21} 3_{22} 3_{32} 3_{33}	N 4_{11} 4_{21} 4_{22}—
He	2	2			
Ne	10	2	2 2 4		
A	18	2	2 2 4	2 2 4	
Kr	36	2	2 2 4	2 2 4 4 6	2 2 4
	n_k—	1_1	2_1 $\underbrace{2 \ \ 4}_{2_2}$	3_1 $\underbrace{2 \ \ 4}_{3_2}$ $\underbrace{4 \ \ 6}_{3_3}$	4_1 $\underbrace{2 \ \ 4}_{4_2}$

The new scheme of electron distribution was shown by Stoner to be supported by a consideration of the intensities of X-ray lines, the absorption of X-rays, chemical and magnetic properties, and optical spectra. It retains all the essential features of Bohr's picture of the building up of atoms, and is equally in accord with chemical considerations, as is especially shown by the work of Main Smith. The electronic arrangements of all the elements from 1 to 92, in their normal states, may now be specified with considerable confidence.

---

[4] "Chemistry and Atomic Structure," London, 1924, *Review of Chemistry and Industry*, March 28, 1924.

[5] *Phil. Mag.*, vol. 47, p. 719 (1924); vol. 49, p. 1289 (1925).

With the attainment of a definite conception of the electronic structure of the various atoms it becomes possible to approach the second of the two problems referred to above, namely, the determination of the spectroscopic terms associated with a given distribution of electron orbits. The first steps were taken by Russell and Saunders, and independently in part by Wentzel, who, in a discussion of the so-called 'anomalous' terms, which have already been mentioned, made one of the most illuminating contributions to spectroscopy of recent years. To the three $^3PP'$ groups of calcium already known two more were added by Russell and Saunders, who were thus able to show that the five groups formed a series which could be approximately represented by a Ritz formula. The surprising result then appeared that, as referred to the regular triplet limits, the later P' terms were numerically negative. The earlier P' terms, having positive values, certainly originated in the neutral atom, and it could scarcely be doubted that the later terms also had the same origin.

The existence of these negative terms implies a greater equivalent energy than that required for ionisation of the atom, and it follows that it is possible for the atom to remain neutral while absorbing more energy than that necessary to remove the series electron. Hence, in accordance with a previous suggestion made by Bohr, but unknown to them, Russell and Saunders concluded that the energy must be divided between two (or more) electrons, each of which is displaced to a higher energy level, without the removal of either of them. The detailed numerical evidence led inevitably to the conclusion that both valence electrons might jump at the same time from outer to inner orbits, and that the net loss of energy would then be radiated as a single quantum, *i.e.* as monochromatic emission.

Arising out of the work of Russell and Saunders, together with further contributions by Pauli, Goudsmit, and Heisenberg, a general theory of complex spectra has been developed in a practical form by Hund.[6] The theory enables the deeper spectrum terms corresponding to any specified configuration of electrons to be determined with considerable certainty.

It is a fundamental feature of the new theory that, in a complex spectrum, the quantum numbers which specify an electron orbit are quite distinct from those which specify a spectroscopic term. The former are five in number, namely, n, k_1, k_2, m_1, m_2. The latter, which number three, are represented by r, l, j. The theory consists of semi-empirical rules for deducing r, l, and j for the deeper-lying terms from the quantum numbers of the electrons in uncompleted groups.

The assignment of five quantum numbers to each electron orbit is due to Pauli, who supplemented it by a hypothesis—generally known as Pauli's principle—which asserts that no two electrons in an atom can occupy orbits having the same values for these five quantities. This principle can be shown to lead immediately to the scheme of electron distribution suggested by Main Smith and Stoner.

The extraordinary theoretical developments in recent years, leading to the prediction of certain features of the spectra of elements and the structure of atoms, have possibly overshadowed the progress in experimental spectroscopy. Nevertheless, much experimental work of immediate importance to theory has been carried on, and much more is urgently called for.

The present resources of experimental spectroscopy would appear to be adequate for the elucidation of the majority of the outstanding problems. For most elements the conditions of excitation can be so modified that the spectrum is well under control, so that all the lines, or only a selection of them, can be produced at will.

The old, well-tried methods of exciting substances to luminosity—the flame, arc, spark, and vacuum tubes—have by no means been superseded. They have, however, been supplemented by numerous other experimental arrangements. Some of these, like the electric furnace so effectively employed at Mount Wilson by A. S. King, have brought the spectrum of an element under more gradual control, so that a valuable aid in the classification of the lines of a complicated spectrum is provided by the order of their appearance as the temperature is raised. Other methods have definitely brought additional spectra within the range of laboratory experience.

One class of 'experiments,' as I have previously mentioned, is provided by the heavenly bodies. Saha's theory of high-temperature ionisation, further developed by Fowler and Milne and by Miss C. H. Payne, has already been utilised in the prediction of the ionisation potentials of certain multiply-ionised atoms for which the structures of the corresponding laboratory spectra have not yet been sufficiently determined to indicate the energies of the normal states. In this way it is conceivable that we may obtain approximate values of the actual energy levels in some of the complex atoms for which only relative values can at present be directly determined from the spectra.

Enough has been said, I hope, to give some idea of the main lines of development and present trend of spectroscopy. The analysis of spectra with which I have been chiefly concerned is a fascinating pursuit, and the establishment of a beautiful order out of an apparent chaos of spectrum lines brings great satisfaction to the investigator. I have endeavoured to show, however, that the analysis of spectra is not an end in itself, but that under the guidance of quantum theory it has fundamental contributions to make to our understanding of atomic structure and of the periodic classification of the chemical elements. It appears not at all improbable that some of the mysteries of chemical valency may also find a solution in the classification of spectrum lines, and there are indications that the conceptions of spectroscopy may ultimately extend our knowledge of the structure of matter in the liquid and solid states.

It may be that in the future the theory of spectra will be so far developed that it will become possible to calculate the positions and intensities of the lines composing the spectrum of an element with greater accuracy than they can be observed. We are, however, still very far from this ideal, and meanwhile experiment and theory must go hand in hand towards a better understanding of the problems that lie immediately before us.

---

[6] *Zeit. f. Phys.*, vol. 33, p 345, vol 34, p. 296 (1925)

Scientific and Industrial Research in Australia and New Zealand.

AT the Imperial Conference now in session, among other important problems for discussion is that of Imperial co-operation in scientific research. By far the most promising schemes for advancement in that direction, in Australia and New Zealand respectively, are those recently evolved by Sir Frank Heath, Secretary to the Department of Scientific and Industrial Research, London, as the result of his recent visit to those countries, at the invitation of their Governments, which have now unanimously adopted the proposals he has laid before them.

In addition to internal development, the importance of the protection of new countries against the accidental introduction of insect pests alone, not to mention plant pests, has lately been emphasised by Dr. Edward M. Ehrhorn, the well-known entomologist of Honolulu. He has stated that the losses caused by insect attack on the principal crops of the United States amount to upwards of 1,000,000,000 dollars a year, "a sum more than sufficient to meet the entire cost of the Federal Government's annual expenditures." Most of these pests were accidentally introduced, and many could have been excluded by a scientifically-controlled quarantine.

Already in Australia rust and other fungoid diseases have attacked the wheat, but their ravages have been greatly lessened by the breeding of rust-resisting varieties, as initiated by Farrer of New South Wales, and by the disinfecting of the seed wheat with copper compounds. Formerly the seed wheat was dipped, before being sown, in a weak solution of copper sulphate. This poisoned the fungoid spores and so saved much loss from rust, but it somewhat damaged the seed wheat. Now, in lieu of this the seed wheat is dusted with finely powdered copper carbonate, and this process alone, as compared with the earlier one, is increasing the value of the Commonwealth wheat yield by about 2,200,000*l*. per annum.

This discovery, of vast value to Australia, the United States, and other wheat-growing countries, has been the result of 'team work,' partly by native-born Australian workers, partly by men trained in the best schools of the homeland, and the whole improved by American investigators. If the increased value of the American and other wheat crops throughout the world, accruing from this discovery, be added to the 2,200,000*l*. a year gained by Australia, the total sum realised would repay, many times over, all cost of agricultural research. A far greater gain will follow when, as the result of scientific breeding of wheat, both rust-resisting and drought-resisting types are evolved. In view of such research, particularly in Australia, Prof. J. D. Watt, of the University of Sydney, considers the desired end is already in sight. What is true of scientific team-work applied to wheat, is true also of all the primary and secondary industries.

The key-note of the Australian and New Zealand research schemes is 'team-work': team-work within Australia and New Zealand themselves, and team-work within the Empire, but such team-work, to attain the best, must not be spasmodic. In Sir Frank Heath's words: "What the industries want is a steady long-sighted policy of help and advice from the State in a national movement for the co-operative attack on scientific problems similar to that successfully initiated here [New Zealand] in the marketing of products overseas." Again, the report on the Australian proposals refers to the distribution of the Commonwealth's activities among the States according to their suitability for different sections of the work as "a means of convincing them that the national effort in scientific things is a pervasive instead of a centralised and bureaucratic influence."

In order to give effect to the proposals of the Commonwealth Government for the reorganisation of the Institute of Science and Industry, an Act was passed by the Commonwealth Legislature in June last which provides as follows:

A Commonwealth Council of Scientific and Industrial Research to be constituted, consisting of not less than nine members, three nominated by the Prime Minister, and appointed by the Governor-General, and including the official chairman of the council. This body is to be the executive during the six-monthly interval between the meetings of the full council. The remaining six members of the council come from the six States of the Commonwealth, each of these members being the chairman, for the time being, of the State Committee (advisory to the Council of Scientific and Industrial Research) in the particular State to which he belongs. In addition, the council may co-opt such other members as may be approved by the Minister on account of their special scientific knowledge. In order to give continuity to the policy of the council, the scheme provides that each of the three executive officers shall hold office for several years.

The Act provides for the State Committees to be constituted "as prescribed." Under the Government scheme, the chairmen are to be selected by the Commonwealth Government after consultation with the State authorities: three members appointed by the State Governments from the staffs of their scientific departments; three members representative of pure science, of which at least two must be from the local universities—such men to be selected by the National Research Council; these six members and the chairmen to co-opt three (or, exceptionally, more) other members representative of primary and secondary industries within the State.

The Commonwealth Council has already held several meetings, and consists of the following:

Executive
- G. A. Julius, *Chairman*, President last year of the Institute of Engineers in Australia.
- Prof. A. C. D. Rivett, Professor of Chemistry, University of Melbourne.
- W. J. Newbigin, Managing Director of the firm of W. J. Adams & Co., Ltd., an engineer and member of the Chamber of Commerce.

The remaining members are:

Queensland. Prof. H. C. Richards (Geology).
New South Wales. Prof. J. D. Watt (Agriculture).
Victoria. Sir David Orme Masson (Chemistry).
Tasmania. Mr. Keam (Pastoralist).
S. Australia Prof. T. Brailsford Robertson (Physiology).
W. Australia. Mr. Perry (Industrialist).

In addition, the following two members have been co-opted:

Queensland. Prof. E. J. Goddard (Biology).
Melbourne. Prof. H. A. Woodruff (Veterinary Science).

Thus, both the Commonwealth Council and the State Committees are widely representative. Great freedom of action is given to the council by placing it immediately under the Prime Minister, not as one of his departments, but as an advisory council to him.

Annual estimates for the special work of the year have to receive the sanction of the Commonwealth Parliament in the usual manner, but the financial provision, of far-reaching importance, adopted by the Parliament is as follows: The appropriation from the consolidated revenue fund of the sum of 250,000*l.* to form a trust account, the capital and interest to be used for the purpose of scientific and industrial investigations. A further sum of 100,000*l.* has been appropriated out of the consolidated revenue fund as an endowment fund (of which the executive of the council are trustees), the interest on which is to be used: (1) to assist persons in their scientific research; and (2) to train students for scientific research. The Commonwealth Parliament also voted 29,000*l.* to clear off all debts left by the old Institute of Science and Industry. In addition, the sum of 50,000*l.* was asked for by the council for the particular work to be undertaken within the present financial year.

At the instance of the Prime Minister, the Right Hon. S. M. Bruce, the Cabinet gave immediate effect to Sir Frank Heath's recommendations for facilitating the further training in the homeland of the most promising young Australian scientific workers by sending four such, at once, to be trained for two years in research institutions, chiefly those attached to the Department of Scientific and Industrial Research, London. Four additional students are about to be nominated for training abroad. An allowance of 150*l.* is made to these students for their passages to and from Australia, and the salary is 300*l.* a year with an additional provision of a sum up to 100*l.* for each student for travelling while abroad. Reciprocal arrangements have now been made for the reception of students from the homeland at centres of research in Australia and New Zealand. This excellent provision is not the least important of the plans for securing good team-work within the Empire.

The field work of the council this year will be as follows: Cold-storage problems in co-operation with the British Food Investigation Board, with special reference to beef; liquid fuels, treatment of fuels for saving oil and other products by low-temperature distillation, Bergius process, etc.; forest products, continuation of researches on making paper pulp out of timber, utilisation of gums, resins, tannins, etc.; animal diseases and pests, blow-fly and buffalo-fly pests, diseases of cattle, sheep, and horses; plant diseases and pests, researches for checking the spread of prickly pear (29,000,000 acres in Australia now overrun by this pest).

The chairman of the council, Mr. Julius, is expected to arrive in England next year to discuss scientific and industrial problems of mutual interest to the homeland and to Australia. Thus, so far as Australia is concerned, the new council is already going strong.

In regard to New Zealand, on the recommendation of the Prime Minister, the Right Hon. J. G. Coates, the Parliament has adopted practically all of Sir Frank Heath's scheme as follows: An Advisory Council of Scientific and Industrial Research is to be formed, under the Prime Minister, for the general utilisation of science for the advancement of New Zealand's industries. It is also to co-ordinate and see to the proper maintenance of the Geological Survey, Magnetic Survey, Meteorological Office, the Hector Observatory, the Samoan Scientific Service, and a State Laboratory for Standards and Tests to include the present Dominion Laboratory. An agricultural college is to be built and an institute of dairying to be established to collaborate with it. Expensive buildings are not suggested, but much of the initial research work is to be done at the college laboratories. It is suggested that the Dairy Products Control Board share with the Government the cost of maintaining such a research institute.

In regard to forestry problems, of great importance to the Dominions and the Empire, in view of the alarming decrease in the supply of soft woods (Great Britain now imports 40,000,000*l.* of timber annually) it is recommended that a forestry institute be created, later, by the Government, assisted by the timber milling companies, and that meanwhile a general report on the whole question of the New Zealand forests be obtained from the ablest forester available. With regard to fuel resources, and how best to utilise the somewhat friable coals of New Zealand, a research student is to be sent at once to the Fuel Research Station of the Department of Scientific and Industrial Research at Greenwich. Then there is the hydro-electric problem: it is estimated that New Zealand has a potential supply of no less than five million continuous horse-power.

So much for the primary industries. For the secondary industries, two technical field officers are to be appointed to assist co-operative research associations, and particularly to advise the smaller industries. Arrangements are to be made for a scientific library to comprise the chief public and university libraries as well as some private libraries. New Zealand is advised to link itself up with the International Research Council by establishing a local National Research Council; and to found National Research Scholarships and grants to professors and others for research work.

The total grants for the last-named services are not to exceed 2000*l.* a year, while the initial cost of the council, apart from office charges, etc., is estimated to be about 7000*l.* a year. A scientific officer is to be attached to the Office of the High Commissioner of

New Zealand in London to act as a liaison between the Department of Scientific and Industrial Research and the new department in the Dominion.

The universities, the New Zealand Institute, and the Cawthron Research Institute all find places in the scheme, as well as the Department of Industry and Commerce. The Advisory Council is to be constituted much as in the Commonwealth, with this important exception, namely, that in view of the smaller distances to be travelled in New Zealand as compared with Australia, the meetings of the council are to be held monthly, the executive being left in the hands of the secretary of the council, a well-trained man of science, Dr. E. Marsden, until recently assistant director of education, formerly a fellow of the University of Manchester and professor of physics at Victoria College, University of New Zealand. A bill to give statutory effect to the above recommendation has recently been carried by the New Zealand House of Representatives.

Thus, in New Zealand, as in Australia, in the future application of science to the development of industry, the watchword is 'team-work,' as for the nations around the Pacific who meet triennially in the Pan-Pacific Science Congress, no less than for the League of Nations. For any work worth the doing the first essential is to find the man, and surely in the selected teams of Australia, and in the leader of the New Zealand Councils for Scientific and Industrial Research, the men have been found.

News and Views.

THE preliminary programme of the third Pan-Pacific Science Congress, which is to be held at Tokyo from Saturday, October 30, until Thursday, November 11, contains a provisional scheme and time-table of the work of the congress, a list of the excursions which have been arranged, lists of sailings, and other matter useful to those who propose to attend the meeting or to contribute to its proceedings. His Imperial Highness Prince Kotohito of Kan-in has consented to act as patron, and H.E. the Prime Minister of Japan will be president of the congress. There is a long and distinguished list of honorary vice-presidents, which includes the diplomatic representatives of the chief Powers, a number of the Japanese Ministers of State, and heads of universities. The arrangements for the meetings have been in the hands of an organising committee appointed by the Japanese National Research Council, under the auspices of which the congress is held. A change has been made in the organisation of the meeting itself to promote solidarity of feeling and action. There is no doubt that the change will also greatly facilitate the conduct of business in a congress covering so wide a field. The different branches of science have been classified into two broad divisions, the physical sciences and the biological sciences, instead of into sections and sub-sections for each branch of science as in previous congresses. Divisional meetings and joint divisional meetings will take the place of the sectional meetings. At these, discussions will take place between allied branches of science on subjects of more or less common interest, in other words on border-line problems. Sectional meetings will continue to be held, but taking quite a subordinate place—for the contributions of a special nature which from their scope are unsuitable for discussion at a divisional meeting.

THE character of the discussions at the congress must, to a great extent, depend upon the number and nature of the communications offered, but the organising committee has drawn up a provisional list of subjects. In the joint divisional meetings it is proposed to hold a symposium on certain plans for international co-operation in the study of the more important scientific problems of the Pacific, and, secondly, to survey the present state of knowledge of the physical and biological oceanography of the Pacific. The subjects suggested for divisional or sectional discussion cover a wide range in all branches of science, from astronomy to economic geography, agriculture, and medicine, in all cases with special reference to the Pacific. It is noticeable that there is a considerable bias in favour of topics which have a practical application. In the physical section meteorology, earthquakes, and the study of volcanoes take a prominent place. In the biological sciences the fauna and flora of the Pacific are to be discussed in relation to distribution, as well as from the practical point of view of protection, and, where appropriate, in relation to economic development. Anthropology is well represented in the discussion of the antiquity of man in the Pacific, the anthropometry of races of the Pacific, the study of Ainu, Papuans, and pygmies, the culture of the East Indies in relation to the question of 'diffusion,' and the relation of food, clothing, and houses to climate. A series of excursions has been arranged to suit the special interests of members of the congress extending from October 18 until November 19, which will include visits to Ainu villages, the famous shrine and temple at Nikko, Hakone volcano, Fuji, coal and copper mines, hot springs, cretaceous, tertiary, pliocene, and other geological formations in various localities, the old Imperial Palace and the University at Kyoto, as well as other places of importance for the study of the fauna and flora or the commercial and industrial activities of Japan. After the official excursions are over, facilities will be afforded for a longer stay if desired.

PROF. R. RUGGLES GATES, who has just returned to London after a visit to Russia, gives us some interesting information as to the position of some scientific work and institutions there. In the course of his letter he says that much valuable work is being done in the various plant-breeding stations which he visited. These included Tammisto, near Helsingfors, Finland, as well as Khibiny in Russian Lappland, north of the Arctic circle, which is devoted chiefly to the production of northern vegetables and oats for fodder; Peterhof and Desto Selo, near

Leningrad, where extensive genetical, biometric, cytological, and physiological investigations are being carried on, especially with cereals, under the direction of Profs. Philiptschenko, Vavilov, and Levitsky, and Drs. Pissarev and Karpetschenko; Petrovsky-Razoumovsky, where extensive experiments, particularly with oat-breeding, are being made by Dr. Schegalov; and Saratov, where the greatest interest attaches to a series of unique wheat-rye hybrids of Prof. Meister, and where Dr. Plachek is improving the varieties of sunflowers, which are extensively grown as a crop in Southern Russia.

In Moscow, the Institute of Experimental Biology is one of several laboratories under the direction of Prof. Koltzoff, in which a great range of genetical and cytological as well as other experimental work in animal biology is being done. The genetical section is in charge of Prof. Tschetverikoff. Much eugenical work is also being done in Moscow and Leningrad, especially in the collection of pedigrees, and a *Russian Journal of Eugenics* is edited by Profs. Koltzoff, Liublinsky and Philiptschenko. The Timiriazev Institute in Moscow, under the direction of Prof. Navashin, is chiefly devoted to research in plant cytology and genetics. Prof. Gates also visited the Botanical Gardens in Leningrad, Tiflis, and Batoum, the chief interest of the Tiflis garden being its large collection of Caucasus plants. A study was made of the tundra vegetation in the far north and the steppe region in Southern Russia and the Caucasus. While in Moscow Prof. Gates was present at the opening of a small museum of Metchnikoff relics in the Institute of Experimental Pathology. Madame Metchnikoff came from Paris for the occasion.

Considerable interest has been aroused among archæologists by discoveries at Glozel, on the right bank of a rivulet called Le Vareille, about twenty miles south-east of Vichy, of which little had been heard in England until attention was directed to them by Prof. S. Reinach in a letter to the *Times* of September 27, in which he referred to their bearing upon the date of the Magdalenian culture. The excavations, which began in 1924 and were carried out by Dr. Morlet, assisted by a young peasant Émile Fradin, yielded last summer a curious combination of objects in association which is at least puzzling. The objects were of stone, bone, and more or less baked clay, without a particle of metal or Celtic or Roman pottery. They consisted of (1) a few polished axes and small flints (there is no flint in the neighbourhood). (2) very thick hand-made vases, one of them decorated with a human head (eyes and nose but no mouth), a fiddle-shaped figurine representing a woman, without a mouth and recalling the so-called owl-vases of Troy; (3) pebbles engraved with outlines of animals or inscriptions or both, in the most degraded Magdalenian style, (4) a large number of clay tablets covered with inscriptions, some long and well engraved. Of these inscriptions some are described as being like the Phœnician, but the greater number are quite different.

Inscriptions from so remote a period are not known if we except some of Piette's earlier painted pebbles from the Mas d'Azil and a few (apparent) graffiti on reindeer horn. The only similar inscriptions of anything like so early a date were found in Portugal in 1894; but these aroused some suspicion and have not been universally accepted. Prof. Reinach, to whom we are indebted for these details of the find, is of the opinion that we have here a religious deposit of early neolithic age associated with a degenerate Magdalenian culture which is thus brought down so late as 4000–3000 B.C., he holds that it points to the western origin of writing. Prof. Elliot Smith, in his presidential address to the Anthropological Society of University College, London, on October 15, referred to this curious association in one deposit of neolithic objects with Cretan affinities, Magdalenian objects, and a linear script. He suggested that if the neolithic phase did not begin in western Europe until the second millenium B.C., there was nothing inherently improbable in the association; but it necessitated cutting off one millenium from the dating on Prof. Reinach's view, that the close of the Magdalenian period might have been so late as 3000 B.C. Further, if the Ægean origin of the pottery was admitted, the claim for the western origin of writing was unjustifiable.

At the Imperial College, South Kensington, on October 13, Dr. W. H. Keesom, professor of physics and director of the Cryogenic Laboratory in the University of Leyden, described the experiments by which he succeeded in solidifying helium in June and July last. The methods of refrigeration employed by the late Dr. Kamerlingh Onnes made it possible to attain a temperature of less than one degree above the absolute zero, and by applying great pressure at this temperature, Dr. Keesom found it possible to reduce helium to the solid state. Under the most favourable conditions a pressure of the order of 100 atmospheres was sufficient for the purpose. In the earliest experiments, in which the use of much higher pressures was contemplated, the solidification took place in a German silver tube, and was demonstrated by the indications of a differential manometer showing that the tubes had become blocked. In later experiments a glass vessel was employed, so that the solid helium could be seen. It was not distinguishable from the liquid to the eye, having apparently the same refractive index and density, but the existence of the solid was proved by the fact that a metal stirrer immersed in the substance became fixed. By means of a simple device for melting the helium in immediate contact with the stirrer, the latter was released, and could be hammered against the unmelted solid a short distance away. A curve of melting-point against pressure was drawn, and it was found that, unlike the corresponding curve for other substances, it did not meet the vapour pressure curve, and there was therefore no triple point. By extrapolation the melting-point curve was shown to become parallel to the axis of temperature at the absolute zero, in accordance with Nernst's heat theorem.

Recently the International Education Board, founded by Mr. John D. Rockefeller in 1923, made an offer of 30,000*l*. towards the cost of erection, equipment, and endowment of new premises for the Department of Animal Breeding in the University of Edinburgh, on condition that a similar sum was obtained in Britain. It was announced by the Principal of the University, Sir Alfred Ewing, on Thursday last that Lord Woolavington had given a sum of 10,000*l*. towards the endowment of a chair of animal breeding in the University, and that the Development Commission would make a substantial grant, so that the condition laid down by the International Education Board might now be regarded as fulfilled.

THE Board of Agriculture first suggested in 1913 that research in animal breeding should be undertaken in Edinburgh, and a joint committee, representative of the University and the College of Agriculture, was appointed to consider the matter in conjunction with the Board and the Development Commission The organisation of the work was interrupted by the outbreak of the War, but was resumed in 1919, and towards the end of 1920 the Department of Animal Breeding was established with Dr. F. A. E Crew as director. It was first housed in the immediate neighbourhood of the Old College, but for the last two years has occupied laboratories in the new Department of Chemistry at West Mains, adjacent to which ten acres of pasture belonging to the University have been made available. The financial arrangements now announced will enable the Department to be provided with premises specially equipped for work on animal breeding, and as a site at West Mains is available, it is anticipated that the building of the new Department will soon be undertaken.

AT a meeting of the Society for the Study of Inebriety on October 12, Dr. J. D. Rolleston read a paper on alcoholism in classical antiquity in which he stated that, in view of the fact that the scientific study of inebriety dates only from the middle of the nineteenth century, very little is to be gleaned from contemporary medical writers as to the prevalence and effects of alcoholism in ancient Greece and Rome. The main sources of information are the poets, especially the gnomic writers and satirists, philosophers, moralists, and encyclopædists such as Pliny the elder and Athenæus. Though there is some indication of the existence of chronic alcoholism, as is shown by passages in Pliny and Seneca, alcoholism in classical antiquity was mainly of a convivial character, and industrial alcoholism, apart from that associated with prostitution, was unknown Dr Rolleston quoted numerous passages from the classical writers dealing with the dysgenic influence of alcohol and other evil effects of drink on the community and the individual, especially the relation of inebriety to insanity, crime and poverty, and the measures, often of a fanciful character, recommended by the ancients for the prevention and treatment of drunkenness In conclusion, Dr. Rolleston pointed out that the alcoholism of classical antiquity differed from that of to-day by its predominance among the upper classes, the lack of legislative control, the absence of distilled liquors and the non-existence of syphilis, which is now often contracted as the result of alcoholic indulgence and runs a severe course in alcoholic subjects.

THE Innwerk Aluminium Co. has built an electric power station at Töging in Germany in order to utilise the various falls on the river Inn. It is the largest hydro-electric power station in Germany. It is estimated that the annual average output will be 465 million kilowatt-hours. A description of the equipment of this station appears in the July number of *A E G Progress*. A peculiarity of the scheme is that no provision is made for storage. The hydraulic energy is immediately converted into electrical energy. There is never waste due to water flowing uselessly over the weir. The amount of power available is so large that it cannot always be utilised for power and lighting At the time the station was built it was doubtful whether it would be more economical to manufacture aluminium or nitrogen Hence the electrical equipment was designed so that either direct current or alternating current could be obtained At the Töging station there are 15 nine-thousand horse-power turbines. The first eight of these machines drive three-phase generators, whilst the other seven drive direct current dynamos, the output of which is used for the manufacture of aluminium, the furnace rooms for which are near the station. The alternating current is carried on overhead wires at 100 kilovolts pressure to the Hart carbide factory, which is ten miles away. Special precautions have been taken to prevent the pole wheel from bursting should a turbine 'run away.' They are made of steel cast in one piece, and two rings of Siemens Martin steel are shrunk on to them The strength of this steel is 78,000 lb. per square inch.

THE fiftieth annual meeting of the Conchological Society of Great Britain and Ireland was held at the City Museum at Leeds on October 16 under the presidency of Mr J. W. Taylor, the doyen of the Society. There was a large gathering of members, and a number of delegates from related societies attended with messages of congratulation and good wishes. The president in his address dealt with the evolution of the Mollusca, and there were various exhibits of interest, including the Stubbs Collection which has been recently acquired by the Museum. The Society was founded in Leeds fifty years ago within a few days by Messrs. W. Nelson, W. D. Roebuck, H. Crowther, and J. W. Taylor, and the last two were happily present at the jubilee, which was appropriately celebrated at Leeds, though the Society has had its headquarters at the Manchester Museum for some years past. Mr. Hugh Watson, of Cambridge, was elected president for the ensuing year.

THE newly-created Society of British Foresters held its inaugural meeting during the recent meeting of the British Association at Oxford. The object of this Society is to help in the technical development of forestry in Great Britain. Forestry is coming more and more into prominence, and it is felt that the time has now arrived for the establishment of an association of those engaged in it and in allied sciences. A journal will be published, and this will provide a place for the publication of the results of forestry investigation and practice in Great Britain, and for the dissemination of results obtained elsewhere. The officers of the Society are: *President*, Mr. R. L. Robinson; *Vice-President*, Prof. R. S. Troup; *Members of Council*, Mr. C. O. Hanson, Major F. M. Oliphant, Mr. R. S. Pearson, Mr. Frank Scott, Mr. J. D. Sutherland, Dr. Malcolm Wilson; *Editor of Journal*, Dr. H. M. Steven; *Business Editor*, Mr. J. Lyford Pike; *Secretary and Treasurer*, Mr. R. Angus Galloway, 8 Rutland Square, Edinburgh

THE following courses of lectures have been arranged at the Royal Institution during November and December. The Tyndall Lectures will be delivered by Dr. G. W. C. Kaye, who will commence a course of three lectures on the acoustics of public buildings on Tuesday, November 2, at 5.15; and on Tuesday, November 23, Sir William Bragg begins a course of four lectures on the imperfect crystallisation of common things. On Thursday afternoons, beginning on November 4, there will be two lectures by Sir Edgeworth David on Antarctic exploration of the past and future; three by Dr. R. R. Marett on the archæology of the Channel Islands; and two by Sir Squire Sprigge on (1) early medical literature and (2) medical literature in relation to journalism. On Saturday afternoons, November 27 and December 4, at three o'clock, Dr. G. C. Simpson will give two lectures on atmospheric electricity. The Juvenile Lectures this year, the hundred and first course, will be delivered by Prof A. V Hill on nerves and muscles, how we move and feel: (1) Nerves and the messages they carry (Dec 28); (2) muscles and how they move (Dec. 30); (3) the heart and some other muscles (Jan 1); (4) the lungs and blood (Jan. 4); (5) nerves and muscles working together (Jan. 6); (6) speed, strength, and endurance (Jan. 8).

THE ninth annual Streatfeild Memorial Lecture will be delivered by Mr. F. C. Robinson at the Institute of Chemistry on Friday, November 19, at 8 P.M. His subject will be "The Chemist in the Non-Ferrous Metallurgical Refinery," and Prof. G. G. Henderson, president of the Institute of Chemistry, will take the chair. Tickets of admission are obtainable on application to the Registrar, Institute of Chemistry, 30 Russell Square, London, W.C.1. Frederick William Streatfeild was on the staff of the City and Guilds Technical College, Finsbury, from its foundation until his death in March 1918, as a teacher of applied chemistry. He won the esteem and affection of several generations of Finsbury students, who established a fund for the provision of an annual memorial lecture to mark their appreciation of his work and worth. Previous Streatfeild Memorial lecturers have been: Sir William Pope (1918), Prof G. T. Morgan (1919), J. H. Coste (1920), W. P. Dreaper (1921), Prof C. H. Desch (1922), E. M. Hawkins (1923), Julian L. Baker (1924), and Francis H. Carr (1925). On the closing of Finsbury Technical College, the administration of the Fund and the arrangements of the lecture were entrusted to the Institute of Chemistry.

FARADAY House Testing Laboratories, Southampton Row, London, W.C.1, have issued a scale of fees for testing mechanical, electrical, and chemical materials, instruments, and machinery. Arrangements are also made for the loan of instruments, workshops, for investigations and reports, and for advice and assistance to inventors.

Two of the best signs of activity and vigour of the optical industry in Great Britain are the number and importance of the scientific papers which are published by optical firms. We have before us a list of fifteen or sixteen publications which have appeared in scientific and technical journals during the last two years from Messrs. Hilger's workshop. Of these, nine were papers read at the recent Optical Convention, two deal with the lens interferometer and its use, two with spectrum analysis and spectrographs, and one with a new measuring micrometer.

WE much regret the appearance of a misprint in Dr. K. R. Ramanathan's letter in NATURE of September 4, p. 337. Observations at Simla referred to near the end show that polarisation for the red reaches values so high as 87 per cent., and not 30 per cent. as printed.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in organic chemistry and an assistant lecturer in geography in the University of Birmingham—The Secretary (October 30). A lecturer in electrical engineering at the Chesterfield Technical College—The Director of Education, S. Mary's Gate, Derby (October 30). A lecturer in agricultural botany at Armstrong College, Newcastle-upon-Tyne—The Registrar (November 6). An assistant lecturer in botany in the University of Birmingham—The Secretary (November 6) A scientific officer for, primarily, research in connexion with electrical ignition appliances at the Royal Aircraft Establishment, South Farnborough—The Chief Superintendent, R.A.E., South Farnborough, Hants (November 10, quoting No. A. 81). A professor of zoology in the University of Birmingham—The Secretary (November 22) An engineer to take charge of the section of wood preservation of the Forest Products Research Laboratory at Princes Risborough—The Secretary, Dept. of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (December 1). A reader in wireless telegraphy and high-frequency technology at the Indian Institute of Science, Bangalore—Dr. W. H. Eccles, Institution of Electrical Engineers, Savoy Place, W.C.2. A woman B.Sc., biology, physiology, and biochemistry, and preferably physics or mathematics, for work at the Wellcome Physiological Research Laboratories, Beckenham—The Director. An assistant agricultural botanist under the Linen Industry Research Association—The Secretary, Research Institute, Lambeg, Co. Antrim. A head of the physics department of Huddersfield Technical College—The Director of Education, Education Offices, Huddersfield.

Our Astronomical Column.

Recent Sunspots and Magnetic Storm.—Although no unusually large spot has appeared as yet this month, the sun's disc has presented a striking feature, consisting of a procession of four large groups of spots in the northern hemisphere. Some of the spots were occasionally naked-eye objects to keen vision, but as they kept just on the limit of visibility they have not been included in the list of the largest spots given from time to time in these columns. Their approximate positions will be of interest to observers, however, and are tabulated as follows:

Group.	Central Meridian Passage	Longitude	Latitude.	Area.
a	Oct. 9·2	232°	15° N	700
b	11·2	205	18 N	900
c	13·7	173	16 N	600
d	16·7	133	24 N	650

(The areas, corrected for foreshortening and expressed in millionths of sun's visible hemisphere, were measured on Oct. 15.)

Group *d*, comprising a roughly circular spot with small companions, represents the return of the large September spot No. 10.

On Oct. 14, at 20^{h}, the commencement of a magnetic disturbance was recorded at Greenwich, which continued for about 12 hours, the greatest deflexion of the declination needle being about 0·5°. At 19^{h} on Oct. 15 a recrudescence of the disturbance took place which rapidly developed into one of great magnitude, the declination traces showing extreme deflexions of more than 1°. Serious difficulties in telegraphic transmission were experienced at the same time, and a display of the aurora was reported from America. At the time of the commencement of the preliminary disturbance, the longitude of the sun's central meridian was 157°, and at the commencement of the great disturbance it was 145°. As will be seen from the above table, the present instance is an example of the considerable uncertainty in ascribing a relation between a particular sunspot and a magnetic storm, judging merely from the position and appearance of the spot. Spectroscopic observations may, of course, come to hand which will throw some light on the matter.

It may be added that the general activity of the sun is still increasing. Apart from the occurrence of spots and faculæ, this fact is shown by the prominences during the last three months. Mr. Newbegin reports that, for the past three weeks, the average number per day he has observed spectroscopically at the sun's limb is 20.

Unusual Display of Large Meteors.—Mr. W. F. Denning writes that during the three nights Oct. 9 to 11 four brilliant meteors were observed by himself or friends at Bristol, and that three recorded paths indicated a well-defined radiant in Corona at 230° + 33°.

On the evening of Oct. 9 at 20^{h} 30^{m} G.M.T. a bright meteor, equal to twice the apparent magnitude of Jupiter, was seen in Draco moving from 244° + 47° to 261° + 59°; motion rather swift. On the same evening at 22^{h} 20^{m} a fireball, three or four times the brightness of Venus, appeared in Auriga, falling approximately from Auriga to low in the N.W. It left a long vaporous trail which remained visible for ten minutes or more. Near the end of its flight it gave a great outburst of light which illuminated the sky and land. This brilliant object had a radiant at about 262° + 55° and was probably a fragment of Giacobini's comet of 1900. The comet has a radiant at 253° + 56° as computed by Rev. M. Davidson, and its orbit is nearest to the earth (distance 5½ millions of miles) on Oct. 9.

On Oct. 10 at 20^{h} 20^{m} a slowish meteor equal in brightness to Venus traversed part of Cygnus, crossing the stars ε and ξ Cygni, the path being from 318° + 30° to 333° + 32°. It left a bright streak for several seconds and burst with a strong flash when between the two stars mentioned.

On Oct. 11 at 21^{h} 17^{m} a meteor as luminous as Jupiter appeared in Perseus, and shot from 53° + 43° to 53° + 23°.

It is an unusual circumstance to get a radiant from brilliant meteors alone. A singular abundance of fireballs has, however, diversified the present season since September 6. They have been directed from a number of different showers, though several have apparently had their origin in radiants near the N.E. and N.N.E. region of the horizon. Corona, as a radiant of meteors in October, is quite unknown, for that constellation is low in the N.W. in the evening hours and sets before 23^{h} at this time of the year.

Comets.—The comet Giacobini-Zinner, discovered in 1900, and seen again on its second return in 1913, has been detected by Dr. Schwassmann at Bergedorf on Oct. 16, 17^{h} 50^{m} U.T., in R.A. 17^{h} 24^{m} 52^{s}, N. Decl. 2° 32′, magnitude 14·0. The indicated value of T, the perihelion passage, is Dec. 11·77, 1926, about four days later than Mr. Cripps's predicted date. His other elements are: ω 171° 44′ 8″, Ω 195° 56′ 35″, 130° 43′ 14″, φ 45° 47′ 29″, log q 9·99726, equinox 1926·0.

Ephemeris for 0^{h} U.T., corrected by above Observation

	R.A.	Decl.	log *r*	log Δ.
Oct. 24	17^{h} $45·1^{m}$	0° 35·1′ N	0·0836	0·1358
Nov. 1	18 9·9	1 38·5 S	0·0618	0·1212
„ 9	18 37·9	3 55·9	0·0415	0·1061
„ 17	19 8·6	6 15·3 S	0·0239	0·0908

This makes the sixth comet to pass perihelion in 1926, four being periodic and two parabolic.

Neujmin's Comet is expected to pass perihelion on January 2 next, however, if a doubtful object observed by Mr. Neujmin in 1920 was really his comet, the date will be 22 days later. The following ephemeris for 0^{h} is by Mr. B. F. Bawtree, on the earlier assumption:

	R.A.	N. Decl.
Oct. 23	9^{h} $59·3^{m}$	18° 34′
„ 31	10 23·3	15 48
Nov. 8	10 47·3	12 45

As two revolutions have taken place since discovery, there is considerable uncertainty in the positions. The comet is likely to be faint.

Mr. J. Polak, of Saratov, had investigated the perturbations of Holmes's comet, discovered in 1892, and seen again in 1899 and 1906, but not since then. Dr. Zwiers calculated its perturbations up to 1906, but after his death no one continued the work. Mr. Polak shows that the Jupiter perturbations in 1908 were very large, increasing the period by 6 months, and diminishing the eccentricity from 0·412 to 0·379. This explains the failure to find the comet in 1913 and 1919. The return in the former year was a very favourable one, and an ephemeris is given in *Astr. Nach.* 5465. The general region is Aug. 4, R.A. 1^{h} 0^{m}; N. Decl. 20°; Oct. 3, R.A. $0^{h}/34^{m}$; N. Decl. 30°. Plates of that region taken in 1913 should be examined for images of the comet.

The perturbations since 1908 have been small and the next perihelion passage will be near March 12, 1928. The comet may be seen (especially by southern observers) in the autumn of 1927. As this is one of the few comets discovered in England it is satisfactory to find that work on it is resumed.

Astr. Nach. 5466 contains an interesting study of the brightness of comet Tempel II in 1925. During the month of July it brightened up four magnitudes, from 10·5 to 6·5, log *r* changed from 0·14 to 0·12, and log Δ from 9·58 to 9·51. These changes are so small that it is clear that the brightening was mainly due to physical change in the comet. One may conjecture that at greater distances the sun's physical effect on the cometic envelopes is insignificant, but that it becomes important at a certain point (not apparently the same for all comets), and henceforth develops rapidly with approach to the sun. It is, however, difficult to frame laws that will cover all cases.

Research Items.

Eskimo Engravings on Walrus Ivory.—Three examples of Eskimo art from Alaska of a type rarely seen in Europe are described by M. L. Giraux in the *Journal de la Société des Américanistes de Paris*, N. Sér. T. 18. The objects in question are made of walrus ivory, measuring 31 cm., 33 cm., and 36 cm. in length respectively, and are engraved and painted or stained in colour with human and animal figures. Among the human figures is that of a male in European clothing. All the figures are realistic, but the animals in particular exhibit an intimate acquaintance on the part of the artist with their characteristic attitudes and habits. Although all the Eskimo of Alaska show considerable dexterity in carving wood, bone, ivory, and reindeer horn, the inhabitants of the coast from the Yukon delta to the lower Kuskokwin river are particularly noted for their artistic skill. The technical methods employed in dealing with the ivory of a walrus tooth in the days before the introduction of iron and steel implements, are of considerable interest, especially in view of the marked resemblance of the objects under consideration to palæolithic engravings. Four grooves were made in the tooth with a piece of quartz or other siliceous stone. When these had been made as deep as the form of the cutting edge of the stone implement allowed, the two pieces were flaked off either by simple pressure of the hand or by means of a wooden knife-blade-like implement, which was inserted in the groove. The central piece of ivory thus obtained was rubbed down to the required shape by a freshly broken stone. The perforation found in some of the objects was then made by a stone drill and sand, working in a slight depression previously made, and actuated by a cord or strap. The polishing was done either with a very fine-grained stone (soapstone) or by the hand used with very fine-grained sand. Lastly, another piece of ivory was employed to produce a high polish. The gravers were sharp pieces of stone, flint, quartz, schist, or soapstone, usually fixed in pieces of wood, each material requiring a special method in manufacturing the graving tool. The colours employed were black (plumbago and charcoal or gunpowder mixed with blood), red (oxide of iron or ochreous earth), yellow (ochreous earth), white (argillaceous clay), and green (oxide of copper). A dark reddish brown used for staining seal skin was obtained by macerating the inner bark of alder in urine for twenty-four hours.

An Endemic Flora.—An unusual analysis of an endemic flora will be found by F. Lewis in the *Annals of the Royal Botanic Gardens, Peradeniya*, vol. 10, part 1. With the data given in Trimen's "Flora of Ceylon," and from his own observations as to altitude, the author has analysed the distribution of the large endemic flora in relation to its distribution at different altitudes. The result is that the greater number of endemics are to be found at the foot of the hills instead of at the highest altitudes, a conclusion which the author briefly discusses, assuming that in the more densely populated lower levels the struggle for existence is greater, and natural selection has thus operated more vigorously.

Japanese Botany.—The botanical output of Japan proceeds apace, and fortunately abstracts will be found of practically all publications in the *Japanese Journal of Botany*. A brief notice of some of the interesting papers is all that can be attempted here. Yoshiji Yoshii has published a very extensive study of the maturation of the seed of *Pharbitis Nil*. The process of maturation can be divided into a series of stages; the chemical changes, water content, etc., of the seeds were studied and also their capacity to germinate when tested at these different stages. (*Journ. of Faculty of Science, Tokyo*, Section III. vol. 1, Part i.) Isaburo Nagai publishes four papers upon mutations in *Oryza sativa* L. in the *Japanese Journal of Botany*, Vol. 3, No. 2; in the same journal Kametaro Oharo has a paper upon Japanese fossil conifer woods, which he has been studying at the palæobotanical institute at Berlin, and there are two cytological papers upon pollen development, that by Tetsu Sakamura and Isamu Stow, dealing with the experimental production of pollen grains with abnormal chromosome numbers in *Gagea lutea*. In the previous issue of the same journal, Ichiro Ohga has an interesting paper upon the structure of ancient but still viable fruits of the Indian Lotus. The author began these studies in Manchuria, and continued them at Tokyo and then at the Johns Hopkins University at Baltimore. These old lotus fruits occurred in a peat bed in the Pulantien Basin, in South Manchuria, and are probably at least three or four hundred years old. The retention of viability for such a long time is probably due in large part to the approximate maintenance of the water and gas content in the tissues of the embryo, due to the structure of the fruit coats and their maintenance in the undisturbed condition of the peat bed. A very full account of the life history, fertilisation and cytology of the fungus *Plasmopara Halstedii*, is given by Prof. Makoto Nishimura in the *Journal of the College of Agriculture*, Hokkaido Imperial University, Sapporo, Vol. 17, Part I, with five plates of drawings which are well reproduced. Koki Masui has a paper upon the mycorhizal relation of the fungus *Cantharellus floccosus*, Schw. with the roots of *Abies firma* in the *Memoirs of the College of Science, Kyoto Imperial University*, vol. 2, No. 1, 1926. It seems clear that this fungus is definitely parasitic on the tree, in many cases killing branches of the root.

Corals and Sediments.—Problems of sedimentation and rock formation in tropical, coral-bearing regions constitute the subject-matter for research in vol. 23 of the papers from the Department of Marine Biology of the Carnegie Institution of Washington. M. N. Bramlette, in dealing with some marine bottom samples from Pago-Pago harbour, Samoa, describes the nature of present sedimentation processes in and around the harbour. Chemical and mechanical analyses of the samples are given and discussed and, in some cases, a detailed analysis of the organic constituents has been made. Borings from the reef were also examined and, on comparison with the bottom samples, shown to be relatively richer in magnesium carbonate. A study of reef-sand from the Bahamas by M. I. Goldman is concerned chiefly with the problem of dolomitisation. The chemical composition of the sand was determined directly and also by calculation from a count of the different constituents of known composition, mainly calcareous skeletons. The difference found is taken to represent a change in chemical composition, the results in the present case indicating a relative decrease in the amount of magnesium carbonate. The results are not considered conclusive, however, and suggestions are put forward for other methods of investigation. N. R. Smith, reporting on a bacteriological examination of 'Chalky Mud' and sea water from the Bahama Banks, classifies the bacteria found and describes an experiment to show that calcite is precipitated from sea water as a result of bacterial growth when food is supplied and when the supply of calcium in solution is maintained by the addition of calcium sulphate. He states also that calcite is formed from natural sea water by the strong ammonifying vibrios found in the mud, the only addition required being organic nutritive matter. J. A. Cushman supplies a list of some recent Foraminifera from Porto Rico with notes on their distribution. An account of some late Miocene or early Pliocene mollusca and sharks' teeth from the Fiji and Tonga Islands by W. C. Mansfield, is accompanied by a useful annotated bibliography of the geology of the Fiji Island. T. W. Vaughan and J. E Hoffmeister describe some Miocene corals from Trinidad, mostly new species.

Vortex Distribution behind an Aerofoil.—Lanchester, in his "Aerodynamics," vol. 1, indicated from general theoretical considerations that the flow in the wake of an advancing aerofoil of finite span should comprise a layer of vorticity immediately behind the trailing edge and two general circulatory motions of opposite directions of rotation, one at each tip. Broadly speaking, this prediction has stimulated investigations at Göttingen, in America, and at the National Physical Laboratory at Teddington, receiving ample verification. In Aeronautical Research Committee Report, R. and M No. 951 (H.M. Stationery Office, 1*s* net), Messrs. Fage and Simmons have subjected this theory to an accurate quantitative test and mapped out the changes which occur in the vortex distribution in the wake of an aerofoil. The result provides an experimental verification of the theoretical relation given by Lanchester, that the total strength of the vorticity leaving a semi-span of an aerofoil, as obtained by integration over the transverse plane close behind the aerofoil, is equal to the circulation around the median section, and that the distribution of vorticity is in close association with the distribution of lift along this span. At 13 chords behind the aerofoil the rolling up of the vortex band is practically complete and, within the limits of experimental error, at a distance of 0·57 chords in front of the aerofoil the flow is irrotational. The theory thus verified has undoubtedly given a new impetus to aeronautical developments.

Cathode Sputtering.—In the ***Ann. der. Phys***, No. 15, p. 672, 1926, A von Hippel describes a new method for the investigation of cathode sputtering, and he shows that sputtered metal particles consist, at any rate to a very large extent, of uncharged atoms. In his experiments a cadmium cathode was usually employed, but experiments were also carried out with silver and zinc cathodes. The particles emitted from the cathode collide with ions and electrons, and if they were atoms they would emit their resonance lines. Thus, if the resonance lines of the cathode material are observed close to the plate, which lies outside the dark space, on which the sputtered particles are deposited, then we have evidence of the atomic nature of the particles. Clear proof of this was obtained, however, by comparing the intensity of the cadmium 3261 line with the intensity of the mercury 2537 line, when the vapour pressure of the mercury inside the sputtering chamber was known. From these observations the vapour pressure of the sputtered particles was calculated, and the value thus obtained agreed, within the limits of experimental error, with the value obtained from calculations based on a knowledge of the thickness of the sputtered film and on the assumption that the particles were atoms. Incidentally it was found that sputtered cadmium absorbed mercury vapour very rapidly.

Age-hardening of Aluminium Alloys.—It has been shown that the alloys of aluminium with manganese and silicon possess the property of age-hardening after quenching from a high temperature, and also that alloys of aluminium with copper show age-hardening to a lesser degree. In the first part of a paper by Kathleen E. Bingham read at the Liège meeting of the Institute of Metals on September 3, and entitled "The Constitution and Age-hardening of some Tenary and Quaternary Alloys of Aluminium containing Nickel," it is shown that the tenary alloys of aluminium with copper and nickel do not possess this property of age-hardening in any appreciable degree. This suggests that the addition of nickel to the alloys of aluminium with copper suppresses the phenomenon of age-hardening. This is explained by the constitution of the alloys, since the property of hardening depends on the precipitation of one or more of the constituents, and it has been shown that with 2 per cent. of nickel and about 6 per cent. of copper there is no $CuAl_2$ present, either at 500° C. or on cooling slowly to 200° C.; *i.e.* 2 per cent. of nickel increases the solubility of $CuAl_2$ in these alloys at both high and low temperatures. Finally, it is shown that the addition of 1 per cent. manganese to the alloys of aluminium with copper and nickel causes the precipitation of a large amount of magnesium silicide on cooling from 500° C. to 200° C., and also affects slightly the solubility of $CuAl_2$ and $NiAl_3$. In the series containing 4 per cent. copper, 2 per cent. nickel, and 1·5 per cent. magnesium, marked age-hardening takes place, and it is suggested that it is due chiefly to the precipitation of magnesium silicide, since it has been seen that any due to the $CuAl_2$ is very slight One per cent. magnesium is already in excess of the amount required for the formation of the compound Mg_2Si, as there is only about 0·13 per cent. silicon in the aluminium used.

Testing on Hardened Steel.—The testing of high-carbon tool steel has hitherto been carried out almost entirely in the form of actual machine tests on tools made from the steel. Axel Lundgren, in a paper read at the Stockholm meeting of the Iron and Steel Institute describes a simpler test. The type of test adopted was a bend test, carried out in a machine specially designed for this work. Steels with more than 1 per cent of carbon annealed in such a manner that the cementite was in a fine-grained form, show, after subsequent hardening and tempering, a higher bend strength and a higher resistance to impact than specimens which, before hardening, have been so annealed that coarse-grained cementite has developed. An annealing which yields a cementite in a spheroidised condition will, after hardening, yield a steel consistently tougher than will a treatment which resulted in the cementite appearing in the form of a network, and this despite the fact that the cementite has afterwards disappeared. Steel with the highest percentage of carbon, 1·3 per cent., shows, after hardening and tempering, a higher bend strength than do lower carbon steels. Annealing so as to produce a fine-grained cementite results, when the steel is hardened and tempered, in the production of a higher bend strength than is obtained from an unannealed steel. The steels quenched at too high a temperature and then tempered at a temperature of 150° to 200° C. show a reduced bending strength, particularly when the tempering temperature is lower. So far as hardness is concerned, the steel with 1·3 per cent. of carbon is slightly harder after heat treatment than the 0·9 per cent. carbon steel. The difference is not great, but with lower carbon contents a rapid decrease in hardness is recorded. Similarly, a slightly greater hardness has been observed in the specimens which were not annealed before hardening, than from those which had been annealed. The influence of the rate of cooling upon the ultimate bending stress, after tempering, has been tested with a tempering temperature of 300° C. In this connexion it has been found that in the case of very rapid cooling in benzene, a much lower bending strength was obtained, than in the case of a less rapid cooling in air.

International Congress of Psychology.

THE eighth International Congress of Psychology was held at Groningen on September 6-11. Nearly 250 psychologists attended. All appreciated the arrangements made by the national committee, consisting of Profs. Heymans (president), Wiersma, Roels (secretary), Brugmans (2nd secretary), Bouman, Buytendijk, Zwaardemaker, and the late Prof. van Wayenburg, and especially by the local reception committee. On the social side, concerts and other entertainments and excursions were arranged, and the reception by the Municipality of Groningen in the Stadspark was a brilliant function.

More than eighty papers were read. Mention may be made of a symposium on intensity differences of sensation, which was opened by Dr. C. S. Myers (London), and Prof. Werner (Hamburg).

Dr. Myers showed how the study of spinal reflexes contributed to our knowledge of intensity differences As the strength of a stimulus increases, not only does each muscle contract with greater vigour, but *additional* muscles are also brought into play. Moreover, when the stimulus becomes strong enough, the original reflex may be suddenly transformed into another. Thus if the skin between the pads and cushion of the dog's hind foot be pressed or stretched in the spinal animal, the leg is reflexly *extended*. But if the stimulus becomes sufficiently powerful, this reflex changes into one totally different, and the leg is reflexly *flexed*. Instead of inducing contact with the stimulus-object, the stimulus now evokes escape from it. Instead of being, as before, related to the act of walking, the reaction now has reference to that of flight. The sensation passes from one of touch to one of pain. Corresponding to such an abrupt change in type of reaction, the whole pattern of events in the spinal cord must be supposed to undergo an equally abrupt change. The evidence thus points to sensational intensity being in actual experience inevitably an impure variable Just as with increase of a reflex stimulus the latter spreads to other reflexes, so, as we increase the strength of a tonal stimulus, new sensations inevitably arise; it alters not merely in intensity but also in timbre. It is indeed seldom, if ever, possible that a stimulus is so weak (or so pure) as not to affect mixed sensory elements.

Yet another feature of reflex action is that, when a stimulus provokes reflex flexion of a limb, it simultaneously inhibits antagonistic reflex extension of that limb. If proven applicable to the sensory field, this means that increase of one sensation is accompanied by decrease of an opposite sensation, *e g.* warmth and coolness, red and green, blue and yellow, white and black. In the white-black pairs there is even a gradual transition from one pure pattern to the other pure pattern through every degree of admixture. It is therefore not surprising that so much discussion has been evoked as to whether changes in the white-black series of sensation are to be regarded as changes in quality or in intensity of sensation. The true answer is that both are inevitably simultaneously changed; or, as Dr. Myers long ago pointed out (*Brit. Journ. of Psychology*, Oct. 1913), intensity differences may be regarded as neither qualitative nor quantitative, but strictly *sui generis, i.e.* intensive.

Prof. Spearman (London) communicated some results obtained from his well-known doctrine of noegenesis, according to which all cognitive operations can be analysed into a system of ultimate laws and processes. These processes were sharply divided into two kinds, the insightful and especially the *eductive* processes, and those which are merely *reproductive*. Thus in the study of individual differences of ability, all current tests of intelligence may be analysed into their eductive and reproductive constituents. The former has shown itself to involve one single general factor, and if anything is to be given the title of 'general intelligence,' it can be nothing else than this As for the other or reproductive kind of process, this has proved to be wholly independent of the general factor. Thus eduction and not reproduction is the only trustworthy basis of a successful mental test. In the same way the operations involved in the so-called learning by trial and error admit of analysis into the two kinds of constituents, eductive and reproductive, and are far from being 'mechanical,' as generally supposed The topic of error is another field illuminated by this doctrine. An exhaustive examination of every sort of belief that can unquestionably be regarded as erroneous—from the highest chains of reasoning down to the merest tricks of illusion—every one of them prove to rest primarily upon the law of retentivity and the process of reproduction. All purely noegenetic processes are incapable of error in the slightest degree.

The doctrine of noegenesis also enables the whole range of cognition to be surveyed, and such ancient 'faculties' as 'memory,' 'imagination,' 'attention,' and so forth, as well as such modern ones as 'the power of censorship' or 'keenness in breaking up a complex'—always resolve themselves without the smallest remainder in terms of ultimate psychological laws.

Demonstrations were given by Dr. Godefroy (Amsterdam) on the principles of electrotachography. His method of investigating the psychogalvanic reflex is essentially the transformation of the galvanogram obtained by the Veraguth-Waller method into its first differential or speed curve. Into the circuit which is led through the person tested, the primary coil of an alternating current transformer has been introduced, while the secondary is connected directly with the galvanometer. Thus whenever a change of intensity of the primary current takes place the galvanometer shows a deflexion, and the ordinates of the curve obtained are proportional to the rapidity of the changes in intensity of the primary current. There is also the advantage that the galvanometer returns to zero after each tachographic deflexion There is, however, at present considerable difference of opinion as to the cause of the psychogalvanic reflex. Dr. Godefroy's experiments lead him to support the hypothesis of the emotional genesis of the phenomenon. Dr. Aveling (London), however, after elaborate experimentation, concludes that the psychogalvanic phenomenon is characteristically the consequent of conation.

Several interesting exhibits and demonstrations were given of various apparatus, designed by Prof. Zwaardemaker of Utrecht, which are well-known to psychologists and to nose and ear specialists, namely, various kinds of olfactometers, an apparatus for demonstrating the presence of odorous molecules in the air, etc.

Prof. Zwaardemaker has recently designed an apparatus for the reinforcement of speech on behalf of the deaf by audions and thermotelephones. The choice of the microphone, the valves and the transformers is a matter of knowledge of modern radio telephony, but Zwaardemaker, not content with subjective listening at the thermotelephone, secured objective measurements by employing the Rayleigh principle of the acoustic mirror.

In conclusion, the records of the Congress point to activity along lines already initiated, and there was little evidence of the breaking of new ground. Thus the researches of the 'configurationists,' useful as they are, as a contrast to the work of some 'atomists,' could yet be assimilated by many outside their camp without sacrificing any psychological principles.

LL. W. J.

Coal Blending.

THE gradual exhaustion of the more easily mined seams of coal in Great Britain, and other factors which are resulting in increasing costs of mining and transport, are combining to focus attention on the necessity of employing more scientific methods in the preparation and utilisation of coal. In coal carbonisation, the main object of the coke oven is to produce coke possessing the special properties required by the metallurgical industries; whereas the chief aim of the gas industry has been to manufacture gas of the quality required for domestic and industrial purposes, and coke as a secondary product has not received the attention it deserves. The possibility of producing coke with the qualities desirable in a solid smokeless fuel for domestic use is now being realised, and coke quality and structure are consequently being given much more consideration.

Many attempts have been made to manufacture a solid smokeless fuel, containing a comparatively high percentage of volatile matter, by the carbonisation of coal at low temperatures; and satisfactory products have been obtained, but the costs of the processes have been so great that it has not yet been possible to establish them on a sound commercial basis

In high temperature carbonisation processes, largely on account of the low thermal conductivity of coal, the charge adjacent to the retort walls is fully carbonised before any marked decomposition of the coal in the centre of the charge has commenced. The exposure of the coke to high temperatures for long periods, and the small amount of volatile matter, both operate in the direction of rendering the product difficult to ignite. The work of numerous investigators, however, has led definitely to the conclusion that these are not the only factors which influence the quality of coke as regards relative ignitability, combustibility, and reactivity. Other factors of importance include the character of the coal carbonised, the state of division of the coal, the method, speed, and duration of heating and the temperature of carbonisation.

The character of the coal to be carbonised may be controlled by grinding and mixing coals of different coking properties with one another or with coke breeze or other substances, in predetermined proportions. The main effects of efficient blending are more rapid heat penetration of the charge and the production of a harder and more easily combustible coke. The method, speed, and duration of heating are largely determined by the design of carbonisation plant.

In a recent paper to the Iron and Steel Institute,[1] Mr. David Brownlie presents a useful survey of the subject of coal blending; that is, the mixing of coals with one another and with other carbonaceous materials, such as low temperature fuels, coke, pitch, etc., especially in connexion with carbonisation. A summary of the paper is not attempted in this article, since the paper, although extending to forty-two pages, is in itself a summary, and the titles of the sections alone occupy more than one page.

Some coking coals are so constituted that they do not require blending for the production of good high-temperature coke, but the amount of coal of this type is limited. Scientific blending would render many more coals available for use in the carbonisation industries. It must be emphasised, however, that the blending of coals on a commercial scale requires close attention, as the correct blend for a particular process and temperature of carbonisation would not necessarily be suitable for other processes or temperatures Other factors, in addition to the amounts of resinous material in the coals constituting a blend, must also be taken into account. For example, the investigations of the Joint Research Committee of the University of Leeds and the Institution of Gas Engineers have shown that the degree of fineness of the coal carbonised exerts important influences. Further, the work of C. B Marson and J. W. Cobb has demonstrated that the character of the coke may be influenced considerably by the nature of the ash constituents. Iron oxide, calcium oxide, and sodium carbonate have marked beneficial effects, but certain other substances examined were apparently inert

The application, on a commercial scale, of the results obtained in laboratory investigations of coal blending presents certain difficulties. In addition to the installation of grinding and mixing machinery, increased bunker capacity would be required. It would also be necessary to ensure that only small variations in the quality of coal from a particular colliery occurred in different consignments The advantages obtained by blending must also compensate for the additional cost of the preparation of the blends; and in this connexion it must be pointed out that the depreciation of grinding machinery, when coke is one of the constituents of the blend, may be considerable.

A. PARKER.

---

[1] Coal Blending. A General Review of Principles as Applied both to High and Low-Temperature Carbonisation, by D. Brownlie Iron and Steel Institute, June 1926.

Physical Phenomena and Molecular Orientation at Interfaces.

THE behaviour and properties of interfaces were discussed at a conference arranged by the Faraday Society on October 1. The subject is of fundamental importance in the science of colloids, and it is only by a better appreciation of the former that we can hope to unravel the peculiarities of such complex systems as are to be found in natural colloidal materials. The liquid-gas and liquid-liquid interfaces are more simple than those containing a solid surface, since liquids present equipotential surfaces. There is little doubt that the concept of a unimolecular layer of orientated molecules as constituting the surface layer of an insoluble oil on the surface of water is correct, and many investigations are being made on the conditions of formation and stability of these orientated, two-dimensional systems in their solid, liquid, vapour, and gaseous states of aggregation. All the usual three-dimensional phase phenomena, such as allotropy or the process of vaporisation, have been shown to have their two-dimensional prototypes. For soluble substances the surface composition can only be calculated by means of the Gibbs' equation, a thermodynamic process which gives no information as to the dimensions or orientations of the surface phase. That within certain ranges of bulk concentrations, however, the Gibbs' layer is unimolecular, is made probable by experiments on sparingly soluble fatty acids and the analogy between the properties of the surfaces of solution and three-dimensional gases.

This simple idea, however, does not appear to be applicable to all types of binary mixtures, it is possible that in some solutions the Gibbs' layer is thicker than one molecule, but reasons for and against are founded as yet on but slender arguments The kinetic interpretation of the lowering of the surface tension by two-dimensional liquids, vapours and gases does not, however, meet with universal acceptance, and we find the concept of a negative surface tension developed on the assumption of a molecular halo or wide zone of molecular attraction. This idea is based upon the view that a material spread upon the surface of water will cover but a definite area, and not expand indefinitely, as is assumed on the kinetic hypothesis, a problem clearly susceptible of experimental solution.

As is the case in solutions, the adsorption of ions at liquid interfaces is attended with the operation of electric forces resulting in an ordered distribution of the ions in the interfacial phase The nature of this distribution is of great importance in an interpretation of the phenomena of electric endosmose and electric cataphoresis. Freundlich has shown quite definitely that the potential difference or electro-kinetic potential of which those phenomena are manifestations is in no way related to the total potential difference across the interface, the one considered by Nernst in his development of a mechanism of operation of electric cells. It is thus necessary to conceive an ionic distribution the total amount of which can be calculated by Gibbs' method, such as will give rise to those two well-defined potential differences. Whilst this problem still awaits a detailed solution, it appears clear that the old and well-known conception of Helmholtz of a condensed double layer, as well as the idea of a diffuse double layer developed by Gouy, must both be rejected in favour of some composite type combining the advantages of both.

Attempts have not been lacking to show that the free surface of a liquid presents an ordered arrangement. Whilst consideration of the mean life of a molecule on the surface of a liquid, as well as the dependence of the surface energy and the Eötvös constant on the molecular structure, show that some orientation does in fact exist, it is clear that the total surface energy of a liquid is not defined entirely by the nature and orientation of the surface layer of molecules.

The nature of the free surface of a solid and the phenomena attending adsorption are more complicated. Whilst unimolecular films are the rule rather than the exception on liquid surfaces, the building up of secondary films, *i.e.* multi-molecular in thickness, is quite frequent on solid surfaces, although the loss in free energy attending the formation of each molecular layer is greatest for the first layer. It is not, however, a simple matter to calculate the film thickness from the amount of material adsorbed, since the surface of a solid is by no means uniform in character, and breaks in the adsorption isotherm may indicate merely the covering up of a fresh portion of the surface possessing a different surface energy. The variation in surface texture, dependent upon the presence of different crystal facets and edges, as well as the presence of broken crystals, is accompanied by a variation in surface energy, the interrelationship for heteropolar materials having been investigated by Born and Lennard Jones. For metals, however, we are not yet in a position to make the necessary calculations. Whilst both catalytic activity and adsorptive powers are dependent on the nature of the surface, the almost specific nature of many of these processes shows that both surface energy and surface structure are necessary factors to be taken into consideration in dealing with these problems.

The Faraday Society is again to be congratulated in promoting a highly successful meeting, at which it was possible not only to listen to a number of distinguished foreign visitors, but also to obtain the point of view which has led different investigators in certain fields to diametrically opposed conclusions.

E. K. R.

The Wellcome Historical Medical Museum.

AFTER closure for nearly a year for reorganisation and enlargement, the Wellcome Historical Medical Museum, Wigmore Street, London, W.1, was reopened on October 14 by Sir Humphry Rolleston, in the unavoidable absence abroad of the founder, Mr. H. S. Wellcome. Sir Arthur Keith delivered a short address, and Sir Frederic Kenyon and Sir D'Arcy Power also spoke in proposing and seconding a vote of thanks to the previous speakers. A brief tour of the Museum discloses the great variety and interest of the collection, but does little more than whet the appetite for return visits on future occasions, when selected objects could be more fully studied.

The visitor first enters the Hall of Primitive Medicine, in which are displayed the paraphernalia of the medicine-man, including his masks and costumes, a reconstructed skull-hunter's hut from south-east New Guinea is here a prominent feature. In the same section are also arranged a large number of charms, amulets, and talismans used by both primitive and modern man. In the Anatomy Room the history of anatomy is illustrated by means of drawings, paintings, and sculpture: there is a fine collection of bone and ivory mannikins used in the teaching of anatomy in the sixteenth and seventeenth centuries. Proceeding through a short picture gallery, the visitor enters the Hall of Statuary, containing statues and casts of the deities associated with medicine in ancient times. In addition, the hall and its gallery contain collections of surgical, scientific, and dental instruments, arranged to illustrate the evolution of each particular instrument. Special mention may be made of the collection of microscopes and that illustrating the development of the modern spectacles.

One of the most interesting collections in the Museum is found at the end of the Portrait Gallery, where the Jenner relics are arranged: there one can see the original manuscripts in which Jenner's views on vaccination are set forth, and also the instruments used by him in his work; a homely touch is provided by the presence of his favourite arm-chair Passing from the Alchemy Room, a flight of stairs is descended to the ground floor; the main hall contains a varied collection of pictures and material illustrating the War in both its naval and military aspects. At the far end is found the Lister Collection, including a portion of the actual Lister Ward from the Old Infirmary in Glasgow, in which he developed the practice of antisepsis in surgery. Passing sections illustrating methods of torture, the plague, and a lying-in room of the sixteenth century, the visitor enters a large hall devoted to the history of pharmacy. Here will be found a sixteenth-century alchemist's laboratory, a London chemist's shop of the eighteenth century, a barber-surgeon's shop, and Chinese and Turkish drug stores.

Two impressions remained with us when we left: the great boon to mankind the discovery of anæsthetics has been, after inspection of the pictures illustrating surgical operations in pre-anæsthetic days, and the persistence of a belief in charms through many centuries up to the present day, in spite of the increase in scientific knowledge.

In the course of his address at the reopening of the Museum, Sir Arthur Keith said that a museum should fulfil two functions: it should serve the needs of students, fostering research, and at the same time it has a duty to the public, that of direct education. One way to write a history is by the study of the writings of others which have been preserved to us; the other is by the examination of the objects of man's handiwork, many of which have been retrieved through excavations, when their situation throws light on the periods at which they were in use: thus the existence of stone, bronze, and iron ages was discovered by this means. History, then, can be written on the shelves of a museum. But a history of medicine is the most difficult of all to write, since the use of a primitive medicine-man's emblems of his art is only really understood when we have a knowledge of his beliefs. On these he bases a theory of medicine, which guides him in the practice thereof; in general, the spirit is the real person and illness is due to the attack of baneful spirits, so that his practice is directed to the driving out of these immaterial beings.

A museum can only fulfil its main function of encouraging research if it is itself a centre of research. It can be seen when a museum is successfully fulfilling this function, by the appearance of members of its staff at scientific meetings, by the publications issuing from it, and by the number of students who make use of it.

In the education of the public the curator of a museum should be an able 'case-dresser.' The average man has little time or inclination for a detailed study of the exhibits, so that he requires his history to be put before him in a few well-chosen and salient objects. Since the best elementary treatises are usually written by the most learned men, it is probable also that the educational function of a museum will be directed equally well with research by the most learned of our curators.

Money is an essential item in the work of a museum, so that the thanks of all are due to those who contribute service to mankind by founding and maintaining it as a centre of research and education.

University and Educational Intelligence.

Cambridge.—Mr. L. H. Thomas, Isaac Newton student and Smith's prizeman, has been elected to a fellowship at Trinity College. Mr. H. M. Robertson (Leeds) has been elected to a research studentship in economics at Emmanuel College, and Mr. A. H. Wilson to an honorary research studentship in mathematics. The Hon. Bertrand Russell, Trinity College, will lecture on "The Analysis of Matter" at Trinity College, giving the Tarner lectures on the philosophy of the sciences.

Dr. A. C. Haddon, Christ's College, has been appointed honorary keeper of the New Guinea collections in the Museum of Archæology and Ethnology. J. A. Ratcliffe, Sidney Sussex College, has been elected to the Stokes Studentship for research in physics at Pembroke College.

The Commissioners have offered to the University for discussion new statutes modifying the statutes with regard to various trust emoluments to bring them into line with the new statutes. They propose a new statute, throwing open scholarships and prizes to women on the same terms as to men, leaving the University power to exclude women from any one or more of the emoluments for which they have not hitherto been eligible.

Edinburgh.—Prof. E. Shearer, in his inaugural address as professor of agriculture, spoke on "Agricultural Education and the Community." He stated that our system of agricultural education is based on lines which are sound and well adapted to the general circumstances of the country. Useful work has been accomplished in the past, but present efficiency and future progress are unduly handicapped by meagre financial provision. Nothing is more certain than that the agricultural future, amidst ever-increasing competition, will lie with those nations that take the fullest advantage of scientific knowledge.

St. Andrews.—The Court has appointed Dr. J. D. McBeath Ross to the lectureship in physical chemistry in University College, Dundee, vacant by the resignation of Dr. O. R. Howell, appointed to a post in Manchester Muncipal Technical College. Mr. J. M. Hay has been appointed to the lectureship in mechanical engineering and machine design in University College, Dundee, vacant by the resignation of Dr. W. J. Walker, appointed to the chair of mechanical engineering in the University of Witwatersrand, Johannesburg, South Africa.

On Wednesday, October 20, H.R.H. the Prince of Wales opened a new women's hostel, a teaching dairy, and farm buildings at the Cheshire School of Agriculture, Reaseheath. These buildings complete the equipment of the institution, and render possible centralisation of a comprehensive scheme of agricultural education, hitherto somewhat scattered. The school lies in the centre of a small estate, the mansion on which serves as a residential hostel for forty men students and as the headquarters of a scientific staff. There are two farms, the larger, 210 acres in area, being used for teaching and commercial ends, and the smaller, which extends to 50 acres, being devoted to experimental work. A 6-acre holding within the estate has been equipped as a poultry department, and the original gardens have been extended and stocked to illustrate various phases of horticultural work. An extensive range of stabling has been adapted as chemical, botanical, and bacteriological laboratories. The dairy, now added to the buildings, has been built primarily for teaching purposes; it has been equipped with the ordinary apparatus of a good cheese-making farm, and also with sufficient examples of dairy machinery to demonstrate the possibilities of mechanical devices. The Women's Hostel is a pleasing structure which perpetuates the half-timbered style so characteristic of the county. There is accommodation for thirty students. A county institution, the school aims primarily at instruction suited to the needs of farmers' sons and daughters, and others taking up rural pursuits for a livelihood. Separate courses, all of three to six months' duration, are provided in agriculture, dairying, horticulture, and poultry-keeping. Though the end in view is severely practical, instruction is largely on the traditional lines of scientific institutions; for it is characteristic of the Cheshire farmer that he wants his son to be taught "something he cannot learn at home," rather than to be trained in manual operations. The school also maintains an extensive advisory service throughout the county.

Contemporary Birthdays.

October, 24, 1854. Right Hon. Sir Horace C. Plunkett, K.C.V.O., F.R.S.

October 26, 1874. Prof. T. M. Lowry, C.B.E., F.R.S.

October 27, 1856. Prof. Ernest William Hobson, F R S.

October 28, 1868. Mr. Frederick William Lanchester, F.R.S.

October 29, 1868. Mr. Charles P. Eugène Schneider.

Sir Horace Plunkett, sometime an Irish administrator, was born in Gloucestershire. He was educated at Eton and University College, Oxford. Soon after attaining his majority he worked at the development of a ranch in Montana, acquainting himself with all the details of American agricultural methods. Afterwards, Irish agriculture and industry engaged his whole-hearted energies for many years, with much practical issue. Chairman of the (then) Sub-Section of Agriculture at the British Association's Dublin meeting in 1908, Sir Horace gave a highly informative address, worthy of reference to-day, on "Science and the Problem of Rural Life."

Prof. Lowry was born at Low Moor, Yorkshire. Educated at Kingswood School, Bath, he entered later the Central Technical College of the City and Guilds Institute, South Kensington. Here for seventeen years, from 1896, he held an assistantship to Prof. H. E. Armstrong, F.R.S. From 1912 until 1916 he was lecturer in chemistry at Guy's Hospital Medical School. In 1920 Prof. Lowry was appointed to the chair of physical chemistry in the University of Cambridge. Bakerian lecturer of the Royal Society in 1921 (in collaboration with Dr. P. C. Austin), he dealt with "Optical Rotatory Dispersion." On the same subject he discoursed in December 1925, before the Société de Chémie Physique, Paris, in exemplification of Biot's researches. Prof. Lowry is the author of two useful works, "Historical Introduction to Chemistry" (1915) and "Inorganic Chemistry" (1922).

Prof. Hobson, Sadleiran professor of pure mathematics in the University of Cambridge, was born at Derby. Entering Christ's College, Cambridge, he graduated senior wrangler The Royal Society awarded him a Royal medal in 1907 in respect of the fundamental character of his contributions to mathematics and mathematical physics, particularly with reference to the history and development of mathematics.

Mr. F. W. Lanchester, whose pioneer work and researches in aeronautics were recognised last year by the Royal Aeronautical Society in the award of its gold medal, and by his election as an honorary fellow, was educated privately and at the Royal College of Science, South Kensington. Early in his career he was technical adviser to the Birmingham Small Arms Company, and to the Daimler Company. From 1909 until 1920 he was a valued member of the Advisory Committee for Aeronautics.

Mr. C. P Eugène Schneider, ironmaster and metallurgist, owner, in family succession, of the famous Creusot Works in France, was nominated in 1917 president of the Iron and Steel Institute, and he held office for a year. It was a departure in procedure cordially and unanimously received. Distinguished specially in metallurgical research and practice, Mr. Schneider is also prominent as a scientific industrialist. In 1920–21 the Iron and Steel Institute published papers of his in its *Journal* on "An Investigation of various Forging Operations carried out under Hydraulic Presses"

Societies and Academies.

London.

Society of Public Analysts, October 6.—A. Chaston **Chapman**: On the presence of compounds of arsenic in marine crustaceans and shellfish. Marine crustaceans and shellfish have been found to contain from 10 to 174 parts of arsenic (as As_2O_3) per million of the wet edible portions. Native oysters contained from 5 to 10 parts, and Portuguese oysters from 33 to 70 parts per million. In fresh-water fish, shellfish and crustaceans, the amounts of arsenic ranged from only about 0·4 to 1·5 parts per million. The arsenic in the marine animals is therefore derived from the sea water. Potted and canned crustacea and shellfish contained from 0·5 to 85 parts of arsenic per million The arsenic in the urine of two experimental subjects was raised from the normal figure of about 1/200 grain per gallon to ¼ grain in one case, and ¼ grain in the other, after a meal of lobster.—A. Chaston **Chapman** and H. **Linden**: On the presence of lead and other metallic impurities in marine crustaceans and shellfish. The following amounts of copper (parts per million of the dried edible portion) were found: lobster, 167; crab, 130; and whelks, 115. The amounts of lead ranged from 5 (whelk) to 25·6 (lobster). Native oysters contained from 12 to 400 parts and Portuguese oysters 10 to 307 parts of lead per million. Like the arsenic, these metallic impurities are probably derived from the sea water—A. R. **Tankard** and D. J. T. **Bagnall**: The examination of fish for formaldehyde. Various kinds of fish gave a positive reaction in Schryvor's phenylhydrazine test, indicating the presence of 1 to 2 parts per million of formaldehyde. Since, however, trimethylamine (a common constituent of fish) can be readily oxidised to formaldehyde, a positive reaction does not necessarily indicate the presence of added formaldehyde. The reaction tends to be less marked when putrefaction of the fish has set in.—Karl **Sandved**: The potentiometric titration of tin with potassium bromate. The best results (error 0·5 per cent.) were obtained by oxidation of the stannous tin with antimony chloride or ferric chloride, and potentiometric titration of the reduction compound with potassium bromate. A method of determining tin in the presence of antimony has been devised, and the potentiometric titration of ferrous iron has been closely studied.—R. R. T. **Young**: The determination of nicotine in tobacco. Kellor's, Kissling's, and other methods have been critically examined. Accurate results are obtained by extracting the tobacco with a mixture of petroleum spirit, ether, and aqueous potash, shaking the ethereal extract with dilute (1 : 1) alcohol containing cochineal, adding excess of hydrochloric acid to the separated aqueous layer, and titrating with standard sodium hydroxide. Ammonia is best determined by distillation after precipitation of the nicotine with iodine, but little ammonia, if any, was present in the tobaccos examined.

Paris.

Academy of Sciences, September 6—Alfred **Rosenblatt**: The plane irrotational movements of incompressible viscous fluids.—H. **Pélabon**: Rectifying contacts. A detector consists essentially of the system metal-dielectric-metal. The thickness of the dielectric must be as small as possible and remain constant. Various practical means of satisfying these conditions are suggested.

September 13.—H. **Deslandres**: Remarks on the law of distribution in time of magnetic storms. The theory of corpuscular radiation appears to be able to explain the greater part of solar phenomena.—**Valère Glivenko**: Surfaces of finite area.—**Julius Wolff**: A generalisation of a theorem of Schwartz.—**Gossot** and **Liouville**: The principles of interior ballistics.—V. N. **Ipatief** and B. A. **Mouromtsef**: The reduction of chromic combinations by hydrogen under pressure and at high temperatures.—F. **Taradoire**: The rapid oxidation of drying oils and antioxygens. With the exception of the nitroso derivatives of diphenylamine, none of the other organic antioxygen substances employed were sufficiently active to prevent the spontaneous inflammation caused by the oxidation of drying oils on cotton wool.—**Raymond-Hamet**: A supposed sympathicotropism of Uzara.—Methodi **Popoff**, Minco **Dobreff**, and George **Paspaleff**: The development of the eggs of the sea-urchin (*Strongylocentrotus lividus*) under the action of extracts of the pollen of the oak and of calla.

September 20.—Th. **Got**: A remarkable class of ruled surfaces.—A. **Myller**: Normal curvature and geodesic torsion.—George D. **Birkhoff**: The signification of the canonical equations of dynamics.—André **Meyer**: The catalytic rôle of mercury in the sulphonation of anthraquinone. To explain the catalytic influence of mercury on this sulphonation, Martinet and Roux have formulated an ingenious hypothesis One deduction from this is that α-anthraquinone sulphonic acid should be transposed into the β-acid by simple heating with concentrated sulphuric acid. This the author is unable to confirm, the α-acid remaining unchanged under these conditions.—E. **Kohn-Abrest** and S. **Kawakibi**: Nitrates in animal and vegetable tissues. Details of a modification of Lunge's method of determining nitrates suitable for organic material.

SYDNEY.

Royal Society of New South Wales, September 1.—F. W. **Booker**: The internal structures of the Pentamerıdae of N.S. Wales. Brachiopod material was examined by means of serial thin sections, from 1 to 1.5 mm. apart. A new sub-genus, Barrandina (Synonym *Pentamerus linguifera*, var. *Wilkinsoni*, Eth. Fils 1892), containing two new species, *B. Wilkinsoni* and *B. Minor*, is described. A structure new to science is noted in the cruralium of these two species. It is also present in *Sieberella galeata*, Dalman, and *Sieberella glabra*, Mitchell, but not in *Pentamerella* (*Barrandella*) *Molongensis*, Mitchell.—M. B. **Welch**: The wood structure of certain eucalypts belonging chiefly to the ash group. The woods of seven species of eucalyptus are described in detail. In common with other members of the genus, the woods are practically diffuse-porous, though growth rings are more prominent in certain of these species than in most. The vessels possess simple end perforation. Transition forms occur between the fibre-tracheids, making up the bulk of the woody tissue, and the typical tracheids. Wood parenchyma is usually not abundant and is chiefly vasicentric.

Official Publications Received.

BRITISH AND COLONIAL.

Journal of the Indian Institute of Science. Vol 9A, Part 2: Vegetable Oils containing Glycerides of Erucic Acid. By J. J. Sudborough, H. E. Watson and P. Ramaswami Ayyar. Pp. 26-70+2 plates. 2.8 rupees. Vol. 9A, Part 3: The Production of Ether by Solid Catalysts. By S. K. Kulkarni Jatkar and H. E. Watson. Pp 71-109+4 plates. 3 rupees. Vol. 9A, Part 4: The Constituents of some Indian Essential Oils. Part 18: Derivatives of Abietic Acids By Madyar Gopal Rau and John Lionel Simonsen. Pp. 111-116+3 plates. 8 annas. (Bangalore.)

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 3, No. 17: Some new Ordovician and Silurian Fossils from Girvan. By Dr. F. R. Cowper Reed. Pp. 735-739+1 plate. 1s. Vol. 54, Part 3, No. 18: The Geology of Jan Mayen. By J. M. Wordie. Pp. 741-745+2 plates. 1s. 6d. Vol. 54, Part 3, No. 20: Calamoichthys calabaricus J. A. Smith. Part 1: The Alimentary and Respiratory Systems. By G. Leslie Purser. Pp 767-784+1 plate. 2s. 6d. Vol. 54, Part 3, No. 21: Contributions to the Study of the Old Red Sandstone Flora of Scotland. iii: On Hostimella (Ptilophyton) Thomsoni, and its Inclusion in a new Genus, Milleria; iv: On a Specimen of Protolepidodendron from the Middle Old Red Sandstone of Caithness; v: On the Identification of the large 'Stems' in the Carmyllie Beds of the Lower Old Red Sandstone as Nematophyton. By Dr. W. H. Lang. Pp. 785-799+2 plates. 5s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Department of Agriculture, Ceylon. Bulletin No. 76: Supplement No. 1 to the Guide to the Central Experiment Station, Peradeniya, issued as Bulletin No. 70. Pp. 24. (Peradeniya.) 40 cents.

Botanical Survey of South Africa. Memoir No. 7: The Native Timber Trees of the Springbok Flats. By Ernest E. Galpin. Pp 26+26 plates. (Pretoria: Government Printing and Stationery Office.)

Department of Science and Agriculture, Jamaica. Microbiological Circular No. 5: Panama Disease in Jamaica. By C. G. Hansford. Pp. ii+26. (Kingston, Jamaica: Government Printing Office.)

University of London: University College. Calendar, Session 1926–1927 (Centenary Year). Pp. clxxx+10+476+44. (London: Taylor and Francis.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 64, No. 358, October. Pp. 989-1092+xxx. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Engineering Abstracts from the Current Periodical Literature of Engineering and Applied Science, published outside the United Kingdom. Published by the Institution of Civil Engineers with the Co-operation of other Engineering Societies in Great Britain and the Dominions. New Series, No. 29, October. Pp. 221. (London: The Institution of Civil Engineers.)

FOREIGN.

Transactions of the Astronomical Observatory of Yale University. Vol. 3, Part 4: Catalogue of 1375 Stars; Re-observation by Means of Photography of Astronomische Gesellschaft Stars between Declinations +1° and +2°, reduced to 1875.0 without applying Proper Motions. By Frank Schlesinger, with the collaboration of C. J. Hudson, Louise Jenkins and Ida Barney. Pp. 135-151. Vol. 3, Part 5: Complement to the Tables of the Motion of the Moon, containing the Remainder Terms for the Century 1800–1900, and Errata in the Tables. By Ernest W. Brown, with the assistance of H. B. Hedrick. Pp. 155-204. Vol 3, Part 6: The Evidence for Changes in the Rate of Rotation of the Earth and their Geophysical Consequences, with a Summary and Discussion of the Deviations of the Moon and Sun from their Gravitational Orbits. By Ernest W. Brown. Pp. 205-235+3 plates. (New Haven, Conn.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 530: Establishment of Radio Standards of Frequency by the Use of a Harmonic Amplifier. By C. B. Jolliffe and Grace Hazen. Pp. 177-189. (Washington, D.C.: Government Printing Office.) 10 cents.

Rapport annuel sur l'état de l'Observatoire de Paris pour l'année 1925, présenté au conseil dans sa séance du 6 mars 1926. Pp. 26. (Paris.)

Cornell University Agricultural Experiment Station. Bulletin 449: Biology and Control of the White-Pine Weevil, *Pissodes strobi* Peck. By Samuel A. Graham. Pp 32. Memoir 97: Calcium Sulfate as a Soil Amendment. By M. H. Cubbon. Pp. 51. (Ithaca, N.Y.)

Jahresbericht der Hamburger Sternwarte in Bergedorf fur das Jahr 1925. Nebst einer Übersicht uber die meteorologischen Beobachtungen 1910–1925. Pp. 34. (Bergedorf.)

Astronomische Abhandlungen der Hamburger Sternwarte in Bergedorf. Band 2, Nr. 7: Beitrage zur physischen Untersuchung der grossen Planeten. 3: Beobachtungen und Zeichnungen des Planeten Mars wahrend der Perihelopposition 1924 ausgefuhrt am 60 cm-Refraktor der Hamburger Sternwarte in Bergedorf. Von K. Graff. Pp. 30+12 Tafeln. (Bergedorf.)

Mitsuru Kuhara's On the Beckmann Rearrangement. Edited by Prof. Shigeru Komatsu. Pp v+83. (Kyoto. Kyoto Imperial University.)

Festschrift der Zentralanstalt fur Meteorologie und Geodynamik zur Feier ihres 75jährigen Bestandes im Jahre 1926. Herausgegeben von der Akademie der Wissenschaften in Wien unter Mitwirkung der Zentralanstalt fur Meteorologie und Geodynamik. Pp. v+195. (Wien.)

Report of the National Research Council for the Year July 1, 1923–June 30, 1924. Pp. iv+59-95+129-206. Report of the National Research Council for the Year July 1, 1924–June 30, 1925. Pp. iv+106. (Washington, D.C.: Government Printing Office.)

American Museum of Natural History. Guide Leaflet Series No. 64: Meteorites, Meteors and Shooting Stars. By Frederic A. Lucas. Pp. 24. (New York City.)

Year Book of the Michigan College of Mines, 1925–1926, Houghton, Michigan. Announcement of Courses, 1926-1927. Pp. 11. (Houghton, Mich.)

The American Journal of Hygiene. Monographic Series, No. 6, September: The School of Hygiene and Public Health of the Johns Hopkins University. Pp. iii+56. (Baltimore, Md.) Free.

Sveriges Geologiska Undersökning. Årsbok, 18, 1924. Motsvarande No. 330–333 av Ser. C. (Avhandlingar och Uppsatser.) Pp. ii+96+129+170+84+20+71. (Stockholm.) 8.50 kr.

Publication No. 537: A Decade of Progress in the Design and Manufacture of Scientific Optical Instruments and Apparatus. Pp 20. (York and London: Cooke, Troughton and Simms, Ltd.)

Price List for 1926-7. Pp. 28 (London: Dubilier Condenser Co., (1925) Ltd.)

Microscopical Illuminating Apparatus. Pp. 32. (London: Ogilvy and Co.)

Diary of Societies.

SATURDAY, October 23.

North of England Institute of Mining and Mechanical Engineers (Newcastle-upon-Tyne), at 2.30.—T. S. Durham: Thin Seam Mining.—J. J. Stout: Description of an Old Windmill.

MONDAY, October 25.

Cambridge Philosophical Society (Annual General Meeting) (in Cavendish Laboratory), at 4.30.—Dr. H. Jeffreys: On Compressional Waves in Two Superposed Layers.—S. Pollard: (a) On the Descriptive Form of Taylor's Theorem; (b) The Summation of a Fourier Integral of Finite Type.—G. C. Steward: Note on the Petzval Optical Condition.—Prof. E. A. Milne: Maxwell's Law, and the Absorption and Emission of Radiation.—(*communicated by title only*.—T. L. Wren: The Correspondence between Lines in Threefold Space and Points of a Quadric Fourfold in Fivefold Space, established by a Geometrical Construction.—Dr. Roughton and Dr. Hartridge: Improvements in the Apparatus for Measuring the Velocity of Very Rapid Chemical Reactions. II.—Dr. Constable: On the Stability of Copper Catalysts Produced by Thermal Decomposition.—J. A. Christiansen: Note on the Velocity of Gas-reactions.—W. T. Richards: Note on the Effect of Alpha Particles on Paraffin.

Institute of Actuaries, at 5.—Sir Joseph Burn: Presidential Inaugural Address.

Royal College of Surgeons of England, at 5.—C. H. Shattock: Demonstration of Surgical Conditions of Blood-Vessels.

Institution of Electrical Engineers (Informal Meeting), at 6.

Institution of Electrical Engineers (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—P. J. Robinson: Chairman's Address.

Institution of Electrical Engineers (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—J. Rosen: Chairman's Address.

Institution of Mechanical Engineers (Graduates' Section, London), at 7.—H. L. Diamond: An Investigation into the Cylinder Losses of Locomotive Engines.

Medical Society of London, at 8.—Clinical Evening.

Royal Society of Medicine (Odontology Section), at 8.—J. B. Parfitt: Presidential Address.—C. A. Wakeford: Some Observations on the Tooth Band and on the Enamel Organs of the Human Deciduous Teeth.

Ethological Society (at Royal Sanitary Institute), at 8.30.—Dr. B. Hollander: Life and Mind (Presidential Address).

Institute of Chemistry (Manchester and District Section) (Annual General Meeting) (at Manchester).—Prof. G. G. Henderson: The Chemist and the Community.

TUESDAY, October 26.

Royal Society of Medicine (Medicine Section), at Guy's Hospital, at 5.—Clinical Meeting.

Institution of Civil Engineers, at 6.—Senator G. Marconi: Radio Communications (James Forrest Lecture).

Illuminating Engineering Society (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street), at 6.30.—Reports on Progress during the Vacation and Developments in Electric Lamps and Lighting Appliances.

Institution of Electrical Engineers (East Midland Sub-Centre) (at Loughborough College), at 6.45.—R. B. Matthews: Electro Farming.

Royal Photographic Society (Kinematograph Group), at 7.—Capt. C. W. R. Knight: Filming the Golden Eagle.

Institute of Chemistry (Edinburgh and East of Scotland Section, jointly with Society of Chemical Industry, Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 7.30.—W. A. Williams: Costs in Industry.

WEDNESDAY, October 27.

Institution of Automobile Engineers (North of England Centre) (at Engineers' Club, Manchester), at 7.—H. Kerr Thomas: The Debt of the Community to the Automobile (Presidential Address).

Institution of Engineers-in-Charge (at Magnet House, Kingsway), at 7.30.—N. H. Barber: Small Refrigeration Plants and their Application.

Faraday Society (at Chemical Society), at 8.—A. C. Vivian: Beryllium.—T. I. G. Rawlins: The Chemical Constants of the Halogen Hydrides.—J. Colvin: The Decomposition of Nitrosotriacetonamine in Presence of Hydroxyl Ion. Part I. The Region of Small Concentration of Alkali.—Freda M. Hunter: Latent Heat of Dilution of Sugar Cane Solutions.—J. J. Hedges: The Adsorption of Water by Colloidal Fibres.—A. N. Campbell: The Anodic Behaviour of Ferro-Manganese.—T. C. Sutton: Abnormal Absorption of Gases by Steel.—R. H. Humphry and R. S. Jane: The Observation of Cataphoresis in Colourless Sols. I. Rubber in Benzene.—J. S. Dunn: A Simple Kinetic Theory of Viscosity.—A. C. Chatterji and N. R. Dhar: Condition of Silver Chromate in Gelatin from Electric Conductivity and Diffusive Experiments.

Royal Society of Arts, at 8.—Dr. R. J. Tillyard: Progress of Economic Entomology, with special reference to Australia and New Zealand (Trueman Wood Lecture).

THURSDAY, October 28.

Institution of Locomotive Engineers (at Engineers' Club, Coventry Street), at 7.—R. C. Bond: Braking of Trains on Electrically-operated Railways.

Institute of Metals (Birmingham Local Section jointly with Birmingham Metallurgical Society, Staffordshire Iron and Steel Institute) (at Engineers' Club, Birmingham), at 7.—Prof. D. Hanson: Fatigue.

Institution of Automobile Engineers (London Graduates' Meeting) (at Watergate House, Adelphi), at 7.30.

Institution of Automobile Engineers (Luton Graduates' Meeting) (at Luton), at 7.30.—W. S. Bull: Hydraulic Transmission as applied to Automobiles.

Chemical Society (at Institution of Mechanical Engineers), at 8.—Prof. S. P. L. Sörensen: The Composition and the Characterisation of Proteins (Hugo Müller Lecture).

FRIDAY, October 29.

Royal College of Surgeons of England, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating Disorders in the Growth of Bone.

North-East Coast Institution of Engineers and Shipbuilders (Annual General Meeting) (Newcastle-upon-Tyne), at 6.—Sir Theodore Morison: How should an Engineer be trained?

Institution of Mechanical Engineers (Informal Meeting), at 7.—R. Lowe: Steel Castings in Mechanical Engineering.

Junior Institution of Engineers, at 7.30.—A. V. Ballhatchet: Distortion in Wireless Reception.

Society of Technical Engineers (at Queen's Hotel, Birmingham), at 7.30.—R. Hazleton: The Engineers' Bill.

Society of Chemical Industry (Liverpool Section) (at Liverpool University), at 8.—Dr. E. F. Armstrong: Research and Enterprise in Chemical Industry: New Routes to Old Chemicals (Hurter Memorial Lecture).

Institute of Chemistry (Glasgow and West of Scotland Section) (at Glasgow).—Annual General Meeting.

SATURDAY, October 30.

Institute of Metals (North-East Coast Local Section, jointly with Institute of British Foundrymen) (at Neville Hall, Newcastle-upon-Tyne), at 6.15.

Royal Society of Medicine (Study of Disease in Children Section) (at Children's Hospital, Birmingham).

PUBLIC LECTURES.

SATURDAY, October 23.

Horniman Museum (Forest Hill), at 3.30.—V. Gordon Childe: The Dawn of Civilisation in Europe.

SUNDAY, October 24.

Guildhouse (Eccleston Square), at 3.30.—Prof. W. A. Bone: The Economic Aspects of Coal.

MONDAY, October 25.

University of Leeds, at 5.15.—Sir Frank Dyson: Eclipses.

King's College, at 5.30.—C. J. Gadd: Evil Spirits in Babylonian Religion.

Southampton University College.—Dr. H. T. Calvert: The Activated Sludge Process of Sewage Treatment (Chadwick Lecture).

TUESDAY, October 26.

Gresham College, at 6.—A. R. Hinks: The Landscape of the Moon. (Succeeding Lectures on October 27, 28, and 29.)

WEDNESDAY, October 27.

Royal Institute of Public Health, at 4.—Prof. L. P. Abercrombie: Town Planning in Relation to Health.

London School of Economics and Political Science, at 6.—F. W. Roberts: The Adrema Machine and its Uses.

Fulham Central Public Library, at 8.—C. G. Paraloe: Roman and Saxon London.

THURSDAY, October 28.

King's College, at 5.30.—J. E. Barnard: The Design and Construction of Modern Microscopes.

Fulham Central Public Library, at 8.—R. Sudell: Bulb Culture.

SATURDAY, October 30.

Horniman Museum (Forest Hill), at 3.30.—Miss M. A. Murray: Seed-Time and Harvest in Ancient Egypt.

SUNDAY, October 31.

Guildhall (Eccleston Square), at 3.30.—Prof. H. H. Turner: The Fight against Fear.

CONGRESSES.

October 24 and 25.

Rumanian Congress of Oto-rhino-laryngology (at Bucharest).

October 25 to 27.

British Commercial Gas Association (at Newcastle-upon-Tyne).

October 25 to 28.

Italian Congress of Surgery (at Padua).

November 4 to 7.

Journées médicales de Montpellier (at Montpellier).

NATURE

SATURDAY, OCTOBER 30, 1926.

CONTENTS.

PAGE
West African Development.—I. 613
Cotton and Food. By Dr. W. Lawrence Balls, F.R.S. 616
Modern Aspects of Evolution. By Prof. Henry Fairfield Osborn, For. Mem. R.S. 617
Mind and Matter. By E. E. F. d'A. 618
Our Bookshelf 619
Letters to the Editor:
The Recurrence of Magnetic Storms.—Dr. H. Deslandres, For. Mem. R S. 621
Science and Psychical Research. — Sir Oliver Lodge, F.R.S. 622
The Naming of Wild Hybrid Swarms.—Dr. L. Cockayne, F.R.S., and H. H. Allan . . . 623
Early Egypt and the Caucasus.—Miss G. Caton-Thompson and Miss E. W. Gardner . . . 624
The Occurrence of Helium and Neon in Vacuum Tubes.—Prof. E. C. C. Baly, F.R.S., and R. W. Riding 625
The Canadian School of Prehistory in France.—Dr. H. M. Ami 626
Liveing's Fire-Damp Indicator.—Prof. C. V. Boys, F.R.S.; The Writer of the Note . . . 626
The Imaginary Roots of Equations.—Dr. H. C. Pocklington, F.R.S. 627
Spatial and Time Relations in Dreams.—Arthur E. Bostwick 627
The Influence of General Electron Displacement on the Reactivity of Conjugated Systems in the Molecules of Carbon Compounds. — Prof. R. Robinson, F.R.S. 627
The *Discovery* Expedition. By Dr. Stanley Kemp, N. A. Mackintosh, and A. C. Hardy . . . 628
City and Guilds (Engineering) College . . . 632
Obituary:
Mr. G. W. Lamplugh, F.R.S. By Sir A. Strahan, K.B.E., F.R.S. 634
Dr. Paul Kammerer 635
News and Views 637
Our Astronomical Column 641
Research Items 642
The Skin Constrictor (Psychogalvanic) Reflex. By Prof. R. J. S. McDowall and Dr. H. M. Wells . 644
Fuel Research. 645
University and Educational Intelligence . . . 646
Contemporary Birthdays 647
Official Publications Received 647
Diary of Societies and Public Lectures . . . 647
Recent Scientific and Technical Books . . Supp. v.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

CALCUTTA UNIVERSITY LIBRARY.

West African Development.

I.

THE Hon. W. G. A. Ormsby-Gore, the present Under-Secretary of State for the Colonies, is tireless in his pursuit of truth—so tireless that he might be suspected of regarding the machine-phrased memoranda emanating from local governments dealing with their particular problems in the same light as a member of Parliament regards the average answer to a parliamentary question. He has evidently set himself the task of knowing and making known the potentialities of the peoples and the countries for which Great Britain has assumed responsibility in the tropics. In 1922 he accompanied the present Viceroy of India on his tour of the West Indies and British Guiana. In 1924 he was appointed chairman of the Parliamentary Commission of Inquiry to East Africa. At the beginning of this year he set out on a tour of the four British West African territories, the report on which has just been presented to Parliament (Cmd. 2744; 3*s*. 6*d*. net).

This report, for which Mr. Ormsby-Gore is alone responsible, will commend itself to scientific workers as an objective survey of the facts to be faced and the problems to be solved in regard to the development of tropical Africa. He has the qualities of a statesman rather than those of a successful politician. He shares certain preconceptions with many of us. He has an abiding faith in the capacity of his fellow-countrymen to create an Empire Commonwealth, a belief in the right of the British nation to exercise a tutelage over the backward races until they no longer need our powerful protection to safeguard themselves against themselves or other peoples, or our guidance in conserving and developing their material resources. But he allows neither his preconceptions regarding our mission, nor his political convictions, to warp his judgments.

Faced with the inexorable facts of African native communities, their tribal or communal ownership in land, communal production, communal obligations in respect to essential services, Mr. Ormsby-Gore has the courage to draw logical conclusions. He realises, as Rivers realised and Morel realised, that our meat may be poison to peoples in a less advanced stage of development. "There can be no common definition of progress, no common standard for all mankind." The paths to the highest attainments need not be along parallel lines. Man's special functions in the universal scheme of things must differ with dissimilarities in race, environments, and inherited institutions. In spite of the shrinkage of the world, these dissimilarities persist and must be recognised, particularly by the white race which has been enabled, by its amazing command over material forces, to bend other races to its will. Before transplanting our laws, our customs, our institutions, our processes, among alien peoples and on alien soil, we should take heed lest we destroy much that is intrinsically valuable. We cannot legislate for every section of humanity as if it were cast in the same mould.

There are tremendous responsibilities implied in our trusteeship of the African native. Our duty to him and to the world does not end by making him a more efficient instrument for the development of the natural resources of his country. We have to safeguard him against the evils arising from a catastrophically sudden contact with our so-called modern civilisation. Our aim should not be to evolve Europeanised Africans, but to enable Africans to build up their own civilisation based upon all that is best in their culture and traditions.

The task confronting our administrators demands much patience, much tact, and a ripe understanding based upon knowledge born of intensive study of the peoples. We cannot afford to send out our administrators like "little children stumbling in the dark." They must be equipped for their task lest they destroy faster than they build. There is now a wealth of accumulated experience and knowledge at our command in our schools of anthropology. It is this which Mr. Ormsby-Gore wishes to enlist in the service of the British administration in tropical Africa.

> "If we are to succeed in our duties towards these peoples as rulers or as missionaries, or as instruments for their advance or civilisation, we must study them objectively and base our policy on real understanding acquired not only from personal contact, but from scientific study of their mental and moral characteristics, of native law and customs, of native history, language and traditions. Native methods of agriculture, native arts and crafts, should be examined scientifically before any attempt is made to supersede what we find existing."

The above quotation is a prelude to a delightful chapter on the indigenous population. The rest of the report is dull in comparison. In the small compass of twelve pages are summarised the results of much reading and still more careful observation. In them is to be found more information most attractively presented of the West African natives, their traditional forms of government, their languages, their forms of religion, their special characteristics, than it is usual to find in several volumes. It is almost Wellsian in style. With zest the author repeats the description by a Mohammedan ruler in Northern Nigeria of an English court of law as a place where "two professional liars appear to prevent the judge from ascertaining the truth." If this is the usual conception held of our legal system by Mohammedans, it is obvious that any attempt to supersede theirs, where judicial and executive functions are combined, would lead to considerable friction.

While the East African tribes have so far no aptitude for trading, and consequently are at the mercy of Indian, Arab, and Syrian middlemen, the West Africans have in their midst a negro tribe, the Hausas, who carry on itinerant trading and have created trading centres throughout Nigeria and the Gold Coast. The Yorubas, another negro tribe, have solved the problem of town-dwelling in a way which should commend itself to our own city-dwellers. They are both farmers and townsmen. They live in great towns—Ibadan contains 250,000 people—and go out daily to cultivate their holdings, some so far as ten to twelve miles from the city. None would interfere with his neighbour's crops. They are as sacrosanct as the fruit of the apple trees planted by German municipalities along their main roads.

Just as in East Africa, in the mountain fastnesses, there are remnants of tribes like the Wachagga and the Bagishu scattered among the Bantu and the Nilotic races, so in West Africa there are remnants of the Bauchi tribe, a primitive pagan people—still, it is alleged, addicted to cannibalism—scattered among the virile and intelligent Moslem tribes of Northern Nigeria. The Bauchi have protected themselves against attack by building heavy stockades hedged with the poisonous euphorbia shrub and cactus, and the use of poisoned arrows. They live in isolated communities, each of which has its own dialect, and are not yet accustomed to wearing clothes. Of the Ashantis we are told that they are organised in a quasi-feudal system, and even their land system is strikingly parallel to that which obtained in Britain in medieval times. The king himself, the Omanhene, has not only a council of barons to advise him, and if they consider necessary, to dethrone him, but also his position is rendered more delicate by a council of women headed by the Queen-Mother, who, being elected to the office, exercises parental authority without necessarily having had the responsibility of giving birth to the king. She is almost invariably a political power to be reckoned with.

The existence of an English-speaking African population raises special problems both in their relations with government and with the vast mass of their fellow Africans in the interior. They have sprung up through long contact with European traders on the coast, and by the creation of settlements for freed slaves from the Americas. Unlike the French, who encourage it, we definitely dislike the assimilation of our culture, our outlook, and our social habits by people of a different race; the nearer they approximate to us in these respects the wider becomes the gulf between them and us. Mr. Ormsby-Gore states the problem, but he gives no indication of a definite policy to be pursued, contenting himself with saying that the relations between the races must be based on mutual respect and understanding. It would be well if we faced the fact that the natives are rapidly becoming suspicious of the motives underlying the social exclusiveness of the English-speaking whites. It is notorious that many of the natives in Northern Rhodesia are forsaking British territory for work in the Belgian Congo, preferring the absence of racial discrimination among the Latin whites to the comparative freedom they enjoy under British rule. We cannot afford to be content with the expression of pious sentiments regarding mutual respect and understanding. We must have a definite policy, one that is intelligible and does not affront the intelligence of the better educated natives, who are capable of exercising considerable sway over their fellow-tribesmen: otherwise we shall create an ever-widening gulf between ourselves and the black races which can never be bridged.

British policy with regard to the administration of the native races has its parallel in the policy of the average captain of industry in a European industrialised state towards the workers in industry. Every material inducement is offered to enable the workers to produce more and to produce better in order that they may live fuller, more contented lives, yet one thing is lacking: neither rulers abroad nor rulers in industry at home are prepared to share the control which they monopolise; and in denying the peoples concerned a progressive share in the control of the machinery of government or of industry, they are wounding their self-esteem and progressively widening the breach between races and between classes.

So far in Africa, Great Britain has not determined to share the highest authority with members of the subject races. We are prepared to delegate authority; we are perpared to permit and even to bolster up a system of indirect rule under our supreme authority; we are not prepared to relinquish control for guidance. Whatever benefits we may have bestowed upon the Africans, therefore, will be regarded by them as being actuated by no higher motive than self-interest or as more subtle means devised for their exploitation. Every new road, every new railway, every new plant-product introduced, every new process, however necessary they may be if the potential resources of these vast territories are to be developed, increases the complexity of the African's life and sounds the death-knell of many of his institutions, habits, and customs. His needs increase and he has to work harder than ever. The transitory delight in the new gives way rapidly to an infinite regret for the loss of the old. Discontent is the parent of suspicion, and the suspicion can only be allayed by fitting him for the assumption of full responsibility.

Education is the only means by which the natives can be fitted to assume responsibility and adjust themselves deliberately to their special environment, and to adjust the environment itself to the changing conditions brought about by impact with the modern world. Mr. Ormsby-Gore has an abiding faith in the efficacy of education as an instrument of progress. He realises that in West Africa at least there is no possibility of creating an English colony. The personnel of the technical services, therefore, must be largely in the hands of the natives themselves, who look to the Europeans for guidance only in the initial stages of development. The chief needs of the country are education services which must supply well-trained natives for medical, sanitary, veterinary, agricultural, and other technical services. They will also have to meet the growing demand for native administrators. The basis of all education must be the primary school system, and it will be the greatest mistake to limit the provision of education to the favoured few. Mr. Ormsby-Gore is probably right in condemning a large number of the small bush schools which flourish throughout the territories, but it would seem to be a mistaken policy to close down any type of school catering for the native communities and selected by themselves for the satisfaction of their appetite for education, before the governments are in a position to satisfy the needs of the natives by the adequate provision of better schools. Our motives in suppressing the one without creating another to take its place would not be understood.

Mr. Ormsby-Gore's picture of the standard of teaching in the schools in West Africa makes somewhat depressing reading, and is certainly a reflection upon the capacity of the administration, the directors of education, and the missionaries. Where any system exists, education has been subordinated to the task of cramming African children for the Oxford and Cambridge junior and senior local examinations and the University of Durham pass degree. The majority of text-books in use in the various schools he considers to be unsuitable. Some of the elementary English reading books in use have been long obsolete in Great Britain. In respect of text-books and readers the schools in West Africa under British administration fall far short of those in use in the neighbouring French colony. Children had a parrot-like knowledge of the names of places in England, but no knowledge at all of the geography of West Africa. Many of the books used dealt with words and objects entirely outside the experience of the African children.

It is evident from the description of what purports to be an education system in West Africa, that education has been entrusted to people without any conception of the true purpose of education or any ideas of modern educational methods. Much is hoped for from the newly created Prince of Wales College at Achimota in the Gold Coast Colony, but it is evident that profound changes will have to be made in the personnel of the advisory committees on education and the education staffs themselves if any effective progress is to be made. What is needed are directors of education and staffs who are professionally trained to be alive to the potentialities of education, to the paramount need for elasticity in the treatment of educational problems, to the importance of psychology as a factor in educational training, and to the need for continuous experiment and research in educational method. With ignorance at the helm, education degenerates into mere instruction, its aim is confined to fitting persons for predetermined tasks, and the wider aim is unfulfilled of fitting them to live fully and to accept the responsibilities of citizenship, the basis of which is ungrudging service to the community. Mr. Ormsby-Gore is disappointingly silent on this aspect of education.

Cotton and Food.

The Cotton-Growing Countries, Present and Potential: Production, Trade, Consumption. International Institute of Agriculture, Rome. Pp. xxxvi + 317. (London: P. S. King and Son, Ltd., 1926.) 12*s.* 6*d.* net.

STUDENTS of the cotton industry were placed under a lasting obligation to the author of "The World's Cotton Crops" when it was published in 1915, and a grasp of the subject thus became available to any reader. The details of cotton-growing interests collected in that book gave internal evidence of the labour required to make an effective compilation by single-handed effort; the form of the book gave a reality and unity to the subject which a bald compilation must lack. It was too much to expect that Prof. Todd would be able to keep his book up-to-date, so that the action of the International Institute of Agriculture in producing the memoir now before us is doubly welcome, both as an authoritative statement of facts and as a supplementary volume to be shelved for reference beside "The World's Cotton Crops."

The present memoir amplifies an earlier publication on the same subject which the Institute issued in 1922. As its title indicates, the fact of a small production does not exclude a country from its pages, so that unexpected information can be derived from them; several acres of cotton grown successfully near Budapest in 1924 may be cited. It is not the function of such a compilation to balance critically the information derived from one country against that from another; this must be left to those who use the facts provided, in which they are assisted by a useful foreword. Such users will be well advised to bear this limitation of function in mind, for in many countries the full potentiality can never be made commercially effective, on account of such restrictions as are imposed by unevenly distributed rainfall, by the area available for irrigation, or by the irrigation available for the area.

The information given for eighty-one geographical localities, including the United States and Liberia, Egypt and Fiji, India and Barbados, is arranged to show so far as practicable the authorities quoted, data of area and crop, local geography and chronology of the crop, botanical and entomological information, together with merchanting particulars, including local manufactures.

Returning from the details which are the chief constituent of this volume, we may with advantage look more carefully at the interesting foreword. Amongst other things to which it directs attention is the stimulus given to cotton growing of late years by the high prices which resulted from short crops in the United States; this stimulus is very evident in some of the tables, where new countries continually appear from 1922 to 1925. It also directs attention to the probability of a continued fall in price from those stimulating levels, and to the consequent repetition of that vicious circling movement so familiar in cotton supply and demand. The foreword leaves the topic at this stage, for it is by such presentation and discussion of facts as this memoir provides that the radius of the vicious circle may be contracted. It is, nevertheless, quite possible that the ostensible circle is in reality part of a spiral, and that the whole cotton industry is entering upon a transition phase, from which it will emerge as a smaller and more highly specialised producer of high quality goods. The years during which short-time working has lately been practised may not be ephemeral, and the fact of such prolonged short time may not be a mere incidental consequence of post-War disturbances; it may be part of a coming shrinkage. While the significance of the artificial fibres as a cause which has begun to contribute to such shrinkage may be open to discussion, there can be little question that the supply of cotton will very soon be liable to direct competition through the rivalry of food crops.

The world's food demands were brought to the notice of the public by Sir Daniel Hall's recent address at the British Association, and there is an admitted probability that these demands will equate to the available known resources within a few generations; the situation will rectify itself, of course, by moving in the same vicious circle of demand and supply as obtains with cotton, but at the cost of some inconvenience to the world, unless it is anticipated. Such anticipation is not merely a problem for the dim and distant future; indeed, Prof. E. M. East has ventured to date the impact to happen within the life of potential centenarians already born. But long before this date is reached there will be a shouldering-out movement, wherein the textile plant will have to get off the arable earth, unless it can show itself to be irreplaceable by synthetic or forest products.

Another phenomenon which may perhaps be symptomatic of the same process in the making is also mentioned in the foreword. The design of the cord tyre for motor-cars gave the durability of the best cotton an opportunity to assert itself, which the chances of accidental damage had obscured in the old fabric tyre; the tyre-maker's demand for Sakel cotton, still more for Sea Island, outran the supply available at a competitive price, and many tyres are now made to wear well enough with lower quality cotton. But those who combine some knowledge of cotton with an interest in the autocar will be well aware that one firm which persisted in using Sakel won itself enviable reputation. Again the solution seems to lie in specialisation towards producing more good cotton, even if less of ordinary cotton.

We notice that the foreword makes one frank statement of ignorance which it is refreshing to meet. "Quality, in cotton, is a very vague term, and cannot be conveniently or tersely expressed, except in terms of the market price." Though this statement may appear surprising, it is quite true, and the absence of any analytical comprehension of 'quality' has been such a drag on the possible usefulness of botanists and plant breeders to the industry as must have been experienced to be appreciated. The late Mr. J. W. McConnel realised this, and initiated research work on the subject some twelve years ago; a book which summarises our broad conclusions is now in course of preparation, while the fuller details are being patiently dissected out in various textile research institutions. It may be hoped, therefore, that when the next issue of this memoir appears, the editor will be in a position to excise the statement we have quoted, and to extend his useful analysis of the general position accordingly.

The text is commendably free from misprints ("*Neocosmospera vas infecta*" is noted on p. 11), which carries the presumption that the tabulated data are equally correct. Thus, for reasons already given, and for its citation of authorities, this volume should be within reach of all who are interested in cotton supplies, whether industrially or scientifically.

W. Lawrence Balls.

Modern Aspects of Evolution.

Nomogenesis: or Evolution determined by Law. By Prof. Leo S. Berg. Translated from the Russian by J. N. Rostovtsow. Pp. xviii + 477. (London: Constable and Co., Ltd., 1926.) 28*s.* net.

THIS volume represents the mature thought of an accomplished ichthyologist and traveller who speaks from the point of view of a naturalist and field observer and marshals, in the first nine chapters, all the difficulties that have arisen through field observation in the original concept of Darwinism. The title "Nomogenesis" signifies "evolution determined by law" rather than by selection from the accidents of variation. In the opinion of the author and in the language of Prof. D'Arcy Thompson, who writes the introduction, "No place is left for Chance in the manifestation of new characters; the course of evolution is fixed and determined. The same laws are at work in the growth of the individual as operated with like results in former generations; and what we call 'recapitulation' means nothing more."

In the work before us, all the arguments against selection are cited from the works of a list of authors which fairly cover the whole field of literature from Darwin to the present time. A very fair statement is made of the arguments of prominent selectionists, like Poulton and Plate, of the new direction of the selection hypothesis in the work of mutationists, as well as of comparable results reached by palæontologists such as Abel, Dollo, and Osborn. But a large and more valuable part of the work and of the literature cited is that pertaining to field observations of naturalists working in every branch of zoology and botany.

The author's general attitude toward the selection theory is a reaction which, in the reviewer's opinion, carries him much too far in the opposite direction: in endeavouring to undermine the whole doctrine of the selection of chance variations, he undermines the broad selection principle as well, and thereby loses all touch with what may be called the larger concept of Darwin and of Wallace, namely, that evolution is constantly guided and directed by "the preservation of favored races in the struggle for life." Nor is any serious attempt made by the author to formulate the coefficients of living forces which are observed to combine in the formation of new sub-species and species. In this aspect the author is facing what we are all obliged to face—complete ignorance of the underlying causes of the origin of the new adaptations and new species which he sums up in the word 'nomogenesis.'

Prof. Berg is naturally strongest in his own field, namely, in his observations on the geographical variations of the fresh-water fishes of Europe, among which he notes the following curious circumstance:

> "As we move further south the number of species and varieties of fishes, as of other animals, increases. But, at the same time, it becomes evident that variations in genera very widely separated often exhibit a tendency to develop *in one direction*. Thus, in the South European and Caucasian species of Chondrostoma (of the Cyprinidæ), we observe a decrease in the number of the rays of the dorsal and anal fins as compared with what occurs in the North European and Russian representatives of that genus: in the North European *Chondrostoma nasus* the dorsal fin usually contains 9 branched rays, and the anal 10-11; in the numerous South European species of the same group there are generally 8-9 branched rays in the dorsal fin, while the number of those rays in the anal falls to 9. Such a decrease in the number of rays is still more pronounced in the South European and Caucasian species, which are grouped about *Chondrostoma toxostoma*: the number of rays in the dorsal and anal fins has in both cases decreased to 7."

Prof. Berg observes a similar diminution of fish rays in other genera of the carp family (Cyprinidae), namely, in bleaks, chubs, and roaches, which are also distinguished as one travels southward by a diminished number of scales, of fin rays, and of vertebræ, and by an abbreviation of the body. He extends this comparison very widely with similar observations by Günther, Jordan, and other ichthyologists, and concludes (p. 268) that "it is highly improbable, and indeed quite incredible, that in all the species named, belonging to separate genera, variations, which have led to the same results in all the species, should have arisen *by chance*."

In Chap. x., "The Formation of New Species," the author extends his comparison to the gudgeon (*Gobio gobio*), and gives his final opinion as follows:

> "*In the origination of new geographical forms* (species, sub-species, nationes) *a vast number of individuals inhabiting a certain geographical area are simultaneously involved in the production of new characters*. . . . The trend towards the development of scales on the throat, united with a combination of other characters, is something *primary, occurring in accordance with some law throughout the entire area of distribution of the southern gudgeon*."

A novel, but we believe thoroughly sound, application of the same directive principle in evolution to new verbal forms in languages is illustrated by Russian and French examples, with the following conclusion by the author:

> "In my opinion, the above-mentioned variations of language are determined by modifications in the organs of speech, *i.e.* possess an anatomical basis. These phenomena, consequently, enter into the domain of the naturalist: they are fully homologous to the new formations to which the various forms of organisms have been subject in time (geologically) and in space (geographically)."

Although the reviewer is unable to agree with many of the points of view of the author and to accept the complete antithesis presented (p. 406) between Darwin's conceptions and his own, this volume is welcomed as a thoughtful and, in large part, original contribution to the newer modern aspect of the evolution theory.

HENRY FAIRFIELD OSBORN.

Mind and Matter.

The "Margery" Case. By E. J. Dingwall. *Proceedings of the Society for Psychical Research.* Vol. 36, Part 98, June 1926. Pp. 79-170. (London: Francis Edwards, 1926.) 6*s.* net.

ONE of the best arguments for the utility of a Society for Psychical Research is furnished by a case of apparently well-authenticated telekinesis and 'materialisation' such as that of the medium known in the United States as 'Margery,' the wife of a highly qualified Boston surgeon.

The test was undertaken by the Society's research officer, Mr. E. J. Dingwall, and its course and result are closely analogous to the case of the 'Goligher Circle,' investigated after the death of Dr. W. J. Crawford. In both cases the investigator was prejudiced in favour of the authenticity of the phenomena and their 'supernormal' character, but was gradually forced to the opposite conclusion by the consistent failure of every attempt to render the phenomena evidential.

As in the case of Crawford's experiments, the proceedings are controlled by an 'operator,' purporting in this case to be the medium's deceased brother Walter, whose direct voice, apparently independent of the sitters, is heard in the room. The voice prophesies or promises the physical phenomenon, and then, under test conditions, it often happens as stated. But when pressed by suggestions which are distasteful to him, Walter either makes promises which are never fulfilled, or turns the thing into a joke with a series of droll witticisms, at which he is both skilled and highly amusing.

Control was made difficult from the beginning by the stipulation that the medium's husband should have free access to the sittings and should control one of the medium's hands. But Mr. Dingwall thought it best to let the phenomena develop along their own lines in the first instance and to tighten up the control later. He was rewarded by some very remarkable manifestations, including the ringing of an enclosed bell constructed by the *Scientific American* Committee. This was done in a red light, but was preceded by an 'incubation' period of darkness.

The record of the sittings shows a steady development which appeared to justify the waiting attitude adopted by the investigator. In the course of the ninth sitting (January 9, 1925) a self-luminous cardboard was introduced, and what appeared to be a mass of teleplasm was thrown upon it and underwent certain changes of shape as promised by Walter. One, two, three, four, or five fingers of all shapes were made to grow out from the mass, some slowly, some quickly; then a short coarse thumb, and finally one long projection with a hook on it, in all twelve inches long. Meanwhile Walter kept up almost continual conversation mixed with his characteristic laugh, all heard in between the medium's obvious snores.

A suggestion made by Mr. Dingwall to employ a gauze cage in order to prevent manipulation by the medium was refused, but as a compensation Walter promised to show a materialised head upon the medium's shoulder, and eventually to show the appearance and disappearance of the teleplastic substance from the body of the medium. From what he said it was clear that the extrusion of the substance would resemble a normal birth, as indeed it has been alleged in the case of other mediums. Walter stipulated that a flat piece of wood should be provided projecting in front of the medium's chair in order to support the substance on its emergence. Mr Dingwall remarks that this proviso is inconsistent with the supposed vitality of the substance. At the twenty-fifth sitting some excellent photographs were taken, and in the course of intermittent illuminations with red light an object was seen on the table resembling a very aged hand. Walter said, "This mass is really blood, the white corpuscles. When it goes back it strikes the heat and dissolves." Mr. Dingwall obtained permission to raise the object from the table. It resembled in shape a hand, but appeared to be a light skinny bag weighing two or three ounces. The medium turned in her chair and the object was pulled out of his hand, crumpling up in the process.

The attempts to show the growth and disappearance of the substance had no evidential value, since a few glimpses of the substance, separated by dark intervals, were only allowed to show successive stages.

Summing up his impressions, Mr. Dingwall says: "The one fact which stands out in favour of the hypothesis of genuineness is undoubtedly the personality and position of Margery and her husband, and the improbability of their engaging in persistent trickery." On the other hand, he considers it possible that a surgeon of rationalistic tendencies might experiment on the gullibility of a presumably expert investigator with the view of its eventual exposure.

The interest of this case lies in the fact that it constitutes, in Mr. Dingwall's opinion, the most advanced example of alleged telekinesis and teleplastics ever investigated by the Society. It is quite arguable that any phenomenon the occurrence of which depends upon the whim of a disembodied entity whose behaviour escapes the application of all human standards is *ipso facto* outside the pale of science; and it is a matter of history that the progress of science has coincided with the elimination of such factors. On this planet, at all events, the controlling mind is the embodied mind of man, and to admit any other to a position of superiority, or even equality, involves the abdication of science.

It is all the more important that alleged phenomena of a 'supernormal' character should be subjected to sympathetic, critical, and competent investigation, and of such investigation Mr. Dingwall's report is a good example.

The Hon. Everard Feilding appends a well-written review of the adverse Hoagland Report on the same medium published in the *Atlantic Monthly* on behalf of a committee of Harvard graduates. He does not regard this highly controversial matter as by any means finally settled. E. E. F. D'A.

Our Bookshelf.

Sarajevo: a Study in the Origins of the Great War. By Dr. R. W. Seton-Watson. Pp. 303. (London: Hutchinson and Co., Ltd., n.d.) 18*s*. net.

THIS important book appears at a very opportune moment. A vigorous and characteristically thorough movement has been going on for some time in Germany, to shift the responsibility for the War from German shoulders, and land it on those of the allies, and in the first place of Russia. Quite recently, the movement has taken hold of a large section of the historians of the United States under the lead of Prof. Barnes, who has been lecturing with great acceptance in Berlin this summer on these lines. They call themselves the 'Revisionist' School, and Prof. Barnes's book is now expected in Great Britain, if indeed it has not already arrived. Now, just before we get it, Dr. Seton-Watson gives us in this compact and well-documented volume an authoritative account of the whole thing from the most important point of view, that is, the relations between the Southern Slavs centred in Serbia and the Austrian Government under Francis Joseph. This was the point of ignition, and the crime of Sarajevo was the spark.

Dr. Seton-Watson has made a life study of the whole Slav question, and his account is obviously impartial and as exhaustive as the published documents permit. These are unusually numerous and full, as the new Succession States have naturally published everything they could. The result is astounding but unquestionable. The assault on Serbia was deliberately engineered with determination, unexampled duplicity, and a complete recklessness of the consequences, by the war party in Vienna, and above all by the Chancellor Berchtold, who, having secured a free hand from Germany, managed gradually, and in the end by a falsehood, to win over the old Emperor to the declaration of war.

The only satisfaction one can derive from the terrible story is that those have paid most heavily who sinned worst. The old Austrian system which produced such things has been completely swept away—the best and greatest clearance of the War. F. S. MARVIN.

The Natural History of Wicken Fen. Edited by Prof. J. Stanley Gardiner. Part 3. Pp. 173-266. (Cambridge: Bowes and Bowes, 1926.) 5*s.* net.

THE acquisition of Wicken Fen by the National Trust has afforded Prof. Stanley Gardiner and his colleagues an opportunity of carrying out a type of natural history investigation which British zoologists have been inclined to neglect, although it promises valuable results. In the British Isles, collecting has tended to diffuseness: the entomologist flits from one area to another where good collections are likely to be made; other local lists owe their existence to the chance presence of enthusiasts, but seldom is a single limited area worked to the bone as regards all its content. Part 3 of the "Natural History of Wicken Fen" continues the results of the intensive study of natural groups, ranging from Oligochæta and Mollusca to several insect orders, and including a flora list and a historical note on changes in the fen during the last forty years, all valuable contributions.

The biological aspect is notably prominent in the papers by Prof. Balfour-Browne, Miss Pickford, and Mr. Hutchinson, and a perfect foundation is being laid for an ecological study which will trace the fluctuations of the animal groups in relation to each other and to the vegetational and soil changes from season to season and from year to year. Zoology has lagged far behind botany in ecological study, but we trust that before this series is completed, the editor may be able to arrange a symposium which will make up some of the leeway. J. R.

Naturforscher und Erfinder: Biographische Miniaturen. Von Prof. Dr. Ludwig Darmstaedter. Pp. vii + 182 + 16 Tafeln. (Bielefeld und Leipzig: Velhagen und Klasing, 1926.) n.p.

THIS charming book consists of thumb-nail sketches of the lives of famous men of science, and is well illustrated with portraits and with facsimiles of autograph letters. Physicians, physicists, chemists, and others all find a place, and the true internationalism of science is reflected in the catholic nature of Prof. Darmstaedter's gallery. Biographical details have a perennial interest, and in the present instance many of them are new, or at least not generally known. One of the most interesting sections deals with the men who were responsible for "the error of phlogiston and its overthrow," namely, Stahl, Black, Marggraf, Priestley, Scheele, and Lavoisier, though microscopists will derive equal enjoyment from the sketches of Leeuwenhoek, Redi, and Ehrenberg, and physicists from the sympathetic insight into the minds of Gilbert, Guericke, von Kleist, Galvani, Volta, and Ohm. Prof. Darmstaedter says that the compilation of this book has brightened his life during the last two years, and he may be assured that the wish he expresses—that his readers may get as much enjoyment from it as he has done—will be fulfilled. If we ourselves may express a wish, it is that he may live long and give us more books of the same kind.

The Whalers of Akutan: an Account of Modern Whaling in the Aleutian Islands. By Knut B. Birkeland. Pp. vi + 171 + 16 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1926.) 14*s.* net.

MODERN whaling with explosive harpoons has spread to all parts of the world, generally through Norwegian enterprise. This book describes vividly the life and methods in a whaling station in Akutan in the Aleutian Islands, where blue whales and sperms were the chief catch. It dwells not only on the adventure and incidents of the life, but also contains a great deal of information about the commercial side of the industry, the preparation of the oil, the utilisation of the débris for fertiliser and whale meat as human food. Since the author, at nearly sixty years of age, was new to whaling when called upon to manage the station, he describes many minor matters that an experienced whaler would be likely to pass by as unworthy of mention. This adds to the interest of the book; but unfortunately he had little opportunity to see much of the Aleutian Islands beyond the station, and has relatively little of value to say about the natives, and nothing about the geography and natural history of these little-known islands.

Methoden der angewandten Geophysik. Von Dr. Richard Ambronn. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, Band 15.) Pp. xii + 258. (Dresden und Leipzig: Theodor Steinkopff, 1926.) 15 gold marks.

As the title indicates, this book is largely influenced by the economic aspect of geophysics. Prominence is given to the discovery of ores and salt deposits by means of the Eötvös torsion balance, and by seismological and magnetic methods. Most of the book deals, however, with the purely scientific parts of the subject. It contains a bibliography of about 1700 references, but unfortunately there are signs that they have not all been verified, and the author seldom gives much information himself, referring the reader instead to original sources, with little indication of what is to be found there. H. J.

Description du ciel. Par André Danjon. (Bibliothèque générale illustrée, 2.) Pp. 80 + 59 planches. (Paris: F. Rieder et Cie, 1926.) 15 francs.

THIS pleasantly written and well-printed booklet gives in eighty pages a brief but wide survey of present-day astronomy. It can be recommended to English readers of the French language who desire acquaintance with modern views and problems in astronomy, rather than a knowledge of the detailed facts. The fifty-nine plates, each occupying a page, are reproductions, good on the whole, of photographs of observatories and telescopes, the sun and moon, the planets, comets, stellar spectra, the Milky Way, clusters, and nebulæ.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Recurrence of Magnetic Storms.

CE journal a publié le 4 Septembre dernier une lettre du Dr Chree intitulée : "The Recurrence of Magnetic Storms" Le Dr. Chree présente un examen critique de plusieurs communications que j'ai faites récemment à l'Académie des Sciences de Paris (voir *Comptes rendus* 182, 1926, p. 296, 669, 733, 1301, et 183, 1926, p. 153), et qui annoncent la répétition des orages magnétiques à des intervalles égaux à iT/6 ; i étant un nombre entier et T la durée moyenne de rotation synodique des taches solaires.

Or les travaux antérieurs de Chree sur la succession de ces orages (*Phil. Trans.*, 1912, A, vol. 112, p. 78, et 1913, vol 213, p 245) font bien ressortir leur tendance à revenir à des intervalles qui sont des multiples de la période T, mais non d'une période plus petite. Aussi le Dr Chree, sans condamner absolument mes résultats, émet des doutes sur leur validité.

Je suis conduit à présenter quelques remarques sur les recherches de Chree et les miennes. Je montrerai brièvement que les méthodes employées par les deux auteurs sont très différentes, et que les résultats obtenus pouvent ne pas être exactement les mêmes.

I. Le Dr. Chree, dans sa note du 4 Septembre, rappelle les bases principales et les conclusions de son étude déjà ancienne des perturbations magnétiques. Il s'appuie sur le nombre, appelé caractère magnétique, 0 (calme) ou 1 (modérément troublé) ou 2 (fortement troublé), qui est adopté chaque jour dans les observatoires magnétiques pour représenter les variations de l'aiguille aimantée pendant les 24 heures. Dans chaque mois d'une longue période de 11 années, il choisit les cinq jours les plus troublés ; ce qui fait en tout 660 jours troublés ; et il prend la moyenne de leurs caractères magnétiques, moyenne qui, dans une première série de 11 années, a été 1·51. Puis il considère les 3 jours qui précèdent et les 35 jours qui suivent chacun des 660 jours troublés, et il prend encore la moyenne de leurs caractères magnétiques. Le rapprochement de ces 39 moyennes conduit à plusieurs propriétés intéressantes, et, en particulier, aux résultats ci-dessus résumés.

D'autre part, l'Observatoire de Meudon que je dirige, et qui est consacré spécialement à l'étude du soleil, enregistre depuis 1922 la déclinaison magnétique sur un papier sensible qui noircit sans développement et est placé dans la salle même de notre grand spectrohéliographe. L'observateur du soleil peut, en soulevant un simple voile, avoir sous les yeux la courbe magnétique des 48 dernières heures, et il est prévenu par une sonnerie, lorsque la perturbation est forte Le papier se déroule avec une faible vitesse (40^{mm} en 24 heures) et est relevé seulement toutes les semaines. L'appareil est surtout avertisseur, et il enregistre toutes les variations un peu notables, en assurant leur comparaison très facile.

Or, dans les premiers mois de 1926, à Meudon où les aurores boréales sont rares, nous avons observé quatre fois ce curieux phénomène, accompagné d'un bel orage magnétique, les 26 Janvier, 23 Février, 5 et 9 Mars. J'ai noté que les deux derniers orages étaient séparés par un intervalle très voisin de T/6, et que, en ajoutant les orages plus faibles des 13, 18, et 23 Janvier, que les 7 orages ont entre eux des différences qui sont des multiples de T/6. Puis, en remontant à l'année 1925, et en examinant les mois de Mars à Août 1926, je trouve encore des orages qui ont entre eux les mêmes différences, et d'autres orages reliés aux précédents d'une manière simple. Finalement les conclusions sont les suivantes : Plusieurs orages, qui sont en général les plus forts, ont entre eux des intervalles qui sont des multiples de T/6 ; d'autres orages, en général moins forts, occupent à peu près le milieu des intervalles précédents, les différences étant des multiples de T/12. Enfin, au milieu des intervalles de la 2^{me} série, on distingue des perturbations plus faibles, qui correspondent aux multiples de T/24. De Janvier 1925 à Août 1926, toutes les perturbations un peu notables sont comprises dans ces trois séries.

Størmer a mis récemment hors de doute que les aurores et les orages magnétiques sont dus à un rayonnement corpusculaire émané du soleil et formé le plus souvent de particules négatives. Les points de forte émission corpusculaire, qui, dans le soleil, sont de véritables volcans, ont donc une distribution régulière ; ils occupent des méridiens dont les différences en longitude sont des multiples de 60°, 30°, et 15°. Comme cette division spéciale est celle des corps à symétrie circulaire qui se refroidissent, les faits précédents conduisent à admettre, tous les onze ans, des brisures régulières dans trois couches solaires, qui, placées sous la surface, rejettent au dehors par intermittences leur matière fortement ionisée ou radioactive. Ils conduisent aussi à une explication simple des variations undécennales du soleil (voir les mémoires originaux).

En fait les orages magnétiques sont rapprochés et comparés tout autrement que dans le travail antérieur de Chree. J'ai noté non la durée de l'orage, comme l'ont fait la plupart des auteurs, mais l'heure de sa pointe caractéristique, de sa pointe maxima, ou, ce qui revient au même, la longitude correspondante du centre du soleil. Les orages les plus frappants sont les orages S de Maunder, à commencement brusque, qui sont en général les plus forts, et j'ai vérifié la loi d'abord sur les orages S de 1925–1926, puis de 1882–1883, qui sont les uns et les autres un peu avant un maximum de taches. Le tableau suivant permet de juger l'accord des orages S de 1882–1883 avec la loi posée. Les longitudes sont celles de Maunder et se rapportent à la première pointe de l'orage.

PERTURBATIONS MAGNÉTIQUES

Dates et particularités	Longitude du centre du soleil.	Différence avec 93°.	Différence avec 51°2.
1882. Avril 16·98 G. S	93°	0	..
„ 20·15 G. S.	51·2	..	0
Juin 15·13 M. S.	30·9	+62°·1	.
Août 2·65 A. S	82	.	−30°·8
Sept 12·12 A. S.	293·9	..	−242·7
Oct. 2·40 G. S	26·3	.	+24·9
Nov. 16·35 M. S	153·5	−60·5	..
„ 17·43 G. S.	159·2	..	−88
„ 25·68 A. S.	30·4	+62·6	..
1883. Fév. 24·57 V. S.	273·4	−180·4	..
Avril 3·37 V. S.	135	.	−82·8
Juill. 8·62 M. S	302·3	−209·3	..
„ 11·72 M. S.	261·4	..	−210·2
„ 29·99 V. S	19·9	..	+31·3
1882. Oct. 5·75 A.	342·1	−249·1	..
1883. Fév 1·75 A.	213·9	−120·7	..

On distingue les deux séries à intervalles de 60° et de 30°. A noter que la deuxième série n'occupe pas exactement les intervalles de la première ; les orages nous arrivent avec un certain retard, ce qui peut tenir à la vitesse plus faible des particules (voir le mémoire original).

Les orages ordinaires non S de 1925–1926, plus nombreux que les orages S, rentrent aussi dans la loi précédente ; ils sont représentés par leur pointe la plus élevée, la variation diurne de l'aiguille étant défalquée. Parfois on hésite pour décider si un orage est S ou non S, ou hésite entre deux longitudes ; mais le cas est rare et il arrive que les deux longitudes peuvent se rattacher à la loi qui est seulement approchée.

Enfin, fait curieux, les petites perturbations (entre 10′ et 2′ d'écart en déclinaison) qui se détachent nettement sur une courbe calme ou peu agitée, satisfont aussi à la loi posée ; et, dans les tableaux publiés, ces petites perturbations sont les plus nombreuses (voir le mémoire original).

Par contre je n'ai pas considéré les parties, d'étendue souvent grande en longitude, où l'agitation est continue, après un fort orage ou en dehors d'un orage. Les pointes sont alors petites, nombreuses et très rapprochées, sans offrir de maximum bien net. L'émission correspondante du soleil n'est plus limitée, comme dans les orages S, à une région étroite de l'astre avec des particules plus ou moins rapides, elle s'étend sur les côtés en longitude, étant en même temps plus faible. Ce mode particulier d'émission sera l'objet d'une étude spéciale.

En résumé, tous les maxima bien nets, grands ou petits, des courbes ont la distribution régulière qui est annoncée ; mais, et il faut insister sur ce point, il y a des lacunes dans leur succession, l'émission solaire étant intermittente, comme l'émission de nos volcans.

Après ces explications, on comprend pourquoi les maxima iT/6, spécialement examinés par le Dr. Chree, n'apparaissent pas dans ses calculs ; les moyennes adoptées ont l'inconvénient de masquer les inégalités périodiques dont l'intensité est très variable. Seule la période T émerge ; ce qui indique qu'elle est la plus fréquente et qu'elle est attachée à des orages forts ; et ce résultat est certes fort important. D'autre part le caractère magnétique sur lequel s'appuie le Dr. Chree, représente incomplètement l'état des choses, et a été déjà vivement critiqué. La division rigide en tranches de 24 heures, qui convient certes pour l'étude de la variation diurne, est beaucoup moins indiquée pour les orages proprement dits Pour faire ressortir les périodes T/6 et T/12, il faudrait prendre dans chaque mois non pas 5, mais 14 jours. Enfin mon étude porte seulement sur 18 mois et celle de Dr. Chree sur les onze années d'une période solaire.

Que le Dr. Chree veuille bien étudier séparément, comme je l'ai fait, chaque perturbation, puis la comparer directement aux autres, et son opinion sera modifiée.

II. Il reste ensuite à reconnaître dans le soleil les points d'émission corpusculaire dont la distribution régulière est annoncée par notre aiguille aimantée. On a d'abord pensé aux taches, puis aux facules, et je me suis rallié à cette dernière opinion Depuis longtemps j'ai l'idée que les points actifs du soleil correspondent surtout aux parties de la facule qui présentent la raie D_3 de l'hélium noire, que la facule soit avec tache ou sans tache. La proportion de gaz helium y est plus grande et donc aussi la proportion de corps radioactifs. L'Observatoire de Meudon s'organise pour enregistrer d'une manière aussi continue que possible ces portions spéciales des facules, et d'Azambuja, astronome de Meudon, a commencé la recherche depuis plusieurs mois.

Le mois dernier, l'astronome anglais A A Buss m'a signalé une note publiée par lui en 1915 dans *The Observatory* et intitulée : "A possible Systematic Distribution of Solar Activity Areas in Longitude." Sur 57 taches relevées de 1912 à 1914 dans une phase de minimum, Buss en note 10 dont les différences en longitude sont très voisines de 60° ou de multiples de 60° ; et il suggère que cette régularité pourra se retrouver dans les orages magnétiques L'intérêt du fait annoncé est manifeste ; et on peut s'étonner que l'auteur n'ait pas poussé plus loin cette première étude. Les 10 taches signalées n'étaient pas toutes parmi les plus fortes ; il faudra rechercher si les autres taches de 1912–1914 ont entre elles des différences qui soient des multiples de 30° et de 15°. Il faudra aussi étendre la recherche aux facules avec taches ou sans taches et aux perturbations magnétiques d'une période solaire tout entière.

III. Le rayonnement corpusculaire du soleil a été jusqu'ici plutôt négligé ; or il a une très grande importance et s'annonce comme étant la cause première de la plupart des grandes variations que subissent le soleil et ses dépendances dans la période undécennale. Le phénomène toujours mystérieux des champs magnétiques intenses, reconnus au Mont Wilson sur plusieurs points de l'astre, est dû peut-être à ce rayonnement Une propriété remarquable des particules électrisées est ici à rappeler : lorsque ces particules ont traversé une certaine quantité de matière, elles ont une trajectoire hélicoïdale (Wilson, Rutherford) Si les hélices ont des rotations de même sens sur une portion un peu notable de la surface, il en résulte un champ magnétique, à composantes horizontale et verticale, très semblable à ceux du soleil. On peut aussi, avec ce rayonnement corpusculaire négatif et positif, expliquer en grande partie les facules, les taches avec leurs deux polarités, les protubérances et filaments : et on s'accorde déjà pour lui attribuer les formes caractéristiques de la couronne solaire.

H. DESLANDRES.
(Directeur.)

Observatoire d'Astronomie physique,
Meudon, le 20 Septembre.

Science and Psychical Research.

NICKNAMES are seldom exhilarating or welcome, especially when intended to be contemptuous, so the question raised on p. 553 (NATURE, October 16), whether Prof Richet can rightly be bracketed with Crookes and Lodge as a 'spiritist,' seems a barren one, but it may be used as a peg for some general remarks.

None of the three would like the term ; all would prefer to be regarded as explorers or gropers in a tangled region off the obvious track, but only one of the three would resent the term as definitely erroneous.

I suppose it is generally admitted that there are facts requiring explanation If the facts are all explicable in terms of human duplicity, the only branch of science to which they can be of the smallest interest will be anthropology or abnormal psychology or psychiatry. But if any of the facts are what we may call for brevity 'real,' they are bound to be sooner or later of importance—even of great importance—not only to psychology but to physiology also, and perhaps to humanity at large. All three of the above-mentioned protagonists have gradually come to believe that that is so, in opposition to many of their colleagues who are still labouring under the delusion of undiluted fraud.

May I assume for the moment that some of the unpalatable or undigested facts are real, in the sense

that when understood they will lead to an extension of natural knowledge. We now require a working hypothesis wherewith to tackle them. The particular hypothesis employed as a tentative clue is comparatively of small importance; and if any onlookers are unwise enough to elevate such vague notions to the rank of a theory, they can scarcely be aware of the high status required of a scientific theory. A working hypothesis is an elastic thing, or rather a living and growing thing; parts can be shed, parts may become consolidated, while other parts may shoot out new growths and bud amazingly, but all are variable; and various hypotheses may be favoured at different times and by different people.

Of the hypotheses so far tried to account for strange happenings, one group of scientific men ejaculate 'fraud'; another set try what they can do with 'ectoplasm'; while a small group, in sympathy with these last, try to go further, and postulate unrecognised intelligences; so this last group may be represented as murmuring 'spirit.' But none of these hypotheses is an explanation: indeed, only the first class imagine that they have an explanation, though if they press it with care and patience they will find it often does not work Let us give the other two a moment's chance.

By ectoplasm, Richet and his group mean a mass of protoplasmic material, emanating under exceptional conditions from the human body, and endowed with singular and unexpected properties; no more astonishing in themselves than the properties exhibited by an egg, or indeed any other form of living tissue, but unusual in location and also unusual in the apparently temporary character of the result Like muscle, ectoplasm is controlled by intelligence and can exert force, but unlike muscle it extrudes itself beyond the normal periphery of the familiar organism. Like a placenta or an egg or a pupa, it exhibits a formative power, being able to manipulate itself or other substances into organised forms; but, unlike the forms to which we have grown accustomed, these are singularly evanescent Nevertheless, while they last they act in an intelligent way, and are as subservient to control as, let us say, a dog. Such are among the facts testified to by Richet, Schrenck-Notzing, Morselli, and other continental investigators.

If we grant all or any of this, merely for the sake of the discussion—for facts are not established by citation of authority—the question arises, What is the control? Is it the unconscious mind of the person from whom the substance emanates—naturally the first and easiest idea—or does it represent the intervention and activity of some intelligence not obviously and in perceptible form present? The three men mentioned above, though sometimes bracketed together, might take different views. I venture to say that their views, whatever they are, must at the present stage be so crude as to be scientifically almost negligible. The facts alone are important; it is those that, granted their genuineness, need far more investigation. In that opinion they all agree. Time enough for a theory when we know more.

In fairness, however, let me go on to excuse, and in some sort justify by an analogy, the third kind of working hypothesis here briefly labelled spirit. Consider the reaction of a race of secluded but intelligent aborigines to whom there comes a rumour, from one or two of their number, about things quite inconceivable and absurd—X-rays, let us say, or telephones, or radio telegraphy. At first utterly sceptical, they may denounce and expel the heretic, but if, nevertheless, the rumour is persisted in by successive generations, and supported by some whose observations are generally treated with respect, some working hypothesis becomes necessary. Delusion is the simplest notion; the idea of corporeal emanations and vibrations is more troublesome, but may be made to look impressive and materialistic; while the hypothesis of the existence of a hitherto unsuspected race of white men, to whose activity the phenomena are due, would probably be stigmatised as a degrading superstition. Whatever it is, it is certainly not a theory of X-rays or of telegraphy; and yet the suggested clue that these incredible things are the work of unknown intelligent operators has, in this case, an element of something that would ultimately lead to an explanation. It may be sneered at as superstitious, but cannot rationally be stigmatised as false.

So also the hypothesis popularly associated with the term 'spirit,' though it is not a theory of either apparitions or telepathy or telekinesis, yet in so far as it contains any element of truth—that is the crux—it may be the beginning of what will ultimately constitute a new branch of science. It may be only the first rung of a ladder; yet if we follow our leaders and begin to climb, who knows what unearthly region may be ultimately scaled! Science is young: the human race may reasonably be expected to continue on this planet for several million years, so it would be rather dull, as well as unlikely, if man's outlook on the universe, and his realm of natural knowledge, should always conform to the orthodoxy of A.D. 1926.

OLIVER LODGE

The Naming of Wild Hybrid Swarms.

ONE of the most important developments of botanical research in New Zealand of recent years, since it concerns not only taxonomy but also the question of evolution, is that of the study of wild hybrids. Evidence has rapidly accumulated as to the prevalence of polymorphic swarms of wild hybrids in several sections of the flora. Whereas (*Trans N Z. Inst.*, 44, 1912, 30) Cockayne stated, "Hardly anything is known as to the occurrence of wild hybrids in New Zealand," he was able later (*New Phytol*, 22, 1923, 124) to list 130 certain or extremely probable groups of interspecific hybrids. The number has since been considerably augmented, and now stands well above 200 The following table is illuminating, taking only the monocotyledons and dicotyledons:

Classes of Genera.	Number of Genera.	Number possessing Hybrids.	Percentage.
Genera with 2-5 species .	125	42	34
Genera with 6-10 species .	33	17	52
Genera with 11-20 species	15	13	87
Genera with over 20 species	16	16	100

All genera containing 14 or more species are known to show hybridism. Remembering that many species are so isolated that hybridism is difficult or impossible, that species in close proximity may bloom at different seasons, and that many groups have not been critically examined in the field, but the vague term 'variation' has been used to explain polymorphy, these figures speak for themselves.

Now this wealth of wild hybrids raises many important questions, not the least of which, as a necessary preliminary to further progress, is the matter of suitable nomenclature. The formular treatment allowed by the "International Rules of Botanical Nomenclature" is too cumbrous for general and field studies. Nor do the "Rules" have in view the existence of the highly polymorphic hybrid swarms—in no few cases hundreds or probably thousands of distinct individuals—that are now known to exist. In the absence of any recognised method of procedure suited to our needs as field ecologists, we have been forced to draw up our own rules. Elsewhere we are publishing a more detailed statement of our case, but it seems well to place the essence of the matter before the wider audience available in the columns of NATURE.

For the whole diverse group arising from the crossing of two species we construct a name formed by the combination, suitably abbreviated, and with the ending appropriately modified, of the specific names of the parents. Thus to the great group *Hebe elliptica* × *salicifolia* we give the name × *Hebe ellipsala*, and so for *Hebe Astoni* × *laevis* the name × *Hebe laevastoni*, preferring euphony to strict adherence to alphabetical order. Where one of the names is quite short it may be used entire, *e.g.* × *Melicope ter-simplex* = *M. simplex* × *ternata*. This idea is derived from names given to horticultural hybrids, *e.g.* × *Iris monspur* = *I. Monnieri* × *spuria*. Where a specific name has been given to a smaller group within the swarm, as has often happened, especially for forms about midway between the parents, we may adopt this name for the minor group. Thus × *Melicope Mantellii* is the name we propose for that small group of hybrids "intermediate" between *M. simplex* and *M ternata*

To us it seems most inappropriate to widen the conception of such names to include the whole group, as not only have we no warrant for doing so, but also confusion would inevitably result Moreover, our method provides for the placing of forms still undiscovered, or those certain to arise later. A hybrid swarm is a totally different biological group from that of a species. In the latter case there can be a "type"; in the former a "type" is impossible. Further, species deal with definite, static groups, but hybrid swarms with indefinite dynamic groups, for the hybrids of to-day are being replaced before our eyes by other forms, yet for these the group name will serve. The name *Nothofagus Blairii* is that of an extremely small group of the vast swarm *N. cliffortioides* × *fusca* (× *N. cliffusca*), but were the name *N Blairii* used for the whole swarm its original conception would vanish, for it would include forms having no characters in common with *N. Blairii*, as originally described, and possessing characters not known previously in the genus, *e.g* almost circular leaves with blistered surfaces.

The procedure outlined above seems to us adequate, of easy application, and helpful in revealing the parentage and history of the hybrids, whereas an arbitrary name reveals little or nothing. To one versed in the names of New Zealand plants, × *Aristotelia fruserrata* at once tells the group is *Aristotelia fruticosa* × *serrata*, whereas to apply the name × *A. Colensoi* to the group not simply tells nothing, but also actually misleads, insomuch as the 'species' *Aristotelia Colensoi* was based on a non-flowering specimen taken from a shrub some seventy years ago that is almost certain to have died some time back, and could not now be matched by any living plant.

Another matter to be considered is the citation of authors' names for hybrids, this not being fully provided for in the "Rules." Thus, if for any reason we still maintain Cheeseman's name *Ranunculus Matthewsii*—it was based on two specimens taken most likely from one individual—for a very limited portion of the large polymorphic group *R. Buchanani* × *Lyallii* we should cite it as × *Ranunculus Matthewsii* (Cheesem.) Ckn. et Allan as hyb., but by the "Rules" we need not use that name at all in moving the group it represents into a group of such a different status as a hybrid swarm.

The "Rules" demand diagnoses in Latin for hybrids as for species This is all very well for small groups made up of fairly uniform individuals, and many such diagnoses occur in systematic literature. Obviously, however, with the groups we are considering, *e.g.* × *Myrtus bullobcordata* with its hundreds of distinct forms, diagnoses of reasonable length must be vague in the extreme, and we think that this requirement should be abandoned. This, of course, does not gainsay that detailed analysis of the individuals composing the groups is imperative.

Since the whole matter is of not merely local interest, but also applies to all floras and is particularly important from the point of view of definite names for the use of students of evolution, and since some commonsense uniformity of treatment is highly desirable, we bring the subject forward in the hope of arousing discussion, so that perhaps some such procedure as we have indicated may be adopted, and suitable rules drawn up for insertion at a future revision of the "Rules." L. COCKAYNE.

Ngaio, Wellington, N.Z.

H. H ALLAN.

Agricultural High School,
Feilding, N Z.

Early Egypt and the Caucasus.

WE are grateful to Sir Flinders Petrie for constituting himself his own reporter (NATURE, Oct. 9, p. 514) in the matter of his reply to our papers at Oxford, for we had at the meeting no opportunity to cover the ground on to which he transferred the argument. On that occasion, we kept studiously to the examination of the prehistoric and the geological evidences for the Caucasian-Solutrean argument. The difficulties we indicated: (1) cultural, (2) distributional, (3) geological, were left unanswered. If Sir Flinders Petrie prefers to argue on historical ground we have here, too, certain comments to make.

The essential question is stated to be a conflict between (*a*) a 'received view,' whereby the Fayum lake gradually rose by the rise of the Nile level up to '205 or 220' feet above present lake, and (*b*) a 'new view,' whereby a high lake in the early human period was gradually dried down to the present size. In regard to this summary of the position the following comments may be apposite.

The view which is labelled 'received' was formulated in the late 'eighties; the chief contributors to the subject being Hanbury Brown, Scott Moncrieff, Cope Whitehouse, and Sir Flinders Petrie himself (as a result of his excavations of Biahmu and Arsinoe). This was long before the Fayum depression had been geologically investigated. The evidence for two lakes was undreamt of, and none of the palæontological or stratigraphical work required as a sound basis for what is primarily a geological theory was attempted, nor had these gentlemen the specialised training to do so. It was not until 1905 that H. J. E. Beadnell published the official geological memoir on the Fayum. As is usual in these official surveys, the Pleistocene received relatively little investigation, but the fact was noticed that the upper limit of the lacustrine beds occurred at 223 feet (O.D. 23 m.), and the view was expressed that this gives evidence for "a great fresh-water lake in Pleistocene and prehistoric times."

The chief authors of the 'received view' do not appear to be in agreement between themselves.

Sir Hanbury Brown writes: "There is nothing to support the theory that there has been any great change in the Nile levels since the waters first found their way into the Fayum," and he believed that the old high-level lake was controlled and artificially kept at 222 feet in XII. Dynasty times. Sir Flinders Petrie, on the other hand, believes that instead of the prehistoric lake being at a more or less constant high level, it was gradually rising, reaching a height of about 205 feet (O.D. 17 m.) in XII. Dynasty times, attaining its full maximum of 220 feet (O.D. 22 m.) in Ptolemaic times.

With regard to the 'new view' (*b*), may we point out that we found abundant evidence for the existence of two lakes, the older corresponding to the 220-foot level; the newer never exceeding a maximum of 205 feet, which was attained in prehistoric times. From this point a steady fall appears to have taken place; the Fayum industry is closely linked to its 190-foot stage and lower, thus limiting the waters of the historic period to something below this level. We should like to add, what is not clear from Sir Flinders Petrie's statement of our case, that we consider, so far as the evidence is available, that both lakes were connected with the Nile, but the nature of this connexion cannot be definitely stated until detailed investigation has been undertaken along the Lahun-Hawara channel.

Our answers to Sir Flinders Petrie's six reasons in support of his view are briefly as follows:

(1) There is no evidence as to the depth of the inlet channel. As regards the question of siltage, geologists with knowledge of modern rivers under similar natural conditions regard blockage as highly probable, and Hanbury Brown himself considered that the growth of rushes in the channel "would check the inflow, and, while preventing the rise of the lake, would favour silt deposit."

(2) Completely ignores the probability of climatic change in Quaternary times, to which the other oases bear witness.

(3) The interpretation of the name "Soknopae Nesos" is not sufficient evidence to counteract hard geological facts.

(4) Schweinfurth notes especially the abundance of ruins around the edge of the basin, and it seems probable, from topographical considerations, that the nature of the underlying ground controlled the choice of site, rather than the relation to the lake level. The partially consolidated lake deposits would give but poor foundations for the massive ancient stone buildings. It should also be noted that dynastic flints were found at levels which would have been submerged at that time according to view (*a*).

(5) Of the four stone structures regarded by Sir Flinders Petrie as quays, three lie at Qasr-el-Sagha; these are known to him by photographs only. The fourth is the termination to the long paved road leading south from Dimê Temple, evidence points to this being not earlier than the first century A.D. The three structures at Qasr-el-Sagha show rough slabs of stone capping outstanding ridges of old lacustrine beds. This accounts for their approximately uniform height. The loosely consolidated material upon which they are based would not serve as foundation for a 'quay.' We are supported in our view of them by several archæologists, who came over at our request to see them, and are emphatic that such structures could not serve as quays. Further, one of these would, on Sir Flinders Petrie's rising levels, have been an island.

(6) The value of Herodotus as a witness can be judged from the fact that his estimate of the circumference of the lake was at least 87 miles too big, supposing the water to have stood at the 220-foot level in his time.

G. CATON-THOMPSON.
E. W. GARDNER.

Bedford College, London.

The Occurrence of Helium and Neon in Vacuum Tubes.

A SHORT time ago we published (*Proc. Roy. Soc.*, A, 109, 186, 1925) an account of some attempts to confirm the observations by Collie, Patterson, and Masson (*ibid.* 91, 30, 1915) of the occurrence of helium and neon in vacuum tubes. In view of the fact that we were able to obtain small quantities of these rare gases by passing the discharge through oxygen at low pressures when a magnesium or aluminium anticathode coated with nitride was used, no trace being found in the absence of the nitride, we attributed their formation to the disintegration of the nitrogen atom. Success depended on the use of an induction coil provided with a hammer break rather than a mercury break, an observation which agrees with those made by the previous authors.

We have now carried out some further experiments which would seem to confirm our original results. In the first place, both helium and neon have been obtained by passing the discharge between a concave aluminium mirror as cathode and a magnesium anode through a mixture of oxygen and nitrogen under reduced pressure. No trace of the rare gases was formed if the discharge were passed in the opposite direction; and since in this series of experiments the two types of discharge were used alternatively, the same mixture of oxygen and nitrogen was used, and the apparatus was not changed in any way, this would obviate any possible criticism that the rare gases had their origin in an air leak.

In the second place, the rare gases are produced when the condensed discharge is passed between aluminium wire electrodes through mixtures of oxygen and nitrogen, no result being obtained in the absence of the condenser. In these experiments the character of the discharge was found to be of great importance, as the production of the rare gases depended on the length of the auxiliary spark-gap, the capacity of the condenser, and the pressure of the gases. An increase in the gas pressure necessitated an increase in the length of the spark-gap. Considerable trouble was at first met with, owing to the fouling of the mercury in the exhaust pump by ozone and active nitrogen, and this difficulty was surmounted by interposing a vessel containing boiling mercury.

In the third place, the aluminium of the electrodes was replaced by tungsten; and in view of Boomer's observation that active helium is readily absorbed by this metal (*Proc. Roy. Soc.*, A, 109, 198, 1925), we confined ourselves to the examination of the electrode splash. Little or no splashing occurred until the pressure of the nitrogen-oxygen mixture was reduced so far that the discharge tube phosphoresced strongly. After the discharge had been passed for sixty hours the electrode splash was heated, and helium and neon were obtained. In these experiments a 14-inch spark coil was used and supplied either with alternating current (110 volts, 50 cycles) or with direct current, using a mercury break. A condenser and auxiliary spark-gap were used in both cases.

Lastly, we have obtained a successful result by passing a condensed discharge between two tungsten electrodes about 1·5 inches apart in mixtures of oxygen and nitrogen at atmospheric pressure. Before use the electrodes were strongly heated in a vacuum to remove all occluded gases. After passing the discharge for sixty hours, the electrodes were strongly heated and, after removing a small trace of hydrogen, pure helium was obtained. This result is one of very few in which helium has been obtained without the presence of neon, and may be accepted as a final disproof of any contamination by air. Moreover, no rare gas was obtained with the uncondensed discharge in the same apparatus.

These more recent results would seem to establish the reality of the formation of helium and neon in vacuum tubes, and completely to confirm the original observations by Collie, Patterson, and Masson. As regards the origin of these gases, we believe that they arise from the disintegration of the nitrogen atom. Attention may be directed to the fact that hydrogen is always to be found in the residual gases along with the helium and neon, although the greatest possible care was taken to remove it from the electrodes before each experiment. At the same time it may be pointed out that in spite of all precautions it is impossible to secure the total absence of oxides of carbon. Whilst it seems very improbable that our last recorded observation at atmospheric pressure can be attributed to the disintegration of carbon, it may be mentioned that Bell and Bassett (*Science*, 56, 512, 1922) noted the presence of helium lines in the spectrum of the negative tongue of the Sperry searchlight and suggest that this gas is produced by the disintegration of the carbon atom.

E. C. C. BALY.
R. W. RIDING.

Chemical Laboratories,
University of Liverpool, September 27.

The Canadian School of Prehistory in France.

THE Canadian School of Prehistoric Research in France was started in Ottawa, Canada, in May 1925, when twelve fellows of the Royal Society of Canada were elected on a committee for the object in question. The first year's work in France under the auspices of "Les Beaux-Arts de France" in Paris, Ministry of Public Instruction, Department of Historical Monuments, etc., has just closed its labours, and the School can now be stated to have been fairly well launched and started, having gathered a rather extensive and interesting lot of materials for study and distribution to various academic and scientific centres throughout the Dominion.

The site, or *gisement*, granted by the Beaux-Arts to Canada is situated in the Dordogne district, at Combe-Capelle, near Monferrand, up the beautiful valley of the Couze river, Commune of St. Avit-Sénieur. Amongst the many problems in prehistory to be solved, there occur a number at this locality, as well as in other not distant *gisements*, including La Micoque and other Moustierian sites of the Vézère valley.

Combe-Capelle was expected to yield some information desired, and the result of the work of the Canadian School at this site, in June, July, and August, has revealed a certain amount of excellent material—especially at the base of the section examined—bearing upon some of those problems. No sensational discoveries were made in this virgin piece of excavation, but a large amount of worked-stone implements of a very primitive sort were found in four distinct layers or beds at Combe-Capelle.

Two nearly complete skeletons of a fairly large rodent (Marmota), besides isolated and fragmentary bones and teeth of bison, equus, rhinoceros (?), were added to the collections of flint or stone implements made on the spot. The work was undertaken as a careful and methodical piece of investigation under the auspices of the Beaux-Arts in order to obtain certain definite results. Very curiously and roughly shaped implements were found in all of the four layers traversed, being especially abundant in the oldest two beds. Types not hitherto much heeded, on close examination, proved to be either new or unrecorded implements made by Moustierian man as revealed in the Combe-Capelle station, exhibiting much cleverness and skill, as well as resourcefulness in the result of his industrial achievements in stone.

The type of human beings living in this very early stage of man's civilisation utilised even the simplest, rudest, or most common type of flint-flake, obtained by one or more well-directed blows given by his right hand or left hand, holding a *percuteur* or hammer, and from this flake wrought a number of fascinating shapes of instruments for his everyday use, whether it were for hunting, skinning animals, cleaning hides, building canoes, or for domestic purposes.

This ancient citizen of the Couze valley, like Moustierian man of other parts of France, of the Channel Islands, and of Great Britain, made a number of racloirs (scrapers), tranchets, blades, knives, saws, and other tools of rough, yet of intelligent workmanship. All the implements found reveal, as of to-day, two types of men: one, careful and industrious, taking an intelligent interest in his work; the other, careless perhaps and heedless of the advantage of turning out a well-made tool, satisfied with a comparatively inferior article to meet his tastes in all likelihood. There were good, fine, and well-made implements discovered at Combe-Capelle, of materials carefully chosen, carefully wrought, which any one, even a twentieth-century man, might be proud to be able to produce. Time, evidently, was not of very much consideration, and amongst the best, or carefully made tools, some must have taken quite a long time to make.

Careful study of the various types discovered at Combe-Capelle by members of the Canadian School in France remains to be made, and it is hoped that excellent results will be achieved, besides the procuring of specimens to illustrate the various epochs in the history of human civilisation, for which France is specially noted:

The Chellean Period (Chelles in Seine and Marne); the Acheulean (Somme valley): Moustierian (Vézère valley); Aurignacian (southern France and at Cro-Magnon in Les Eyzies); Magdalenian (La Madeleine, of the Vézère valley); the Azilian (Mas-d'Azil, of southern France); and the Tardenoisian (Tardenois-en-Fer)—all French stations marking the advancement and progress of humanity throughout the ages of man in Quaternary times, in the last chapter of the history of life on this planet. H. M. AMI.

London, September 25.

Liveing's Fire-Damp Indicator.

THE author of a note on p. 497 of NATURE of October 2, while giving credit to E. H. Liveing as the originator of the method of detecting and measuring fire-damp by means of an electrically heated platinum wire, wrote: "The apparatus in skilful hands would certainly measure fire-damp, but its value lay rather in its promise than in its practical utility." I desire to protest against this disparaging statement. I helped Mr. Liveing to make his original magneto-electrical machine, for this was before the days of the Faure battery or the Clowes hydrogen lamp. While all sorts of physical laboratory methods for comparing the temperatures of the two platinum helices, for example, Wheatstone bridge, etc., were considered. Liveing elected to adopt the more simple photometric device of a sliding white angle block placed between the two sources of light. When the two sides appeared equally bright the position of the block read against a scale indicated the proportion of fire-damp. This was an operation which a fireman could perform quite as quickly and easily as the usual one with a ' cap '

Not long after the development of this instrument, I went at the instance of Mr. Fletcher, of Bolton, to investigate fire-damp in his own and in some neighbouring fiery pits. Its practical utility was such that, at any place selected, about a quarter of a minute was sufficient to turn the handle, slide the block, and read the proportion from ¼ per cent., the lower limit, up to about 2 per cent. While I was in Bolton there was a minor explosion of fire-damp in a neighbouring pit, and Mr. Fletcher and I went there immediately. On reaching the place where the gas had fired the safety lamp filled with flame. On collecting gas from the roof I found it to be practically pure fire-damp, for, like hydrogen, it quenched the wire exposed to it in consequence of its greater mobility. If instead of writing " practical utility " the author had used the expression " general adoption," he would have been right. At this time the really practical man had much influence. He suspected instruments which he did not understand, and he did not want to have fire-damp found even in minute quantities where none could be detected by the usual means, and where therefore no danger existed.

C. V. BOYS.

IN my note I had no intention of disparaging the very ingenious invention of Mr. E. H. Liveing, on the contrary, I wished, while commenting on a new application of the same principle, to recall the fact that the credit of utilising the increased glow of a heated wire over which a methane-air mixture is drawn, as a measure of the methane present, is due to Mr. Liveing. Like Prof. Boys, I tested the apparatus both near working faces and in the return airways of mines which gave off fire-damp. Although I cannot claim to approach Prof. Boys's unique experience in photometric work, I had had several years' practice in comparing the illuminating power of lights—and especially of lights of different tints—and I found it possible to make concordant readings with the instrument. But my companions—men of great mining experience—did not agree with my readings, or with each other's. The impression formed by me was that the indicator was not adopted because the mine-managers thought (rightly or wrongly) the instrument allowed too much margin to the ' personal equation.'

THE WRITER OF THE NOTE.

The Imaginary Roots of Equations.

IN discussing the stability of an oscillating system, it is often necessary to know whether the period-equation has any root the real part of which is positive We proceed to show how to find out the number of such roots. Let the equation $f(x)=0$ be of degree n and let $f(iy)=u+iv$ where u and v are real. If v is of higher degree than u put $f_1(y)=-v$, $f_2(y)=u$, otherwise put $f_1(y)=u$, $f_2(y)=v$. Go through the operation of finding the G.C.M. of f_1 and f_2 with the difference that the sign of each remainder is changed before it is recorded or used as a dividend (just as in getting Sturm's Functions), and let the remainders (with changed signs) be $f_3(y), \ldots f_m(y)$. Let the number of changes of sign in the sequence $f_1, \ldots f_m$ be χ when $y=\infty$ and χ' when $y=-\infty$. Then the number of roots of $f(x)$ having their real parts positive, less the number having their real parts negative, is $\chi'-\chi$. If now there are r real roots of the common divisor $f_m(y)$ of f_1 and f_2, then $f(x)$ has $(\chi'-\chi+n-r)/2$ roots with the real part positive, $(\chi-\chi'+n-r)/2$ with the real part negative, and r purely imaginary roots.

For proof we divide f_1 and f_2 by $f_m(y)$ and $f(x)$ by the corresponding factor $f_m(-ix)$, and then find the increase in argument of $f(x)/f_m(-ix)$ on going round the positive half plane by considering its passages through $n\pi$ in the first case or $\pi/2+n\pi$ in the second. The number for the infinite semicircle is the degree of $f(x)/f_m(-ix)$, and that for the axis of y is found by reasoning very similar to that used for Sturm's Functions to be $\chi'-\chi$.

H. C. POCKLINGTON.

6 Blenheim Crescent,
Leeds.

Spatial and Time Relations in Dreams.

THE letter with regard to so-called ' mind-pictures,' printed on page 372 in NATURE of September 11, has greatly interested me because such non-volitional pictures have been very familiar to me from my childhood up. I used frequently to amuse myself by observing them, especially when in bed, just before I went to sleep, but I can bring them on by closing my eyes at almost any time. They are non-volitional in the sense that I do not knowingly control their content. So far as my consciousness is concerned, I am simply in the position of an observer. The pictures are of moving events and include landscapes with persons and animals, buildings, trees, vehicles, etc. I am totally ignorant at any one moment with regard to what may appear on the scene at the next, and the whole thing is as interesting and amusing as if I were observing an actual scene. The fact that I do not amuse myself with these pictures in my adult age as I used to do as a child, I attribute to the fact that they are mentally tiring. Their production must involve some expenditure of energy in the brain in a way of which I am ignorant.

ARTHUR E. BOSTWICK,
Librarian.

St. Louis Public Library,
St. Louis, Mo., September 30

The Influence of General Electron Displacement on the Reactivity of Conjugated Systems in the Molecules of Carbon Compounds.

IN the September issue of the *Journal of the Chemical Society*, Baker and Ingold state that the nitration of benzoic esters is being investigated at Leeds. A similar study is in progress in these laboratories, and preliminary results show, for example, that the proportion of the *m*-nitrobenzoic acid derivative obtained on nitration rises in the series $Ph.CO_2 \longleftarrow CR_3$ (R = alkyl), $Ph.CO_2.CH_3$, $Ph.CO_2 \longrightarrow CH_2 \longrightarrow C_6H_4NO_2$. This is in accordance with the writer's theoretical views (*Chemistry and Industry*, 1925, **44**, 118, 563; Allan, Oxford, Robinson, and Smith, *J. Chem. Soc*, **129**, 401, 1926; Ing and Robinson, *ibid.*, 1655), and it is anticipated that the nitration of benzoic esters (and of substituted benzamides) will afford a convenient auxiliary method for the estimation of the electron affinities of various groups. The arrows show the assumed direction of displacement of electrons, methyl benzoate being the standard of reference.

R. ROBINSON.

The University, Manchester,
October 10.

The *Discovery* Expedition.

By Dr. Stanley Kemp, Director of Research.

August 18, 1926.

The R.R.S. *Discovery* left Falmouth on October 5, 1925, and, after touching at Las Palmas and Ascension Island, arrived at Cape Town on December 20. On this passage apparatus and nets were tested, and certain defects which were found were made good. Later passages, until our return to Cape Town in June of the present year, are shown in the accompanying track-chart (Fig. 1).

We left Cape Town on January 17, delivered mails and stores at Tristan d'Acunha on January 30, and sailed for South Georgia on February 1. During the first few days very heavy weather was experienced and we were driven far out of our course by gales of almost hurricane force from the west and south-east On the passage five deep-water stations were taken. We sighted our first iceberg on February 16, and arrived at Grytviken, in Cumberland Bay, on February 20. For about two months from this date we were engaged in observations on the whaling grounds, sailing for the Falkland Islands on April 17 and arriving in Port Stanley on April 25. A short cruise was made to Falkland Sound (northern end), where whales had been reported, and on May 20 we left on the return passage, laying a course to the north-east in order to pass the reported position of two shoals. On the passage nine full stations were taken and large plankton nets were towed at intervening points. Strong westerly winds and high seas prevented us from making as many observations as we had hoped. We reached Cape Town on June 29.

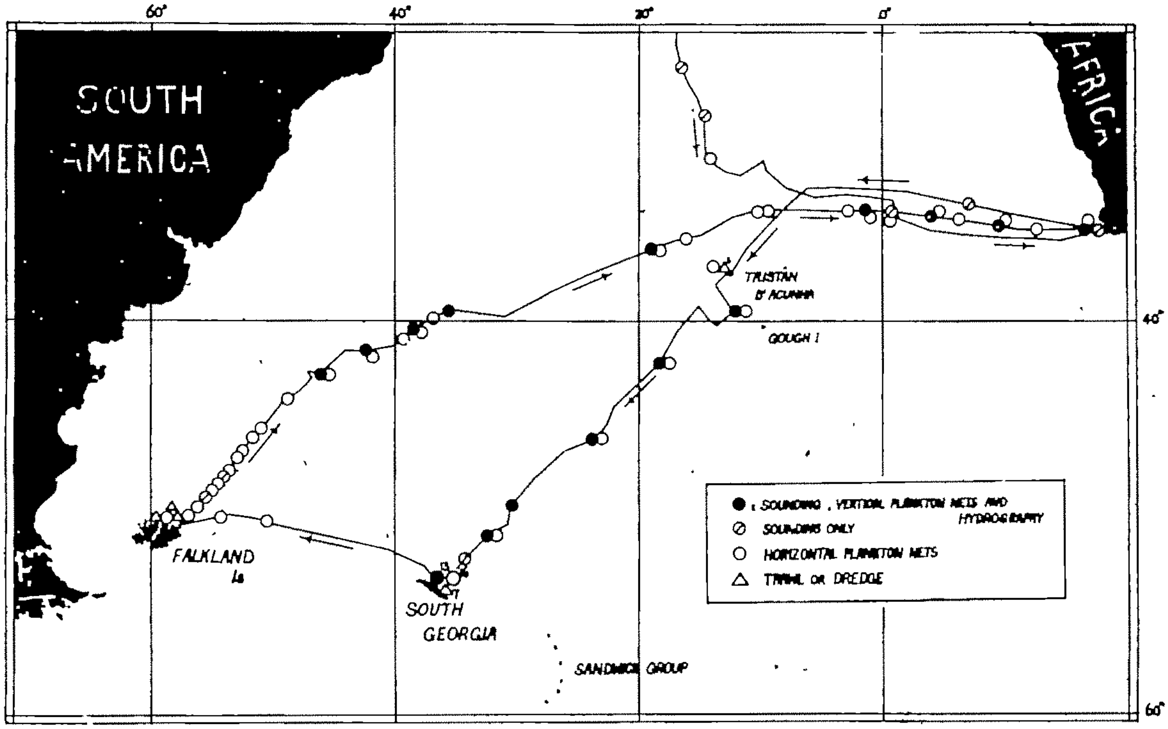


Fig. 1.—Track-chart of the R.R.S. *Discovery*, November 1925–June 1926.

An account of the *Discovery* expedition and its objects has already been published in this journal (vol. 115, 1925, p. 950), and our principal aim during the recent cruise was to carry out a biological and hydrographic survey of the South Georgian whaling grounds. In this we were largely frustrated by the bad weather which prevailed. Data of considerable interest were, however, obtained and experience acquired which will be of great value in our next attempt.

During the 1925–1926 season the whaling grounds at South Georgia were situated on the shelf on the north-east side of the island in soundings of 200 to 250 metres. In this area, at the time of our visit, Euphausian Crustacea were plentiful and *Euphausia superba*, which in our experience forms the only food of fin and blue whales, was often extremely abundant. *E. superba* is a comparatively large species, too active to be caught in vertical nets; to obtain adequate samples it is necessary to use nets towed horizontally. We have not yet sufficient material for a study of the life-history of this species. On the whaling grounds we obtained a few very early post-larval forms, while the great majority were in stages just short of sexual maturity. An Amphipod of the genus Euthemisto occurs in prodigious numbers in the same area and appears to feed almost exclusively on young Euphausians.

As regards hydrographic conditions on the whaling grounds, the most striking feature was the existence of a cold middle layer, with temperatures of about 0° C. at a depth of some 150 metres. This layer was found to within about ten miles of the shore and, as shown by observations taken on our passage from Tristan d'Acunha, extends seaward to 50° 26′ S. The salinity increased regularly from about 33·7 per thousand at the surface to 34·3 per thousand at the bottom. As might be expected, at the end of the season Diatoms were almost absent on the whaling grounds, but a dense patch of *Thalassothrix longissima* was found in 51° 55′ S. and another of *Rhizosolenia polydactyla* between South Georgia and the Falkland Islands. Phosphates showed very high values in the whaling area, the readings, expressed in mgm. per m.^{3}, varying from 102 to 108 at the surface to 183 at the bottom. Hydrogen-ion concentration varied from 8·26 at the surface to 7·96 in the lower layers.

During a short cruise to the northern end of Falkland Sound, quantities of *Grimothea gregaria* were taken. This decapod Crustacean, which is the pelagic post-larval stage of the rock-lobster, *Munida gregaria*, no doubt forms the food of the rorqual whales which periodically visit the islands.

Large midwater nets have been hauled on numerous occasions, more particularly on the passage from the Falklands to the Cape, yielding collections which should add greatly to our knowledge of the plankton of this region. Among the more interesting forms are great numbers of Diphyids, including a species with scarlet zooids, several pelagic Nemertines—one 13 cm. in length—Decapods with luminous organs belonging to the genera Sergestes, Systellaspis, Hoplophorus, and Stylopandalus, the Pteropod Schizobrachium, Thaumatolampas, and other peculiar Cephalopods, and, among the fish, Chiasmodon, Cynomacrurus, and *Stylophthalmus paradoxus*.

The Continuous Plankton Recorder has been employed on numerous occasions and has given successful records on runs which exceed 1300 miles in total length. Mr. A. C. Hardy, to whom the invention of this instrument is due, contributes an account of the apparatus and of the results so far obtained (see App. II.).

The 40-feet otter trawl was used on a few occasions in shallow water at South Georgia and off the Falkland Islands. The bottom fauna is very rich and varied, and, particularly in the former locality, quantities of Nototheniiform fish were taken. Among large collections of invertebrates special mention may perhaps be made of the ten-legged Pycnogonid *Decolopoda antarctica*, of which six individuals were obtained. Dredgings off Tristan d'Acunha resulted in large hauls of Alcyonaria and Antipatharia, and it was found that some colonies of the latter were being invaded by a small, brilliantly luminous Actinian, apparently allied to the genus Girardia.

Between the equator and Ascension Island, over a distance of some 600 miles, vast quantities of Pyrosoma were seen every night at the surface, giving a most wonderful display of luminescence, and, at a later date, not far from Cape Town, a colony of another species of this Tunicate was caught which must have been fully 8 ft. in length when intact. Patches of discoloration in the water were on one occasion found to be due to the alga Trichodesmium, on others to swarms of Salpa, in which numbers of semi-parasitic Copepods of the genus Sapphirina were obtained.

During the course of the work, 48 deep-sea soundings have been taken and an examination made in the vicinity of a reported shoal lying to the north-east of the Falkland Islands. Latterly, tests have been made with a modified form of the Nansen tube, designed to bring up cores of ooze enclosed in glass tubes. With this apparatus a core of red clay 47 cm. in length, and one of Globigerina ooze 30 cm. in length, have been secured. It is anticipated that still better results will be obtained in the future. At two points between Tristan d'Acunha and South Georgia, in 46° 35′ S. and 50° 26′ S., the bottom was found to consist of a pure radiolarian ooze, a deposit apparently hitherto reported only from the Pacific. The deep-water echo-sounding apparatus unfortunately developed defects which rendered it unserviceable, but repairs have been put in hand and it is hoped that good results will be obtained with it during the latter half of the voyage.

While at South Georgia, the coasts of which are very poorly charted, as much survey work as possible was undertaken by Lieut.-Comm. J. M. Chaplin. He made a special visit in a sailing vessel to Undine Harbour in order to fix positions at the north-west end of the island.

To shoot and haul large nets and to carry out all the operations necessary for modern oceanographic research in a barque-rigged vessel such as the *Discovery* has naturally proved to be a formidable undertaking. The results we have obtained are due in no small measure to the interest and enthusiasm shown by Commander J. R. Stenhouse, who has invariably done his utmost to render the work successful.

A second ship belonging to the expedition, the R.S.S. *William Scoresby*, has recently arrived in Cape Town. She is of the whale-catcher type, and has been designed especially for whale-marking and trawling. According to the provisional programme which has been drawn up, both vessels will be employed on the south-west coast of Africa until the middle of October, the *Discovery* in plankton investigations on the whaling grounds off Saldanha Bay and the *William Scoresby* in whale-marking. Towards the end of October the passage to South Georgia will be made, the *Discovery* taking a southerly route and skirting the pack-ice. At the end of the year the two vessels will co-operate in a survey of the South Georgia whaling grounds, the *Discovery* afterwards proceeding to the South Shetlands, while the *William Scoresby* undertakes trawling in the vicinity of the Falkland Islands. The Marine Station at Grytviken, South Georgia, will be open throughout the season. I append an account of the work at Grytviken.

APPENDIX I.

WORK OF THE MARINE STATION AT GRYTVIKEN.

By N. A. MACKINTOSH.

The Marine Station was established chiefly for investigations on whales brought to the whaling station, and work has now been in progress since February 1925.

The main problems with which the whale work is concerned fall under the following headings: (1) the specific and subspecific identity of southern whales in comparison with their northern representatives; (2) the investigation of various problems connected with the reproduction, growth, and general breeding habits of whales; and (3) the interrelations of breeding, migration, nourishment, age, adolescence, etc. Data have been obtained from 738 whales examined at South Georgia.

The routine work included under the first heading consists in the collection, by a series of measurements, of statistical records of the bodily proportions of a large number of whales and notes on a variety of external characters taken with the view of determining what characters are constant and to what extent variation may occur. In this way a large body of material has been collected for subsequent analysis. Attention has been paid to such parasites as occur, since the study of the species of external and internal parasites might be found to have a bearing on the distribution of species or communities of whales.

In regard to breeding and the subjects with which it is related, it should be pointed out that whaling at South Georgia is carried on almost exclusively during the southern summer. The indications point to the winter as the period of maximum pairing and calving, and the material so far obtained cannot therefore be regarded as complete until observations have been made which extend over the whole year. In order that these observations can be made, work is now being started in South Africa at Saldanha Bay, where whaling is carried on during the southern winter. In the meantime, some provisional conclusions can be drawn from the results obtained at South Georgia.

The type of information required relates to such problems as the time occupied by the different stages in the reproductive cycle, and the seasons at which they take place, the time required to reach sexual and full maturity, etc., and to the general reproductive potentiality of the stock of whalebone whales in southern waters. A certain amount of evidence has been obtained on a number of these points, and some indication can be given of the lines on which the investigations are developing. A study of the monthly increment in the average length of fœtal fin whales at South Georgia corroborates the theory that both pairing and parturition occur most frequently during the winter months, while the diversity of lengths of the fœtuses taken at any one time shows that the pairing and consequently the calving seasons are relatively extensive. There is evidence that parturition occurs when the fœtus has reached a length of about 6·0 metres, and the monthly average fœtal lengths suggest that this length would in general be reached about the middle of the southern winter. It does not in any case seem possible that the period of gestation can be much more or much less than a year. With regard to the frequency of the recurrence of pregnancy, the most that can be said at present is that whales probably do not become pregnant every year.

The study of the ovaries has revealed no sign of œstrus occurring between October and May, which is in keeping with the supposition that impregnation mostly takes place during the southern winter. The testes also appear to be in a quiescent condition. The inspection of the ovaries of whales taken in South African waters should be of special value in defining the pairing season more exactly.

An important point to be considered is the proportion of sexually immature whales which are killed. In the case of fin whales, about 26 per cent. are estimated to be immature, while in the case of blue whales, the ratio is so high as 58 per cent., a fact to which attention must be paid in considering the effect of the whaling industry on the general stock of whales.

A point of special interest arises from a study of the numbers of blue whales taken at different sizes. There are indications that the majority of these whales approximate to one of three different lengths, two of which represent a stage of growth at which the animal is still sexually immature. This suggests that young blue whales are inclined to visit South Georgian waters at two successive stages in their development towards maturity, living elsewhere between the stages until they grow to the next size. If they make regular annual migrations, the suggestion at once arises that the difference between the first and second sizes represents a year's growth. Then, assuming that the young are born in the warmer waters during winter and travel towards South Georgia during their first spring, it would follow that sexual maturity is reached just three years after birth. This, however, is a point which will need confirmation from a larger body of material, and it is noteworthy that no indications of the same nature have been detected in the fin whale statistics.

In regard to the estimation of the age of whales, there is some indication that the number of corpora lutea, including the traces of very old ones left in the ovaries, may be to some extent correlated with the age of the whale. The evidence is arrived at from a comparison of the length of the whale with the number of corpora lutea, and partly from the fact that blue whales, which appear to be taken in general at an earlier age than fin whales, usually have fewer old corpora lutea in the ovaries.

Several other points of interest have arisen, amongst which are the observation of a curious structure, found only in some immature female fin whales, which consists of a fleshy band bridging the entrance to the vagina, and the finding of a 24-mm. fin whale fœtus. Twin fœtuses have been found on two occasions.

Other work done at the Marine Station includes the chemical analysis of water-samples collected by the *Discovery* and investigations on elephant seals and on the bird life of the island. With the help of a motor-boat, with which the station is now provided, observations have been begun on the rich fauna of Cumberland Bay.

APPENDIX II.

A NEW METHOD OF PLANKTON RESEARCH.

By A. C. HARDY.

Hitherto our knowledge of the density and distribution of the plankton has been gained from samples taken at a number of stations within the area concerned. When, as on long cruises, the stations have to be twenty, fifty, or even a hundred or more miles apart, it may be doubted whether such samples are giving a true idea of the planktonic content of the water traversed: at one point one may strike a swarm of Copepods, or between two others miss an important zone of Diatoms. For a long time I have felt the need of an instrument which, by giving a continuous record mile by mile to scale, would enable one to study and compare the uniformity or irregularity of planktonic life in different areas, to measure the size, varying internal density, and frequency of patches, and to indicate more exactly than can be done with comparable tow-nettings whether any correlation exists between different species.

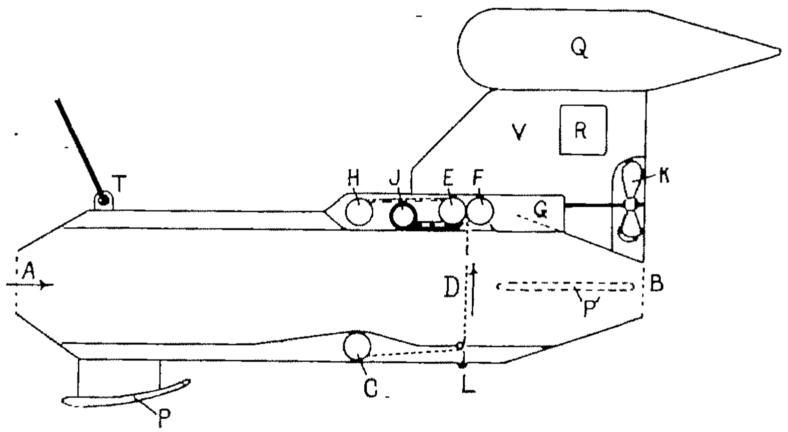


FIG. 2.—Diagrammatic section of the continuous plankton recorder.

Whilst on the *Discovery* expedition I have been experimenting with such an instrument, which I am calling the Continuous Plankton Recorder. Numerous little defects and difficulties have had to be overcome; but now that, taken together, more than 1300 miles of plankton have been recorded, it may be of interest to publish a brief description of the instrument and a note of some of the results obtained by its use. It is a development of the simple Plankton Indicator which I used in the North Sea (*Min. of Agric. and Fisheries Fishery Investigations* II, vol. 8, No. 7, 1926), but in place of the silk netting discs, which had to be reloaded for each sample, I have substituted a long continuously moving roll operated by a propeller turned by the water through which it is towed. Like the Indicator, it is used at full speed without stopping the ship.

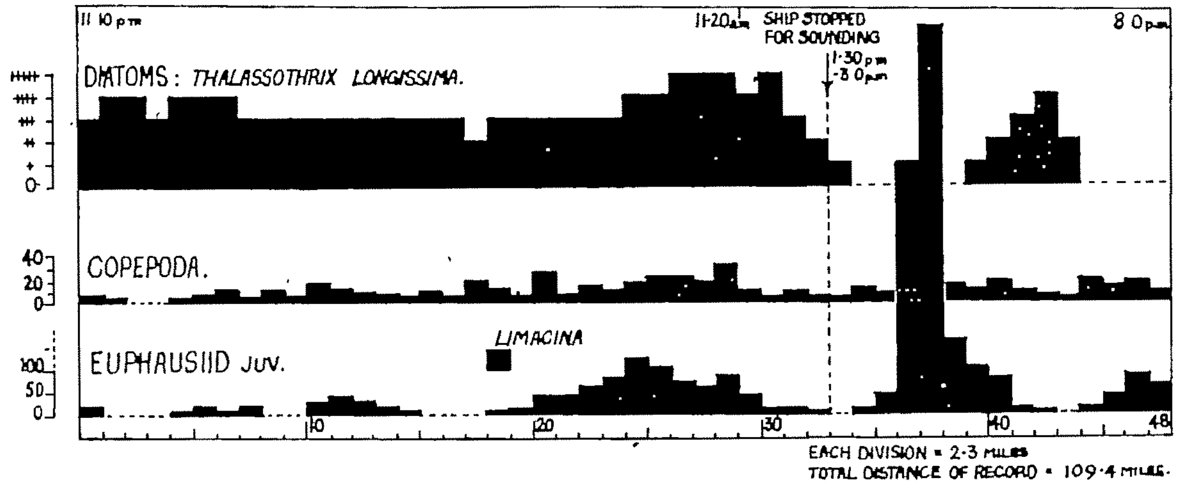


FIG. 3.—Graphic representation of continuous plankton record approaching South Georgia, February 18-19, 1926

Fig. 2 is a diagram of the instrument. It has a hollow cylindrical body tapered at each end, is weighted in front and furnished with planes P and P′, a vertical fin V with adjustable rudder R, and buoyancy chamber Q, so that when it is towed at the point T it 'flies' like a paravane in a horizontal position in the water at the required depth. I am greatly indebted to H.M.S. *Vernon*, Portsmouth, which carried out stability tests up to a speed of 16 knots and fitted the present planes and fin in place of those of my own design which proved unsatisfactory.

As the apparatus is towed, water enters through the circular opening A, passes through the cylinder and out at B. A length of silk netting, 9 inches wide and with 60 meshes to the inch, is arranged to wind off the braked roller C across the stream of water at D, where, supported behind by a gridwork of fine rollers, it catches the organisms in the water, then between the driving rollers E and F, which are of soft rubber but with hard ends gripping the edges of the silk, and so on to the storage roller H. The openings A and B, of 4 inches diameter, are smaller than that of D and approximately equal to the filtration area of the netting; a steady flow of water is thus assured, which by its pressure causes the organisms to adhere to the silk. The rollers E and F are driven through the gear-box G by the propeller K, and the storage roller H from E by a chain and friction drive, which prevents acceleration in winding due to its increasing diameter. At J, in a box, is a roll immersed in 5 per cent. formalin; this winds in with the catching roll between E and F, so preserving and separating the layers of organisms on the storage roller H. The instrument is hinged at L and made to open so that the rollers C, J, and H can be quickly taken out and replaced by others. It will be noted that the opening A is not masked by any towing bridle and cuts the water cleanly. The drawings of the instrument were prepared by Mr. M. T. Denne of

310 Regent Street, W., to whom I am indebted for a number of valuable suggestions.

Each silk-catching roll is ruled with transverse numbered lines at 6-inch intervals. Rolls up to 75 sections in length may be used. The blades of the propeller are adjustable so that each section may represent an equal distance of one or more miles as required; the distance actually travelled by the instrument is measured by the ship's log.

At the end of the record the completed roll is unwound across a glass stage with mirror below and examined section by section with a microscope; occasionally an organism may have been removed from the netting for identification. As detailed an analysis is made as may be desired or time permits, from an exact quantitative estimation of all the species to a rough estimation of the general density in different places. The specimens are sometimes damaged in the process of winding, but in nearly all cases they can be identified; in areas where the plankton is well known determination is conspicuously easy. The instrument is not intended for collecting purposes, and, having different functions, is a supplement to, rather than a substitute for, the plankton net.

Fig. 3 shows one of the records obtained; it indicates the distribution of the Diatom *Thalassothrix longissima*, the Pteropod Limacina, the Copepoda, and young Euphausians on a run of 109·4 miles, each section representing approximately 2·3 miles. In the twenty-two records so far made there is evidence of a marked variation in the density and regularity of the plankton in different oceanic regions, and various methods of comparison may be adopted. Discontinuity is expected more in coastal waters, but in mid-ocean sharply defined patches of small Salps, *S. democratica* and *S. longicauda*, Pteropods of the genus Limacina, young Ianthina, Ostracods, Copepods such as *Candacia æthiopica* and *Calanus robustior*, and young Euphausians have been demonstrated. On the other hand, Diphyids and Chætognaths, where they occur, have tended to be constant in numbers. On one occasion, by their occurrence in patches on the roll together, a relation was suspected between small Salps and the Copepod *Sapphirina angusta*; this was afterwards confirmed by living material, the latter being found to enter the former and feed upon the food collected on the endostyle.

Operations with the instrument were temporarily suspended owing to a mechanical defect; this has, however, been remedied, and I hope in the coming season that many more results may be obtained.

City and Guilds (Engineering) College.

THE Duke of York, on October 21, opened the extension of the City and Guilds (Engineering) College at South Kensington, which has been provided by the munificence of the Goldsmiths' Company at a capital cost for building of 87,000*l*. Soon after the Royal Charter was granted in 1907 to the Imperial College of Science and Technology, of which the City and Guilds College forms the engineering department, it was decided that a large extension was necessary to provide adequate equipment for engineering education and research. A site was granted for the purpose by the Commissioners of the 1851 Exhibition to the north of the old college in Exhibition Road, and Prof. Dalby, the Dean of the College, drew up a scheme for three new laboratories: (1) hydraulics, (2) structural engineering, motive power engineering and strength of materials, and (3) railway engineering. Building was commenced in 1911 and completed in 1914, the architect being Sir Aston Webb. The laboratories, one of which is top-lighted, cover an area of 32,900 square feet. Apart from the cost of the building, defrayed by the Goldsmiths' Company, Mr. Hawksley contributed 4000*l*. towards the equipment of the hydraulics laboratory, the governing body of the Imperial College expended 20,000*l*. on equipment, and the Clothworkers' Company has provided 4000*l* per annum for a number of years towards the cost of research. During the War, the buildings were occupied by the Government for war purposes, the structural laboratories, in particular, being used by the Admiralty as research laboratories.

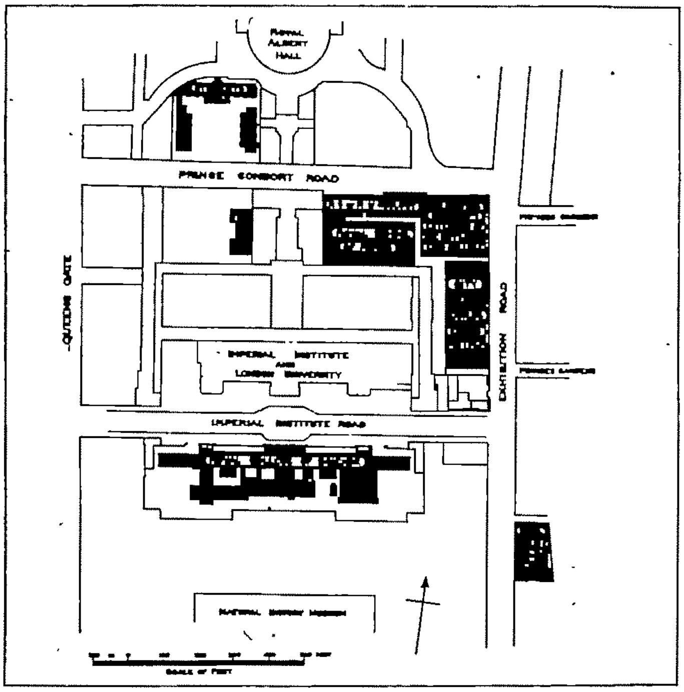


Fig. 1.—General plan of the associated buildings which have been erected on the site of the 1851 Exhibition The areas coloured black indicate the buildings of the Imperial College of Science and Technology

The main building of the extension is in the shape of a letter **L**, the short arm facing Exhibition Road and the long arm Prince Consort Road, the space in the angle being filled by the top-lighted laboratory. The façades are pleasing and well-designed, and the building forms a worthy addition to the great group of educational and public buildings for which South Kensington is famous. Equipment has been provided for the laboratories on a generous scale with the double object of training engineering students and providing for research. With the old building the new extension forms a complete unit providing undergraduate training in all branches of engineering for 500 students, post-graduate instruction for between 50 and 100 students, and opportunities for research.

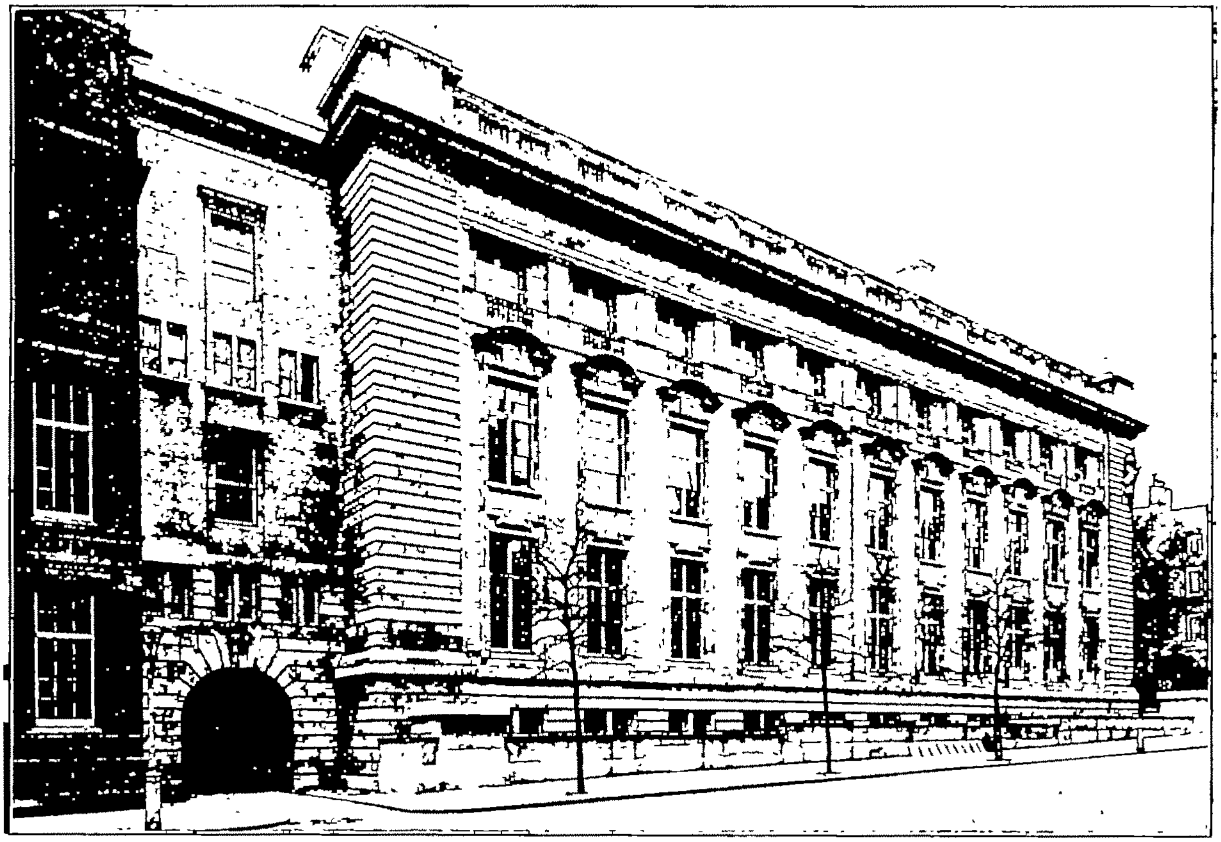


FIG. 1.—The front, facing Exhibition Road, of the Goldsmiths' Company's Engineering Extension of the City and Guilds (Engineering) College.

In the unavoidable absence of Lord Buckmaster, the chairman of the governing body of the Imperial College, the guests were received by Mr. Herbert Wright, the chairman of the Executive Committee Sir Dugald Clerk, as Prime Warden of the Goldsmiths' Company, delivered the building to Mr. Wright, representing the governing body of the Imperial College, and to Mr. Walter T. Prideaux, representing the delegacy of the City and Guilds (Engineering) College. The Duke of York, in declaring the building open, made a graceful reference to the interest which his grandfather, the late King Edward VII, had always shown in technical education The late King, then Prince of Wales, laid the foundation column of the original City and Guilds College building in 1881 and became president of the City and Guilds Institute. Three years later he opened the buildings, declaring that the college represented one of the most cherished objects his lamented father (the Prince Consort) had in view. Finally, in 1909, towards the end of his reign, King Edward laid the foundation stone of the new Royal School of Mines, adjoining the engineering extension and also forming part of the Imperial College. Throughout his life his interest in technical education, inspired by the example of his father, was sustained and enthusiastic, and he took an active part in establishing many of the institutions at South Kensington which were rendered possible by the success of the 1851 Exhibition

The completion of this great undertaking, which places London in the leading position it should occupy in engineering education and research, provides an appropriate occasion for expressing appreciation of the work of the City Guilds in the promotion of technical education. Their munificence was enlisted in the earliest days of the movement and has not been restricted to London. Mr. C. T. Millis, the historian of technical education, states that the total grants of the City companies to the City and Guilds Institute amounted to the end of 1924 to 1,122,994*l*., the Goldsmiths' Company heading the list with total grants of 204,523*l*., followed by the Clothworkers', the Fishmongers' and the Mercers' Companies. Adding contributions to other institutions, including the Universities of Leeds and Sheffield, and the East London College, he estimates that the total amount expended by the companies must have exceeded 2,000,000*l*.

Naturally, the original schemes for promoting technical education were somewhat nebulous and have suffered modification in course of time. For example, the college at South Kensington, now dedicated to the training of engineers, was originally intended for the training of teachers in diverse crafts and industries. With the lapse of time also, the Government and other public authorities have accepted an increasing responsibility for the maintenance of technical institutions; and the companies, relatively impoverished by the War and confronted by many other urgent calls for financial assistance, have shown a tendency to restrict their educational expenditure. One of the unfortunate results of this economy has been the recent closing of the Finsbury Technical College.

There is a desire also on the part of some of the companies to restrict their interest in technical education to the crafts represented by the respective companies; thus, the Clothworkers' Company has subsidised the textile department of the University of Leeds by a capital sum of 220,000*l.* and an annual grant of 4000*l.*; the Drapers' Company has devoted 20,000*l.* to scholarships for the textile industries; and the Leathersellers' Company have expended more than 20,000*l.* for a building for the Leather Tanning College.

In the early days of the technical education movement, a strong feeling was expressed by Huxley and others that part of the wealth of the city companies could be used to great advantage for the assistance of technical education. The educational deficiencies of the British workman were the first object of solicitude, and the provision of purely craft training still retains an important place in schemes of technical education. Developments in engineering, in the use of electricity, and in many other industries based on science, brought a demand for more specialised training, a demand which, in respect of civil, mechanical and electrical engineering, has been admirably met by the City and Guilds (Engineering) College.

The College has been loyally served by many distinguished professors and instructors and has rigorously maintained a high efficiency in all its work. No college can be trusted more implicitly to ensure proper standards of education and training in the award of degrees and diplomas. The College has sent out a large number of well-trained engineers to all parts of the world, and the Duke of York was well advised that he may expect to meet many City and Guilds men during his forthcoming Imperial tour. It will afford great satisfaction to all friends of engineering education that the College, thanks mainly to the generosity of the Goldsmiths' Company, has acquired this important addition to its equipment.

Obituary.

Mr. G. W. Lamplugh, F.R.S.

By the death of George William Lamplugh on October 9, British geology has lost one of its ablest exponents. Born at Driffield on April 8, 1859, he was educated at private schools, but spent the latter part of his boyhood at Bridlington, where the absorbing interest of the Yorkshire coast stimulated his natural bent for geology. Here arose a question, the answer to which was to determine the course of his future life. He had actually embarked upon a commercial career with geological work as a recreation. On one hand lay lucrative posts with the possibility of affluence; on the other, scientific research with a small competence. He considered the matter with characteristic deliberation; the possibility of affluence appealed to him not at all; he decided in favour of a life of research as soon as he was satisfied that the competence, if small, would suffice for his modest needs. In 1892 he joined the staff of the Geological Survey.

Lamplugh's first paper was published in the *Geological Magazine* in 1878 when he was nineteen years of age. In this and several papers which followed in the next few years, he described the sequence of beds which constitute the glacial drift of the Yorkshire coast, and the occurrence of marine shells, more or less fragmentary, in them. He noted also the drawn-out remains of a pond deposit crowded with the fresh-water shell *Limnæa peregra*, which occurred as lenticles in the boulder clay. At that time marine shells in the glacial drift were held by many to betoken submergence. Lamplugh then, as always, formed his own conclusions. Of the Bridlington Crag he writes that it is "probable that its great thickness and amassed appearance may have been due to the accumulating power of a huge mass of ice, which, grounding (and not, as with the smaller bergs, merely grating) on a soft bottom, would slowly continue its forward course for some distance . . . and might push before it a constantly increasing mass of sand and shells"; and again: "the movement of ice at one time on a soft sea-bottom and, at another, over the silty bed of a pond, has produced precisely similar effects." More than thirty years later I was with him and shared his excitement on seeing the process of transportation he had pictured, actually in operation in Spitsbergen.

The more important part of Lamplugh's work in those early years lay, however, in his study of the Speeton series and of his comparison of it with the Tealby series of Lincolnshire. He approached the subject from a thoroughly scientific point of view, bringing to bear an intimate knowledge of the fossils, acquired apparently and not taught, as well as detailed field-work. One of the results was to show "that in Lincolnshire, as in Yorkshire, the various species of belemnites present in the rocks afford the most natural and convenient means for classifying the strata; but that the well-defined zones which they form do not always coincide with the lithological divisions." This work attracted the attention of Prof. Alexis Pavlow, of the University of Moscow, and led to a joint paper on the correlation of the Upper Jurassic and Lower Cretaceous horizons of Speeton with their equivalents in Russia and other parts of Europe.

In 1892, as a member of the staff of the Geological Survey, Lamplugh commenced official duties which were to occupy nearly all the remainder of his life. He was entrusted soon after his appointment with the geological surveying of the Isle of Man. Except for a few weeks, during which I accompanied him for the purpose of initiating him in survey methods, he accomplished this great work single-handed. The range of problems which confronted him was prodigious, including as it did the sequence and structures of the older palæozoic rocks, the mapping of the newer palæozoic rocks and of the Trias, the great suite of igneous rocks, both contemporaneous and intrusive, an extraordinary development of glacial deposits, and lastly, mining developments that had once been of much importance. Some of these lay outside the scope of his previous experience, but on all he brought to bear a judgment founded on the deliberate and exhaustive consideration of a problem from every point of view that was characteristic of him. Incidentally, I am reminded that we disagreed on the interpretation of the small tract we mapped together. I thought that certain structures in the volcanic rocks of Scarlet Point might be attributed to the turmoil of the eruption. He took the view that they were due to subsequent overthrusting. Which was right I do not know. The Isle of Man occupied him for five years. His memoir upon it, with its wealth of records and of original observations, takes rank as a classic in modern geology.

In 1901 Lamplugh was placed, as a district geologist, in charge of the Irish branch of the Geological Survey. He remained in Dublin until that branch was transferred to an Irish Department in 1905, and during his stay took part in the mapping of the country round Dublin, Belfast, Cork, and Limerick, turning his experience of glacial phenomena to great advantage. On his return to England he served as district geologist for the Midland district and afterwards for North Wales. Administrative duties took up much of his time, but he contributed to and edited several memoirs. Later on he was engaged in surveying part of the Wealden area and became concerned with the borings which were then being made to prove the extent of the Kent coal-field. The records of the boreholes were obtainable only under much difficulty, and many of them until they were interpreted by him were unintelligible. They revealed developments of the Secondary strata that differed from any known exposures, and when accompanied by the palæontological observations made by his colleague Dr. Kitchin, threw a new light on the Secondary geology of southern England. In 1903, with the late J. F. Walker, he wrote "On a Fossiliferous Band at the top of the Lower Greensand near Leighton Buzzard." The conclusions formed were not accepted by palæontologists, on the ground that the fossils were characteristic of a higher stratigraphical horizon and could not be in place. The beds, it was argued, must have been inverted, presumably by glacial agency. Lamplugh's last paper, in the *Quarterly Journal of the Geological Society*, in 1922, was devoted to a detailed account of all the sections in which the band had been recognised. He showed that the sequence originally described by himself and Walker has invariably held good in every successive exposure and over a large area. He did not regard the palæontological evidence as conclusive, and considered the suggestion of inversion to be untenable.

It was Lamplugh's desire to continue his work on the Lower Cretaceous rocks after his retirement from the Geological Survey in 1920, but it was not long before failing health rendered it impossible. In 1914 Lamplugh had been appointed assistant director for England and Wales. He held the post until his retirement. Never could there have been a more loyal colleague than he was to me.

Lamplugh loved travelling, but always with the view of increasing his geological experience. In 1884 he visited the Eastern and Central States of North America, Vancouver, and Alaska, and went southwards to the Mexican border and as far as New Orleans. In 1893 he saw the Grand Cañon of the Colorado, and in 1897 attended a British Association excursion to Vancouver. In 1905 he made a systematic examination of the gorge of the Zambezi, below the falls. "It is difficult to believe," he writes, "that the fissure into which the river is so suddenly precipitated has been formed gradually by the action of the river itself, and not by some great convulsion during which the very crust of the earth was rent." He was able, nevertheless, to find conclusive proof that the gorge was due to the erosive action of water as the river gnawed its way back into the heart of the continent, a view that had been put forward by Molyneux. In 1910 he attended the International Geological Congress at Stockholm and took part in an excursion to Spitsbergen. There, under the leadership of Baron De Geer, we were shown not only a magnificent development of Tertiary, Secondary, and Upper Palæozoic rocks, but also shelly drift in the process of manufacture. His last trip was to Australia, for the meeting of the British Association in 1914.

Lamplugh received several honours, but, if I may say so without breach of confidence, declined some through a somewhat over-sensitive modesty. In 1891 he was awarded by the Geological Society a half of the Lyell fund in recognition of his work on the Yorkshire coast, and in 1901 he received the Bigsby medal as an acknowledgment of the value of his researches on the Speeton series. In 1925 he was awarded the Wollaston medal, the highest honour in the bestowal of the society. He became a fellow of the Geological Society in 1890, served several times on the council, partly as vice-president, and was president in 1918–20. He was elected to the Royal Society in 1905, and served on the council in 1914–16. He was for a time secretary of Section C of the British Association, and was president of the section in 1906. He was past-president of the Yorkshire Naturalists' Union, of the Hull Geological Society, and of the Hertfordshire Natural History Society, and an honorary member of several other societies.

Lamplugh's work was characterised by thoroughness of observation and by his habit of devoting prolonged consideration to a subject before forming conclusions. Though an original thinker, he never advanced a view that he was not able to support by sound evidence. He was a wide reader, mainly of a class of literature that makes no appeal to the multitude, and had acquired a critical judgment of style. In his own writing he took infinite pains to express his exact meaning, and expected this of others. As a colleague he was loyal; as a friend, lovable. A. STRAHAN.

DR. PAUL KAMMERER.

THE family Kammerer is of Saxon descent. The ancestors migrated first to Transylvania, and from there to Lower Austria and Vienna. Here Paul Kammerer's father erected a manufactory for scientific instruments. Paul Kammerer was born on August 18, 1880, studied at the University of Vienna in 1899–1904, took the degree of doctor in philosophy on June 23, 1904, and got the *venia legendi* for experimental morphology at the philosophical faculty of this same University. Having been a member of the staff of the Biologische Versuchsanstalt since its beginning (1902), he was given the post of state-adjoint when this institution was taken over by the Viennese Academy of Sciences, and remained in this post from 1914 until 1923. He then applied for his pension, and undertook lecturing tours to many European states, and twice to North America. Last year he was called to Moscow, where he was appointed to a chair in the State University and was entrusted with the erection of a laboratory for the biological department of the Moscow Academy. However, in a moment of mental depression, he deemed himself not able to undertake this task and shot himself on the Hochschneeberg, near Vienna, on September 23.

Kammerer's work will without doubt secure him a lasting place in the memory of biologists, even if some points in his papers require further elucidation and are still open to criticism. His scientific investigations were mostly published in the *Archiv. für Entwicklungsmechanik*. They apply to experimental modification of animal form, colour, and function, to their behaviour in subsequent generations, to regeneration and age, symbiosis, and the crossing of species. Kammerer's first studies were in pœcilogony or the modifiability of gestation in the same species For his discoveries of this phenomenon in *Salamandra atra* and *S. maculosa* he was awarded the Sömmering medal for the year 1909 by the Senckenbergische Naturforschende Gesellschaft in Frankfort-on-Maine. The president of this society, Prof. A. Knoblauch, had himself undertaken the task of repeating some of these experiments (*Zool. Garten*, 45, n. 11, 12, 1904). Kammerer later extended his studies on pœcilogony to Hyla, Alytes (1906), Proteus (1912), and Lacerta (1910, 1925). Summarising the results, we may say that external factors, especially temperature and moisture, may modify the reproductive process in amphibians and reptiles in such a manner as to shift it in the direction taken by other species living in localities with a corresponding climate.

For many years Kammerer was occupied with the adaptation of amphibians, reptiles, and other animals to the colour of the background. He showed that *Salamandra maculosa* is capable of changing its colour after metamorphosis according to the colour of light reaching its eyes (1913), and that this slow morphological colour-change evolves from the quick physiological colour-change in the larvæ (1922). These results, often doubted, have been confirmed from different quarters (see Przibram a. Dembowski, 1922; *A. f. Entwm.* 50, 108; Biedermann in *Ergebnisse der Biologie*, 1, 1925; MacBride, *Proc. Zool. Soc. London*, 3, 983, 1925). Succeeding several times in raising Proteus, Kammerer had the opportunity, in his experiments on pœcilogony and colour-change, to test the dependence of the eye on light, a question to which he was able to give a positive answer (1912). He also proved the restoration of the power of vision (*Pflüger's Archiv.*, 1913). The possibility that these specimens with enlarged eyes may have been mutations was later discarded even by the originator of this explanation, Jacques Loeb, in his last book, "The Organism as a Whole" (1916), as highly improbable.

Kammerer exhibited his most remarkable specimens to the Linnean Society of London, and in Cambridge, during the year 1923. The honour he was shown during his visit to England was one of his most pleasant recollections. Even if Kammerer's proof of the inheritance of acquired characteristics may be held to require confirmation, it is not too much to say that no one else has made greater advance towards the solution of this fundamental question, and that his numerous papers include several very important contributions to biological science. Results confirmatory of his views have been obtained by Dürkhen (1924) and Heslop Harrison (1925), who worked entirely independently of Kammerer, and on totally different animals. Kammerer's last paper on the origin of the island-races of Lacerta in the Adriatic (1926) is one of the finest contributions to the theory of evolution which has appeared since Darwin.

Prof. Alexander Gutbier, Rector of the University of Jena, died suddenly on October 4 at the age of fifty years. We learn from the *Chemiker Zeitung* that Prof. Gutbier was a native of Leipzig. He became professor of chemistry at the Technische Hochschule at Stuttgart in 1912, and ten years later he succeeded Prof. Knorr at Jena, where he built up an efficient modern chemical institute, in which numerous valuable researches in analytical and colloid chemistry were carried out. His own publications dealt chiefly with investigations of tellurium, selenium, and the noble metals, with atomic weight determinations, and with colloidal metals and protective colloids. He also published several works on practical chemistry.

We regret to announce the following deaths:

His Honour Sir John Bucknill, Puisne Judge of the Patna High Court, formerly editor of the *Journal of the South African Ornithologists' Union* and author of works on the birds of Surrey and of Cyprus, on October 5, aged fifty-three years.

Prof J. D. F. Gilchrist, professor of zoology in the University of Cape Town, and president in 1922 of the South African Association for the Advancement of Science, aged sixty years.

Mr. George Lewis, who devoted the greater part of his life to the study of the Coleoptera, and particularly the Histeridæ, visiting China, Japan, Ceylon, and Algiers, on September 5, aged eighty-seven years.

M. Edouard Naville, fellow of King's College, London, and a foreign associate of the Institute of France, distinguished for his archæological work in Egypt, on October 17, aged eighty-two years.

Mr. Washington A. Roebling, engineer and builder of the Brooklyn Bridge, on July 21, aged eighty-nine years.

Mr. Oberlin Smith, an authority on the pressing and stamping of metals, and a past president of the American Institute of Mechanical Engineers, on July 18, aged eighty-six years.

Mr. Charles Turner, for many years principal of the Manchester School of Pharmacy, who made many contributions to our knowledge of the freshwater algæ, on September 10, aged sixty-two years.

News and Views.

The address given by the Secretary of State for the Dominions and Colonies at the fourth session of the Imperial Conference is a further revelation of the growing popularity of scientific research as a theme for statesmen's utterances and an indication of their lost faith in ephemeral economic theories. The greater part of Mr. Amery's discourse was devoted to a survey of the problems of Empire development which await investigation and the steps which must be taken towards their solution. He announced that a very small committee has been appointed to consider what existing research organisations can do for the improvement of the production, transportation, and storage of Empire food-stuffs and raw materials required for manufacturers, what further support is necessary to make their work more effective, and what additional institutions are required He reminded the Empire premiers that the standard of work of the agricultural departments of the Colonies and of the agricultural staffs of various private companies is no credit to the Empire, and that there is need for greater support for such institutions as the Imperial College of Tropical Agriculture at Trinidad and the Amani Institute in Tanganyika, to act as training centres for agricultural staffs and as an inspiration to all agricultural departments in the tropics. Out of the fund at the disposal of the Empire Marketing Board, further support has been given to assist the work of the Low Temperature Research Station at Cambridge, probably a grant will be made to the Fruit Research Station at East Malling, and the Imperial Bureau of Entomology has been allocated a contribution to enable it to set up a special laboratory for the breeding of beneficial parasites and their distribution as required to all parts of the Empire. Mr. Amery expressed his belief that incalculable results will follow the expenditure of money derived from a fund which can be freely allocated to the vital needs of research on Empire problems.

Mr. Amery might have reminded the Empire delegates that the British Empire is on its defence in the matter of scientific research. Great Britain has assumed the responsibility for the development of the illimitable potential resources of a large part of the world's surface. It possesses some of the finest scientific investigators in the world, but hitherto our statesmen have not performed the essential function of catalysts in bringing the knowledge of the latter to bear upon the problems of the former. Several other colonial powers, notably France, Belgium, and Holland, have given more scope and encouragement to the work of their scientific researchers than Great Britain, and a former colonial power, Germany, in the comparatively few years in which it was interested in colonial development, built up a corps of research workers in every field of scientific endeavour and a chain of scientific institutions which still commands the respect of the world. Mr. Amery's speech, it is hoped, will imbue the Empire premiers and other representatives with the same enthusiasm and appreciation for the need to apply science to the problems facing them as he and his able Under-Secretary, Mr. Ormsby-Gore, already possess. Elsewhere in this issue of Nature appears the first of two articles referring to Mr. Ormsby-Gore's recently published report on West Africa, a report which can be commended to the Empire delegates for their most careful study. Therein is set forth in some detail the avoidable waste which occurs in this part of the British Empire in connexion with the production, storage, and transport of the products of the tropics, the avoidable waste of human endeavour and human life, the toll taken by insect pests on human beings, domestic stock and plants, the non-utilisation of natural resources, and the tremendous expansion of trade which would result if these problems were investigated by competent scientific workers

Both Mr. Amery and Mr. Ormsby-Gore emphasise the need for co-ordination and dissemination of the knowledge accumulated by scientific investigators, to the end that science shall be applied generally throughout the Empire to the common problems of development But neither of them realises, apparently, that the present machinery of administration is inadequate to this all-important task. Last year the Prime Minister raised great hopes by the announcement of the creation of a body charged with the responsibility of initiating research into imperial problems These hopes have not been realised. The new body, the Civil Research Committee, was modelled on the Imperial Defence Committee; its deliberations are characterised by the utmost secrecy: even its findings and its reports on subjects of general interest are not made available to the public, and it has been overloaded with irrelevant problems. No scientific man was appointed to the Committee; its work has been farmed out to *ad hoc* sub-committees possessing no powers and commanding no funds. It bears no resemblance to the body suggested by Mr. Baldwin, and later by Lord Balfour during the House of Lords debate on the Report of the East Africa Commission—the Report which gave such prominence to the need for scientific research in Empire development. Perhaps Mr. Garvin's demand in the *Observer* of October 24 for "a Great General Staff for . . . the systematic accumulation and arrangement of knowledge—a greater Domesday Book showing clearly what works, enterprises, and scientific institutions are required to make the most of the resources of the Empire in every part," may have the desired effect. Mr. Garvin might have added that it is imperative that this general staff should be composed mainly of those who have been trained in the methods of science, appreciate the aims of science, and understand its language.

In his inaugural address to the Institution of Electrical Engineers, delivered on October 21, Dr. W. H. Eccles presented a review of the present-day position of electrical industry in Great Britain, both in relation to its development and to the state of the industry in other countries. The conclusions he drew are in some respects unfavourable to British practice and he suggested certain necessary lines of advance. Dealing first with electric supply, Dr. Eccles finds for the five countries, the United States, Canada, Germany, France, and Great Britain, taking only the larger undertakings which had collectively an output of 2000 million units or more in 1925, that the output in units per kilowatt of plant installed varied from 4500 for Canada to 2110 for Great Britain and 1820 for France. The low efficiency of the British undertakings is attributed to the smallness of the machines and stations and the rigid separation of the undertakings. The chief cause of the slow development in Great Britain appears to be the neglect of the principle of intercommunication. With a few large generating stations between which there is thorough intercommunication, each in turn can take the peak of the other's load. The size of each station need not then be so great and the efficiency of the whole undertaking is enhanced. In Germany there are four great zones the power of which varies from 400,000 kilowatts to 1,500,000 kilowatts, and these zones are now being connected into one national system. Similarly in France, the United States and Italy, but in Britain the largest plant capacity is that of the London Power Company, which is about 250,000 kilowatts. The use of electricity on railways was discussed, and it was pointed out that the electrification of main lines may not lower the cost of working; its chief advantage will lie in providing national intercommunication networks and in extending electrical facilities into areas which could not otherwise be made suitable for modern factories.

It is satisfactory to note the growth in the use of electricity in the chemical and metallurgical industries pointed out by Dr. Eccles There is a marked rise in the production of aluminium. In the case of sodium, we imported from Norway 41,860*l.* worth and exported 14,000*l.* worth in 1924; in 1925 the figures are 17,000*l* for import and 28,000*l.* for export. Increases are also taking place in the production of ammonium sulphate and magnesium. Electricity in agriculture is backward in Britain. In Germany, 90 per cent of the farms have an electric supply; in America there are 700,000 farms using electricity, but in Britain only 400 farms, *i.e.* 0·8 per cent., are supplied with electricity One of the brightest points in the address refers to the export of submarine cable for telegraphy and telephony. The new type of cable loaded with permalloy (American) or mumetal (English) has rendered possible the transmission across the Atlantic of 2500 letters a minute Of the 12,000 miles of this cable which has been ordered, all but one length is from British manufacturers. The positions of the telephone, telegraph and radio manufacture and services also come under review, and two appendices give details of the imports and exports of electrical apparatus and machinery for 1912, 1913, 1923, 1924 and 1925. The third appendix gives the export figures for the United States, Great Britain, and Germany for 1913, 1924 and 1925

PERHAPS the most significant fact brought forward by Dr Eccles in his address was that referring to research and invention. Dr. Eccles has obtained statistics of the patents granted in America, Germany, and Great Britain, the three principal electrical countries. The native inventors were in the case of America 89·2 per cent. of the whole number; in Germany 77 per cent.; and in Britain, 57 per cent. Of the electrical patents in America, 13·5 per cent. are of foreign origin, and in Germany the figure is 26 per cent., in Britain 59 per cent. are foreign. This means that "in this intellectual side of industry we have a big adverse trade balance, for which, doubtless, we pay a correspondingly large annual tribute in money." Dr. Eccles insists again upon the folly of starving technical education and research, which must both be considerably extended, unless we are to "pay other nations to do the necessary brain work for us."

ON Monday last, October 25, a commercial high-speed radio telegraph service, utilising the principles of short-wave beam transmission and reception, was opened between Great Britain and Canada. This event followed the satisfactory completion of a preliminary seven days' test conducted by the General Post Office, during which the average speed of signalling was 600 letters per minute simultaneously in each direction In England the transmitting station is situated near Bodmin and the receiving station near Bridgwater, while the corresponding stations in Canada are in the neighbourhood of Montreal. The stations at each end of this communication channel are similar in design, and they utilise a straight row of vertical aerials located in front of a similar row of wires forming the reflector, the resulting radiation is thus concentrated in the form of a beam directed towards the receiver. The wave-length employed is in the neighbourhood of 100 metres, and while the transmitting power is only 20 kilowatts, the effect of the reflectors at each end is to give a very much greater received signal strength than is obtainable with the usual type of aerial arrangement. Among the advantages possessed by this beam system for long-distance radio communication are the comparatively low capital cost of erection, economy of maintenance, freedom from atmospheric interference, and the possibility of very high signalling speeds. The combination of these advantages should result in the handling of a large volume of traffic at a cheap rate. The service now opened is the first of four similar beam circuits which will link Great Britain directly with Canada, South Africa, India and Australia. The completion of these 'point-to-point' services will, together with the high-power 'world-wide' station already in operation at Rugby, place Great Britain in the forefront of commercial radio practice.

THE news that Messrs. Brunner, Mond and Co., Ltd., Nobel Industries, Ltd., the British Dyestuffs Corporation, Ltd., and the United Alkali Co, Ltd. are about to fuse their interests and form a huge chemical combination on the lines of the German Dye Trust, was not entirely unexpected, owing to recent activity in the shares of some of these companies. Rumour had mated Brunner, Mond and Co. with the

Dyestuffs Corporation, but the adhesion of the other two companies to the alliance was not anticipated. Only in July last, Lord Ashfield told his shareholders that it was more than probable that the Corporation would co-operate, and possibly consolidate, with other large chemical undertakings. On October 22 the directors of the four companies announced in the Press the proposed formation of a new company to acquire their shares and to develop their businesses and resources on broad Imperial lines. Nobel Industries already controls thirty companies largely, but not exclusively, engaged in the manufacture of explosives; and Brunner, Mond and Co. has a controlling interest in such important undertakings as Synthetic Ammonia and Nitrates, Ltd., and the Castner-Kellner Alkali Co., Ltd. The aggregate authorised capital of the associating companies is 47,500,000*l*., and their issued share capital is 38,225,714*l*. On October 22 the market value of the ordinary and deferred shares (24,918,753*l*.) was more than 40,000,000*l*.

SIR ALFRED MOND will be chairman of the new holding company, and Sir Harry McGowan, chairman of Nobel Industries, will be its president and vice-chairman. In a statement issued to the Press, Sir Alfred Mond emphasised the national and Imperial aspect of the combination. The existence of similar organisations on the Continent and in the United States has compelled the British manufacturers to combine their forces and present a united front to the rest of the world. The identity of the individual companies is not to be destroyed, but the board of the new company will act as a supervisory and connecting link between them, in finance and in policy. Modern mergers are not made to create monopolies or to inflate prices, but to achieve economy in effort and costs, and to provide insurance against market fluctuations. A combination such as that now contemplated will be able to finance, develop and explore many new potentialities in chemical industry, and so keep Great Britain in the front rank both as regards national safety and the supply of chemical products to a vast number of industries that depend upon chemistry. Few will disagree with Sir Alfred's remarks, although he did not mention certain disadvantages that sometimes result from the concentration of money and power in the hands of small groups.

ON October 22 a destructive earthquake occurred in the district of Alexandropol (or Leninakan) in Armenia. Three hundred persons were killed and twelve villages were badly damaged, but as communications in many places are interrupted, the full extent of the disaster is as yet unknown. Alexandropol is one of the most active earthquake-centres in the territory between the Black Sea and the Caspian, though it is surpassed in the frequency and severity of its earthquakes by two other centres, near Tiflis and Chemakha. On the same day three earthquakes were felt in California, only one of which was strong enough to cause slight damage. The interest of the shocks is due to their possible connexion with the San Andreas rift and the earthquake of 1906. Their centre was evidently some distance, perhaps a hundred miles, to the south of San Francisco.

SHORTLY after the announcement of the recent discovery of a skull of Pithecanthropus type at Trinil in Java (see NATURE, October 2, p. 491) private information from Washington made it appear likely that its importance had been overrated, and that the skull would not provide the data relating to the facial portion which anthropologists especially desired. Later news had not confirmed the first announcement that the skull was complete. It now appears that the find is not a skull but a cast in spongy stone of volcanic origin. Its appearance indicates that volcanic ash settled round the skull and, in time, the bone disappeared. The cast shows the frontal bone, the right and two-thirds of the left parietal bones, the upper part of the right and a little of the left temporal bones, and the supra-orbital ridge. It must be noted that the cast was not obtained *in situ* but from natives by whom it had been unearthed, so that the geological conditions of its discovery must remain in doubt. It is not easy to understand how a cast made in such circumstances, which normally would give the internal and not the external form, could show the characteristic supra-orbital ridge, but for the re-solution of this and other questions, the arrival of photographs must be awaited.

THE problem of peopling Australia is discussed by Mr. J. de V. Loder in an article in the October issue of the *Empire Review*. He quotes the late Lord Leverhulme's advocacy of black labour in tropical Australia as an opinion based solely on economic grounds, without consideration of the deeper sociological issues involved. It is not merely the desirability of excluding cheap labour that would undercut the whites, but the danger of introducing social, political, and religious ideals unacceptable to white civilisation, that are the real arguments in favour of the 'white Australia' policy. The suitability of the tropics for permanent white settlement by an increasing population has not been proved, and cannot be proved except by experiment. Modern science has done much to solve the problem, but there still remains a doubt as to the possibility of racial acclimatisation on a large scale. Mr. Loder thinks that the policy of keeping Australia for the white races is a justifiable gamble, and sees possibilities for white settlement in the hot dry regions of the north which are suited for sheep-ranching. In the hot wet regions he is less hopeful, and unfortunately for Australia these are the really productive and valuable parts of tropical Australia. In any event, there is little hope of attracting emigrants to such lands until the more temperate parts of Australia are filled.

ON October 9, H.R.H. the Duke of York opened the new X-ray Department in the Royal Infirmary of Edinburgh, which has just been completed at a cost of 52,000*l*. The new Department, which is about 160 feet long by 60 feet wide, contains a sunk basement and two floors. The basement contains a large motor generator supplying alternating current to the whole of the Department, together with X-ray transformers, main control boards, and a workshop Thus there is no moving machinery with its attendant rumble on the ground floor where all the X-ray rooms are situated (radiographic, screening and treatment). The deep therapy (250,000 volts) and superficial therapy sets are valve rectified. There are also a lecture and demonstrating hall, dark rooms, waiting and examination rooms, together with private rooms for the staff. On the upper floor, accommodation is provided for electrical and massage treatment, remedial exercises, radium treatment, and artificial sunlight treatment. Some features of the new building are designed with the view of furnishing the fullest protection for the operators against constant exposure to the X-rays. The walls are constructed of concrete slabs containing barium sulphate. These afford protection equivalent to 5 mm. of lead, as measured by the National Physical Laboratory, which has also inspected the completed Department. From the point of view of the X-ray Protection Committee's recommendations, the new Department is almost ideal, and it should prove a worthy model for future X-ray departments. The University has instituted a diploma, D.R.Edin., for which a candidate will take a suitable course in physics at the University and carry out practical work in the infirmary, the course extending over about a year.

AT the thirtieth annual meeting and annual foray of the British Mycological Society, held at Hereford on Sept. 27-Oct. 2, Dr. G. H. Pethybridge, president, gave an address on "Mycology and Plant Pathology." The British Mycological Society to some extent may be looked upon as an expansion and continuation of the activities of the Woolhope Naturalists' Field Club, which originated fungus forays more than half a century ago. The fungus flora of Britain is now fairly well worked out, and more attention might be paid to the ecology and bionomics of fungi. Tracing the development of plant pathology in Britain, we find that at one time mycology was regarded as of little or no importance in relation to the causation of plant diseases; fungi occurring in connexion with disease were regarded as the *result* of such disease, not the cause of it. Disease in plants is the consequence of disharmony between the plant and its environment. A parasite, if present, is part of the environment considered in its widest sense, and it must not be forgotten that both host and parasite are to some extent variable or unstable and that the fluctuating factors of the environment may influence the parasite as well as the host However, the parasite—most frequently a fungus—is often the most important factor in disease production. Plant pathology in Great Britain is of comparatively recent growth. The possibility of the introduction of the Colorado beetle occasioned the passing of the first Act of Parliament dealing with the protection of crops; it was extended and amplified as the Destructive Insects and Pests Act in 1907 on account of the spread of the American gooseberry mildew. A small *ad hoc* inspectorate was then inaugurated by the Board of Agriculture. The greatest stimulus to the development of plant pathology has followed from the provision by the State of greatly increased funds through the Development and Roads Improvement Funds Acts 1909 and 1910, and afterwards through the Corn Production Acts (Repeal) Act of 1921.

AN appointment to a Beit Memorial Fellowship, of the annual value of 1000*l*. and tenable for five years, is to be made for whole-time research in tropical medicine; allowances will be given for travelling and laboratory expenses. Applicants must be of European descent and of degree standing in a university of the British Empire approved by the Trustees of the fund, and must state their proposed subject of research. Forms of application, obtainable from the honorary secretary of the fund, Sir James K. Fowler, at 35 Clarges Street, London, W.1, are to be returned on or by February 1 next. This fellowship is a noteworthy addition to the opportunities for research now available, and there is no doubt that it will lead to important contributions to our knowledge of health and disease in the tropics.

THE seventeenth annual Exhibition of Electrical, Optical and other Physical Apparatus arranged by the Physical and the Optical Societies will be held at the Imperial College of Science and Technology on January 4-6. It has been decided again to include, in addition to the well-established Trade Section, a Research and Experimental Section similar to that successfully initiated in last January. The groups in this section comprise: (*a*) Exhibits illustrating the results of recent physical research and improvements in laboratory practice; (*b*) effective lecture experiments, (*c*) repetitions of famous historical experiments. Offers of exhibits should be addressed to the Secretary of the Physical Society at the Imperial College of Science and Technology, South Kensington, S.W.7, not later than November 16.

THE People's League of Health, 12 Stratford Place, Oxford Street, London, W.1, has arranged two interesting series of lectures to be delivered during November and December at the rooms of the Medical Society of London, 11 Chandos Street, Cavendish Square, W.1. One series, on November 1, 8, 15, 22, 29, December 6, 13, and 20, deals with the mind in normal and abnormal subjects, and the lecturers are Dr. E. Mapother, Dr. E. D. Macnamara, Dr. N. Hobhouse, Dr H. Crichton-Miller, Sir Maurice Craig, Sir Robert Armstrong-Jones, Dr. W. A. Potts, and Dr. A. F. Tredgold. The other series, on November 3, 10, 17, 24, December 1, 8, and 15, is on various aspects of diet and foods, and the lecturers are Dr. H. Campbell, Prof Leonard Hill, Prof. Winifred Cullis, Prof. W. E. Dixon, Dr. J. Lewis Rosedale, Prof. Hugh MacLean, and Dr. R. Ll. J. Llewellyn. The lecture hour is 6 P.M.

A LICENCE under Section 20 of the Companies (Consolidation) Act, 1908, has now been issued by the Board of Trade to the Research Association of British Paint, Colour, and Varnish Manufacturers, which has been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The Secretary of this Association is Mr. J. B. Graham, 8 St Martin's Place, London, W.C.2.

IN the short notice of "Phototopography" by Mr. A. L. Higgins which appeared in NATURE of June 26, p. 889, it was stated that ground photographs had been used for surveys in Canada but not in other parts of the British Empire. The Surveyor-General of India points out that experiments with the phototheodolite were carried out in India more than twenty-five years ago, and the method was utilised on the Mount Everest expedition The ground photographs which are being taken this year in Kashmir will be utilised in conjunction with plane-table surveys They will only cover a small area of the country. It was not the reviewer's intention to suggest that ground photo-surveying had not been tested in India or elsewhere, but that it had not been adopted for ordinary topographic surveys outside Canada.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in physics at the Royal Dental Hospital of London, School of Dental Surgery—The Dean of the School, Leicester Square, W.C 2 (November 1). A head of the department of Leather Trades of the Port Elizabeth Technical College, South Africa—G. H Penney and Co., 23 Lime Street, E.C 3 (November 8). A head of the mechanical engineering department of the L.C.C. School of Engineering and Navigation, Poplar—The Education Officer, T.1.a., County Hall, Westminster Bridge, S.E.1 (November 8). A chemist for tobacco work under the Egyptian Government—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1 (November 12). An assistant lecturer (man) on education at King's College—The Secretary, King's College, Strand, W.C.2 (November 26). A professor of archæology in the University of Edinburgh—The Secretary, University, Edinburgh (December 31). An assistant chief entomologist, an entomologist and a mycologist under the Egyptian Ministry of Agriculture—The Under-Secretary of State for Agriculture, Ministry of Agriculture, Cairo (January 1). An expert in pisciculture under the Egyptian Government—The Royal Egyptian Legation, 7 Charles Street, Berkeley Square, W.1. A lecturer in physics and electrical engineering at the Handsworth Technical School—The Principal, Handsworth Technical School. Goldshill Road, Handsworth, Birmingham. A head of the mining department of the Barnsley Technical and Mining School—The Principal, Harvey Institute, Barnsley. A technical officer in the air-worthiness department, Royal Aircraft Establishment, South Farnborough—The Chief Superintendent, R.A.E., South Farnborough, Hants, quoting A. 130).

Our Astronomical Column.

RELATIVITY AND THE DAYTON MILLER EXPERIMENTS.—The issue of the *Nineteenth Century* for October contains an article on this subject by Prof. H. Wildon Carr. The article is largely of a philosophical character and emphasises the great change that relativity has brought about in our outlook on the phenomena of the universe. Interesting parallels are drawn with the Copernican revolution, and with the birth of philosophy in ancient Greece. There is also an explanation of the theory in non-technical language Incidentally, Prof. Carr gives 5000 miles per minute as the earth's orbital speed: it should be 1110.

Referring to the system of dynamics accepted by Newton, Prof. Carr says: "It is now rejected as untrue in theory and useless in practice." This statement, however, needs qualification. The tables of the sun, moon, and planets that are still in use are based on pure Newtonian principles, save for an empirical increase in the motion of certain perihelia (adopted long before Einstein explained its cause) and an empirical term in the moon's motion (quite unconnected with Einstein). The most ardent relativist would not desire to supersede these tables, since the changes in them that would result from Einstein's law are absolutely inappreciable with our present means of observation

The close of the paper deals with Dr. Dayton Miller's repetition of the Michelson-Morley experiment, but it describes him as still adhering to the theory of an ether-drag, which diminishes with increasing altitude. Dr. Miller made it fairly clear in his lecture at the Royal Institution some months ago that he no longer holds this view. He now considers that observations at all altitudes (including the original Michelson-Morley experiment) indicate an apparent change in the velocity of light depending on the sidereal time of observation. The change is only a small fraction of the orbital speed of the earth: it was suggested that the Lorentz-Fitzgerald contraction damps down the observable effect, but does not conceal it entirely. This tends to weaken the argument drawn by Prof. Carr for the non-existence of the ether, from the difficulties which he rightly puts forward as regards an ether-drag.

SOLAR ACTIVITY DURING 1925.—An account of solar observations made at the Astrophysical Observatory of Catania is published by G. A Favaro in "L' attività del sole nell' anno 1925," in continuation of the series commenced in 1919. Observations for sunspots were made on 332 days in the year 1925, for faculæ 290 days, for prominences 194 days, and for the measurement of the height of the chromosphere on 140 days. Tables are given of the mean frequency of sunspots, faculæ, and prominences. Drawings also illustrate the chief disturbances of the year, the dates selected for sunspots being February 14, May 5, November 26, and December 27; those for prominences being February 24, June 17 and 18. The highest prominence recorded during 1925 occurred on February 24 with a maximum height of 211″, or about 153,000 km. The mean height of the chromosphere measured in the *C* line of hydrogen was 10″·9 or about 8000 km., the monthly means of the measures ranging from 10″·5 to 11″·7

It is of interest to show in tabular form the rise of solar activity since the last spot minimum in 1923 as indicated by various observations.

Observation	Place	Year 1923.	1924.	1925.
Daily sunspot frequency (groups and single spots) .	Catania	0·7	1·8	3·6
Wolfer's "Spot Numbers" .	Zurich	5·8	16·7	41·6
Daily spot areas [1] . . .	Greenwich	55	276	829
Days without spots . . .	Greenwich	171	97	19

[1] Corrected for foreshortening, in millionths of the sun's visible surface.

Research Items.

INDIAN ORIGINS.—An ingenious if highly speculative note by Mr. H. Bruce Hannah in the *Journal and Proceedings of the Asiatic Society of Bengal*, N.S., Vol. 21, No. 1, deals with the question of the approximate period of the Mahābhārata war and the ethnological affinities of the participants in it. According to the legend the war was fought between the Kūrūs and their cousins the Pāndavas The concrete historical protagonists appear to have been the Kūrūs (Dasyūs and their followers) and the Pāncha-Janāh. The Pāncha-Janāh consisted of the Pūrūs or Pauravas, Yādūs or Yādavas, Tūrvaśas, Ānūs, and Drūhyūs—all mentioned in the Rig Veda. They were probably four communities of western Asia, namely, the Philistines, the Amorites of Yādai in Nāharin, broken Hittites, and a Phallus-worshipping people called "The People of the Pillar," of Heliopolis, in Deltaic Khem, who had been driven out by Rameses III. about 1156 B.C. These were the people responsible for the introduction into India of the divine names afterwards transmuted into Indra, Mitra, etc. They settled in the Punjab, where they found aborigines and a dominant race of dark white, or perhaps semi-mongoloid, stock. These latter were the representatives of a widely diffused ancient central Asiatic people known to the rosy-blond Aryanians as Dahyūs or Tokhs, and descendants of the Kūśa or "wolf-folk." They were not, however, uncivilised, and they dwelt in cities. Possibly the culture discovered at Mohenjo-Daro and Harappa and the civilisation of Susa discovered by de Morgan are vestiges of this civilisation. As a result of the struggle between the Dasyūs and the Pāncha-Janāh about 1000 B C. in the Mahābhārata war, the Dasyūs or Kūrūs established themselves and acquired some of the culture of the Aryan Kshatriyās, evolving what has come to be known as Brāhmanism and caste. Further, it is suggested that about 4000 B.C. Dahyūs from central Asia penetrated to south India and, combining with the aborigines, founded the Dravidian race.

NEW AND LITTLE-KNOWN INSECTICIDES.—In the August issue of the *Annals of Applied Biology* (vol. 13, No. 3) Messrs. F. Tattersfield, C T. Gimingham, and H. M. Morris have a fourth contribution dealing with studies on insecticides. In the present instance they are more especially concerned with the insecticidal properties of plant materials, in the form of alcoholic extracts. Perhaps the most interesting plants with insecticidal properties are certain kinds used by natives of tropical countries as fish poisons. The roots and stems of White Haiari and the stems of Black Haiari (both species of Lonchocarpus from British Guiana), the roots of *Tephrosia toxicaria* and the leaves of *T. vogelii*, when tested as stomach poisons, all exert both a repellent and toxic action to caterpillars. The most toxic substance obtained from the Haiaris is shown to be identical with tubatoxin, the crystalline poison found in *Derris elliptica*. In the same journal Messrs. C. T. Gimingham, A. M. Massee, and F. Tattersfield discuss the toxicity of 3 : 5-dinitro-*o*-cresol and its sodium salt to the eggs of certain species of insects. The figures obtained show that these compounds have a very high toxicity to insect eggs. The 3 : 5-dinitro-*o*-cresol at concentrations ranging from 0·5 per cent. to 0·15 per cent. killed 80-82 per cent. of the eggs of the hop-damson aphis and did not injure the trees upon which the trials were carried out. These two compounds exercised a marked cleansing effect upon the bark, and it is evident, if further trials substantiate the results obtained, that such compounds afford considerable promise as winter sprays upon various fruit-trees.

LITERATURE OF SALMON FISHERIES.—In a paper recently prepared by Mr. W. J. M. Menzies (*Fisheries, Scotland, Salmon Fish*, 1925, II (Edinburgh and London: H.M. Stationery Office, 3*s.* 6*d.* net)) is given a general index to the reports and papers issued by the Fishery Board for Scotland on the subject of salmon fisheries for the years 1882–1924 inclusive. This has been arranged to contain an authors' index, a subject index, and a district index in which can be found all the published information about any particular district, river, or loch. Arranged as it is in these three divisions, the work should prove of great value

FOREST IN RELATION TO HUMUS.—Dr. W. H. Pearsall has recently reviewed (*Journ. of Ecology*, vol. 14, No 2, August 1926) a number of publications upon the Finnish forests; a comprehensive publication of similar nature upon the Swedish conifer forests and their relation to the different types of humus, by Henrik Hesselman (*Meddelanden från Statens Skogsförsoksånstalt*, Hafte 22, No. 5), has also appeared. Different types of humus covering are distinguished, and attention is directed to the importance of the agencies preventing undue accumulation of leaf debris in the permanent forest. The mobility of the nitrogen in the products of decay, during the changes undergone by vegetable remains in the humus layer, is suggested as a very important factor in forest ecology, as also the content of the humus in acid and basic buffering substances. The Swedish study covers some 330 pages, with a 40-page abstract in German.

VALUES OF SCOTS AND CORSICAN PINES.—A recent number of the Oxford Forestry Memoirs (No. 6, by W. E. Hiley), entitled "The Financial Return from the Cultivation of Scots and Corsican Pine," should prove of value to those interested in afforestation work in Great Britain. By means of financial calculations the author endeavours to show, using for convenience the general term *range of probability*, the financial advantages to be attained by planting either Scots pine or Corsican pine on suitable soils of different quality. Mr. Hiley bases his conclusions on the possibility that higher prices may rule in the future than those at present obtainable for these timbers It may be premised that Corsican pine costs more to raise in the initial stages than the Scots, and its timber is at present priced lower "The result of this investigation," says the author, "shows that on first quality plantations, if the costs of the two species are the same, except that Corsican pine costs 1*l.* per acre more to plant than Scots pine, then the financial yield from the two species will be equal if the prices obtained for Corsican pine timber are 59 per cent. of those obtained for Scots pine timber of the same size. On Quality II. sites, too, the price of Corsican pine timber would have to be about 60 per cent. of that of Scots pine to yield the same financial return. If the prices for Corsican are more than 60 per cent. of those for Scots the advantage is with the former, and if they are three-quarters, the advantages in favour of Corsican pine are very great" As a result of his study of this important matter the author considers that only under the most favourable set of conditions—cheap land, planting and cost of maintenance combined with high quality growth and a rise of prices of 1½ per cent.

per annum—could Scots pine yield five per cent. compound interest on money invested in it, and under similar conditions four per cent. on second quality soil. The possibility, of doubtful practical feasibility on large areas, of so ameliorating pine soils that they would grow more profitable conifers, for example, larch, or Douglas fir, is also considered.

UNITED STATES RIVER SURVEYS.—In recent years the United States Geological Survey has published a number of monographs on various river systems from the point of view of water supply. The same department has now issued, as Water-Supply Paper 558, a preliminary index to all existing river surveys in the United States accompanied by a map showing the drainage areas. Twelve major drainage areas are recognised as the basis of the classification adopted both by the Geological Survey and the Weather Bureau. The index is by States and rivers, with references to the drainage areas indicated on the map. Maps produced by all Government departments and various States and private bodies are included. The list, which is to be revised from time to time, forms a useful guide to the cartographic resources of the United States.

TERTIARY MARLS IN NORTH CAROLINA.—Mr. L. B. Kellum undertook the task of clearing up certain doubtful relations in the Tertiary section of North Carolina represented by the Castle Hayne and Trent Marls, through a systematic study of their faunas. The result, as set forth in the *U.S. Geological Survey Professional Paper* 143, has been to show that the Castle Mayne Marl has its strongest affinity with the Jackson horizon of the Eocene, and that the Trent Marl is of approximately the same age as the Miocene 'Silex Beds' of the Tampa of Florida. The palæontological portion occupies the greater part of the paper. The Castle Hayne fauna comprises 305 species, of which 214 are Bryozoa, and these last have been described elsewhere by F. Canu and R. S. Bassler (*U.S. Nat. Mus. Bull.* 106). The Trent Marls yielded only 26 species of Mollusca. Tables of the local distribution of all these are given with systematic descriptions, especial attention being devoted to the new species and varieties. Eleven exceedingly good plates and a useful index complete this important paper

MAGNETIC MOMENTS OF ALKALI METAL ATOMS — In the *Physical Review* for September, J B. Taylor describes a modification of the apparatus of Gerlach and Stern with which he has carried out determinations of the magnetic moments of sodium and potassium atoms. The metals were evaporated into the apparatus at 345° C. and 245° C. respectively, and the images formed by the deposition of the atomic rays on cool glass strips were rendered visible by immersing the strips in hydrochloric acid gas, whereupon films of opaque chloride were formed. Both metals were found to possess an atomic moment of one Bohr magneton, within the limits of experimental error, which were about ten per cent.

ELECTROMETERS.—The new list of electrometers and photo-electric cells issued by the Cambridge Instrument Co., Ltd., contains complete descriptions of the instruments and outlines of the theory of their action. The table of sensitivity data of electrometers given in the list will prove of special value to research workers. Taking the instruments under normal working conditions, the sensitivities of those using microscopes magnifying 8 to 12 times with eyepiece scales of 0·1 mm. are for the tilted gold leaf 100, the string 30, and the Lindemann 40 divisions per volt; for the Dolezalek quadrant 1000 mm. and the Compton quadrant 12,000 mm. per volt on a scale a metre away. These values may be varied considerably by changing the volts on plates or needle or the diameter of the suspending fibre, with corresponding changes in the time required to obtain a reading of the instrument. The photo-electric cells are of the pattern used at the Clarendon Laboratory, Oxford.

SURVEYING INSTRUMENTS.—A new catalogue (No. 541), issued by Messrs C. F. Casella and Co., Ltd., contains a description and price list of the very large number of instruments which this well-known firm is prepared to supply. There is scarcely an instrument required by the surveyor, engineer, navigator, or draughtsman which cannot be found in the catalogue. The firm invites special attention to its new Double Reading Micrometer Theodolite. This instrument is so arranged that all four micrometers and the bubble can be read without moving from the front of the instrument. Much time is saved by this device. Another new instrument to be noted is the Casella Precise Tilting Level. The spirit-level is entirely enclosed in the instrument, and is fitted with a prism, which brings the two ends of the bubble into view in the field of the telescope. By means of a slow-motion tilting screw under the telescope, the two ends of the bubble can be brought into vertical alignment, and the telescope is then level. The adjustment of the bubble is made by moving the prism longitudinally, by means of a slow-motion screw. This enables a very fine adjustment to be obtained. Messrs. Casella are willing to let out certain survey instruments on hire.

NITROGEN IN IRON-CHROMIUM ALLOYS.—In a paper on "The Effect of Nitrogen on Chromium, and some Iron-Chromium Alloys," read at the Stockholm meeting of the Iron and Steel Institute by Mr. Frank Adcock, it is shown that when chromium is melted in an atmosphere containing nitrogen, the gas is rapidly absorbed and alloys containing up to 3·9 per cent. of nitrogen are readily obtained. Hence the melting-point of the pure metal cannot be ascertained when the melt is exposed to such an atmosphere Pure iron, on the other hand, absorbs the gas slowly, and even when nitrogen is passed for thirty minutes over the surface of molten iron, 0·02 per cent only is retained. Iron-chromium alloys both in the liquid and solid states take up nitrogen at high temperatures; the quantity of nitrogen in the alloy increasing with the chromium content. In alloys containing about 12 per cent. of chromium, nitrogen gives rise to a martensitic type of structure closely resembling that usually associated with iron-carbon alloys. The hardness of these alloys can be considerably modified by heat treatment, and ranges from about 115 Brinell in the annealed state to 315 Brinell when quenched. Most of the alloys containing nitrogen in the range 20 to 60 per cent. chromium present a two-phase structure under the microscope. Although one of these constituents invariably develops a structure of the sorbitic or pearlitic type on suitable heat treatment, these changes are not accompanied by any great variation in hardness. This pearlitic or lamellar type of structure is absent from the corresponding pure iron-chromium alloys, and is thus not due to carbon. It would thus appear that the presence of nitrogen in iron-chromium alloys can give rise to structures closely resembling those generally attributed to carbon in ordinary steel. Micrographs of stainless iron often reveal a martensitic type of structure which has been difficult to explain. This work on the effect of nitrogen may reveal the cause of this structure.

The Skin Constrictor (Psychogalvanic) Reflex.[1]

By Prof. R. J. S. McDOWALL and Dr. H. M. WELLS.

THE term 'psychogalvanic reflex' has been given to the fall in the electrical resistance of the skin which occurs during mental effort or emotion. It is probable that the fall in resistance in not the sole change which occurs, but from the work of Thouliss it is evident that it is by far the greatest change concerned. Various explanations have been sought for by individuals whose interests lay in special directions and who were not fully acquainted with the literature of the subject or with the physiology of the factors concerned.

It will be shown below that the fall in resistance can readily be explained as being the result of constriction of the blood vessels of the skin. In the past, this conception has been ignored because of the fact first noted by Veraguth, that the reflex was not abolished by the cutting off of the blood to the part concerned. Since, however, it has become realised, largely as the result of the investigations of Krogh, that the peripheral vessels are independent of the blood pressure, such negative evidence carries no weight.

THE INFLUENCE OF THE CIRCULATION ON THE RESISTANCE OF THE SKIN.

In the past too little attention has been paid to this aspect of the problem. In 1924, however, Aveling, McDowall and Wells carried out a series of experiments on chloralosed or decerebrate animals in which it was found that all procedures calculated to bring about vaso-constriction in the skin, *e.g.* hæmorrhage, adrenaline and cold, caused a fall in the electrical resistance; while conditions producing vaso-dilatation, *e.g.* obstruction of the venous return, caused a rise. They found that the fall could be brought about by sensory stimulation in a decerebrate animal, thus showing the elementary nature of the reflex, and suggested that the term 'skin constrictor' reflex should be substituted. It should be stated that conclusive evidence was obtained that the change in electrical resistance was not brought about by activity of the sweat glands. This sweat hypothesis was shown to be based on ignorance of the pharmacological action of pilocarpine and atropine. It was actually shown that pilocarpine, in the sweating stage when the blood-vessels are dilated, caused a rise in resistance, although it may be preceded by a fall in the pallor stage. In this point the results of Waller were confirmed. In final condemnation of the sweat theory, it may be stated that Golla records an example of neurotic hyperidrosis in which the sweat literally dripped from the patient who gave a normal reflex. It is inconceivable that such activity would not interfere with the reflex were it due to increased glandular activity.

The work has now been further extended by Wells, who has shown in a very simple series of experiments, the details of which will be given in a forthcoming paper, that any alteration of the circulation through the skin of the hand causes a considerable change in electrical resistance, greatly in excess of that occurring in the reflex. For example, if the carbon dioxide which normally keeps up the tone of the vasomotor centre be reduced by over-ventilation, a procedure producing an obvious pallor of the skin, the fall in resistance may amount to 20-30 per cent. of the original resistance. On the other hand, if the peripheral vessels be dilated by preventing the normal venous return by compression of the arm with a sphygmomanometer cuff at a pressure of 50 to 60 mm., there is a marked rise in resistance.

It is, however, important to note that all such experiments can only be carried out if conditions, as indicated below, are such that vaso-constriction can show itself; while it is not until the subject is thoroughly accustomed to the procedure of the experiment that the effect of psychical states can be got rid of.

THE INFLUENCE OF THE CIRCULATION ON THE REFLEX.

It has long been known that in cold weather it may be very difficult to obtain the skin constrictor reflex; indeed, it is a routine procedure amongst psychologists to wash the hands in warm water in such circumstances. It is evident that if the cold causes the skin vessels to be constricted, no further constriction may be expected. Mere compression of the skin vessels by the electrodes may prevent the reflex from showing itself. There is little doubt that this accounts for the fact that it is most readily obtained from the palms of the hands and the soles of the feet, since the superficial blood-vessels in these regions are protected by a greatly thickened stratum corneum. This may readily be observed by pressing the finger on the palm and back of the hand and comparing the pressure necessary to cause an evanescent pallor. There seems little doubt that the failure to obtain a rise in resistance in blushing is due to the fact that the vessels in the face are exposed, since Wells has shown that hyperæmia of the hand, produced by plunging the hand alternately into hot and cold water, gives a marked result.

In the usual method of obtaining the reflex there is added to the pressure of the electrodes the cold due to evaporation of the saline by which they are kept moist, while the skin becomes sodden. All these factors may interfere with the appearance of the reflex.

Similarly, the reflex is abolished by drugs which cause marked dilatation and paralysis of the skin vessels, such as large doses of alcohol and atropine.

It is important also to remark that many observers who have been unable to explain the fact have noted that there is great difficulty in obtaining the reflex in patients suffering from arterial disease such as arteriosclerosis.

EVIDENCE OF VASO-CONSTRICTION DURING THE REFLEX.

It is stated by Krogh that if the ear of an unanæsthetised rabbit is observed, the occurrence of the slightest unusual sound causes the blood-vessels in that region to become constricted, while Carrier, working in the same laboratory, has recorded closure of the skin capillaries of man during a thunderstorm which caused much apprehension in the subject. Hemingway in this laboratory, using Lombard's method, has found that there is commonly a closure of the capillaries of the skin during conditions which produce the reflex. The constriction is, however, limited to certain capillaries, while others remain permanently open. To be certain of these changes it is necessary to observe a given area of skin for several days in order to be thoroughly familiar with the normal state of the region; and due precautions must be taken to prevent the capillaries being affected from other causes during the observations.

---

[1] Summary of a paper by the authors before Section I (Physiology) of the British Association, delivered at Oxford on August 5. (From the Department of Physiology, King's College, University of London.)

It would be expected from the foregoing that if the reflex is caused by vaso-constriction, there ought to be a diminution in the volume of the limb as shown by the plethysmograph. This has been thoroughly investigated by Golla, and in a Croonian lecture he states that he not only found that there was a constriction of the limb, but also that the time relations and the degree of constriction corresponded to the change in electrical resistance. We have fully confirmed these results, which may readily be demonstrated by the 'rubber glove' method.

On searching the literature the extremely interesting fact has come to light that this was the first experiment of its kind ever done by Mosso, the inventor of the plethysmograph. Mosso records that so important did he consider the experiment that he visited Ludwig in Leipzig to demonstrate it. So impressed was the 'father of physiology' by the reduction in the volume of the limb of the subject, Prof. Paglianni, that he wrote in German on the tracing "Enter the lion."

Mosso goes on to relate how the volume of the limb changed in a subject passing from 'seen' to 'unseen' Greek translation, and remarks that in such emotional constriction we have the explanation of the common saying "Cold hands and a warm heart."

Since the blood flow through the skin influences an individual's temperature sensations, a number of common sayings such as "the blood running cold," "the pallor of fright," "eat till you grow cold," may be considered to have been placed on a definite physiological basis.

Taken together with the experiments on animals, it appears clear that the reflex is a very elementary one which may be brought about without co-operation of the higher centres, as the result of sensory stimulation. It should therefore be known as the *skin constrictor reflex* and may be considered as part of the mechanism by which the animal normally adapts itself to the anticipation of muscular exercise and defence. In man it occurs not only on sensory stimulation, *e.g.* of a pin-prick, but also in anticipation of the stimulus. Here we may look upon a threatening movement as a conditioned stimulus which has developed as an effect of experience. The fact that many of the emotional stimuli affecting civilised man may bring about a reflex so closely associated with sensory stimulation physiologically and apparently teleologically, suggests that in responding to such stimuli the individual is, in a sense, defending or preparing to defend himself. The problem appears to offer an excellent line of psychological investigation.

Fuel Research.

AT the postponed annual general meeting of the Institution of Gas Engineers, commencing September 21, a number of papers were submitted, some of a professional kind, dealing with such subjects as the layout and extension of works, and the supply of high-pressure gas, while others dealt with the principles and problems of carbonisation.

Among the latter was the sixteenth Report of the Joint Research Committee of the University of Leeds and the Institution of Gas Engineers, which contained the first results forthcoming from a systematic study of the different factors which influence the results obtained in the carbonisation of coal. The first factor examined was the influence of the size of the coal particles, which was shown to exercise an appreciable influence not only on the strength and nature of the coke produced, but also on the gas yield, this latter fact being traced to a cracking of the tar, which was more pronounced with the charges made up from the smaller sizes of coal. The retort used for the process was of 'Cronite' metal supported by a complete fireclay sheath, which enabled a gas-tight apparatus to be secured working at a temperature of 1000° C. without deterioration. A carbon balance could be struck, and also a thermal balance, which confirmed the deduction previously made that the products of carbonisation contained within 2 per cent. or 3 per cent. as much potential heat of combustion as the original coal.

A paper dealing with somewhat similar subjects was submitted by Mr. T. F. E. Rhead, who described results obtained on the experimental plant of the Birmingham Corporation Gas Department. Mr. Rhead concluded by a plea for closer scientific supervision of the retorting process as essential if it is to be carried out efficiently and economically.

C. B. Marson and J. W. Cobb reported striking results which they had obtained in studying the influence of the ash constituents in the gasification of specially prepared cokes in steam and in carbon dioxide. Working on a coal containing only 1 per cent. of ash, it was found that additions of 5 per cent. of different oxides made, in some cases, great difference in the results obtained. With the same rate of steam supply, the percentages decomposed were 61 for 'pure' coke, and 82, 91, and 98 for the calcium oxide, iron oxide, and sodium carbonate cokes respectively, while the corresponding percentages of carbon dioxide in the water gas generated were 9·2, 5·4, 21·6, and 0·4 respectively. Again, the percentages of carbon monoxide found after passing carbon dioxide at the same rate through the different cokes were 6·6, 29·9, 45·6, and 89·0 for the 'pure' coke, iron oxide coke, calcium oxide coke, and sodium carbonate coke respectively, while the enhanced reactivity was also displayed by the figure for quantity in grams gasified per hour, which was more than twenty times as great for the sodium carbonate coke as for the 'pure' coke. The increased reactivity of these special cokes so tested was, in the main, due to the specific catalytic effect of the added compound, and not to the alteration in physical structure on carbonisation resulting from the addition, which was sometimes itself quite remarkable. The importance of the results in connexion with such subjects as the preparation of a free-burning carbonised smokeless fuel is obvious.

The fifteenth Report of the Joint Research Committee of the University of Leeds and the Institution of Gas Engineers was of a preliminary nature, and was concerned entirely with a careful and detailed examination of the conditions which have to be satisfied if trustworthy determinations are to be made, by the iodine pentoxide method, of any carbon monoxide produced in the use of typical gas appliances.

Another report submitted at the meeting was that of the Refractory Materials Committee, in the form of a series of papers. Among these may be mentioned papers by A. J. Dale, entitled "The Testing of Refractory Material for Resistance to Slag Corrosion and Erosion," and "The Control of Silica Brick-Making, based on Load-Test Indications," one by E. J. Vickers, entitled "The Influence of Oxidising and Reducing Atmospheres on Refractory Materials," and another by A. T. Green, continuing his work on "Temperature Diffusivities and Thermal Conductivities in relation to Silica and Fireclay Refractories."

University and Educational Intelligence.

BIRMINGHAM.—The Rev. Hilderic Friend, who recently presented his collections of earthworms to the British Museum, has now given to the biological department of the University a further collection of material, on which he has been working for thirty-six years. This material includes tubes of oligochætes (chiefly enchytræids) and water worms—some of them type specimens and quite unique. The gift also includes a valuable collection of books and MSS. and material relating to the distribution of annelids in Great Britain and Ireland.

The Alcester Rural District Council has presented to the Museum of Anatomy, as a permanent loan, a number of human skulls discovered in the course of some excavations at Alcester.

Messrs. Latch and Batchelor (Wire Rope Manufacturers, of Hay Mills, Birmingham) have offered to the Department of Oil Engineering a scholarship of 60*l.* per annum for three years, to be awarded to a candidate from one of the public schools and tenable in the Department of Oil Engineering as the Latch and Batchelor Scholarship.

Prof. W. Boulton has been elected Dean of the Faculty of Science to succeed Prof. T. Turner. Dr. F. W. Norris has been appointed lecturer in the Department of Brewing.

Prof. Keesom of Leyden lectured to a large and very appreciative audience in the Physics Department, on October 18, on the liquefaction and solidification of helium.

Messrs. Cadbury Bros. have made to the city a munificent gift of more than 150 acres of land, of which 100 acres is to be devoted to the site and grounds of a hospital. The land adjoins the site of the University at Edgbaston, so that the gift will have a far-reaching effect on the medical school of the University and will do much to solve the difficulties arising from the present geographical separation of the University buildings and the General and Queen's Hospitals.

CAMBRIDGE.—Mr. R. W. Ditchburn, Trinity, has been awarded an Isaac Newton studentship This studentship was founded for the encouragement of study and research in astronomy and physical optics.

LEEDS.—The distinction of emeritus professor has been conferred on Prof. A. G. Perkin, who has recently retired from the chair of colour chemistry.

LONDON.—Subject to the consent of the Chancellor of the Exchequer to proposals put forward by the University, the Senate has authorised definite negotiations with the Duke of Bedford for the purchase of part of the Bloomsbury site.

Dr. Percy Stocks has been appointed as from August 1 to the University readership in medical statistics tenable at University College. Dr. Stocks was educated at Manchester Grammar School (1901–1907) and King's College, Cambridge (1907–11). In 1911 he obtained a medical scholarship at the University of Manchester. Recently he has been medical officer to the Galton Laboratory (1921–26) and also lecturer in vital statistics and epidemiology at University College since 1924. His published work includes several papers on the inheritance of bodily deformity published in *Biometrika* and the *Annals of Eugenics*, and a work entitled "Blood Pressure in Early Life" (Cambridge University Press, 1924).

Dr. C. H. Lobban has been appointed as from August 1 to the University readership in civil engineering tenable at King's College. He studied at Glasgow Technical College and the University of Glasgow. After works experience he became demonstrator in engineering at Glasgow, and later lecturer in engineering at Manchester; he was professor of civil engineering at the University of Madras from 1908 until 1910. Since 1920 he has been lecturer in civil engineering at King's College, London, and has also been consulting engineer in connexion with several important buildings in London and Nottingham. He is the author of a series of seven articles on "Railway Engineering" (1920).

Dr. H. T. Flint has been appointed as from January 1 to the University readership in physics tenable at King's College. He is a graduate in mathematics and physics of the University of Birmingham. Since 1920 he has been a recognised teacher of physics at King's College, London. His published work includes papers on the theory of relativity, and on four-dimensional vector analysis in the *Phil. Mag*, "A Generalized Vector Analysis with Applications to Electrodynamical Theory" (*Proc. Roy. Soc.*, A, 1925), and "Text-Book of Advanced Practical Physics for Students" (Methuen).

A free public lecture on "Recent Developments in Cosmical Physics" will be delivered by Dr. J. H. Jeans at University College on Tuesday, November 9, at 5 o'clock. No tickets will be required.

NOTICE is given by the Royal College of Surgeons of England that the Thomas Vicary lecture will be given at the College at 5 o'clock on Thursday, November 4, by Prof. G. Elliot Smith, who will take as his subject "The Significance of Anatomy." The Bradshaw lecture will be given on Thursday, November 11, at 5 o'clock, by Mr. E. W. Hey Groves. The subject will be "Reconstructive Surgery of the Hip Joint."

THE Northampton Polytechnic Institute, situated at the Islington end of Clerkenwell, offers in its "Announcements, Educational and Social, for the Session 1926–27" a wide variety of courses In engineering, full-time courses extending over four years are provided on the 'sandwich' system, students in their first year attending the Institute during each of the three terms, whilst for the second and third years they attend during the first two terms only and spend the remaining five months of each year in the works of industrial firms or, when necessary, abroad. Specialisation begins with the third year, when students choose between civil, mechanical, aeronautical, electrical, and radio engineering. The Department of Applied Optics caters for (1) optical engineers, optical instrument makers, and optical glass workers, this work being co-ordinated with advanced classes conducted at the Imperial College of Science; (2) ophthalmic and dispensary opticians. A Horological Department under the direction of an advisory committee representing the British Horological Institute, the Worshipful Company of Clockmakers, and the governing body of the Institute provide a full-time one-year course designed to attract members of the trade from all parts of the country. Other subjects in which instruction is provided, mainly in the evening, are telegraphy and telephony, industrial chemistry, electro-chemistry, furriering, and domestic subjects and women's trades. Grants-in-aid are received from the Skinners' and Saddlers' Companies. Students are actively encouraged to participate in the social and recreative activities of the Institute, the plant for which includes a 100-ft. swimming-bath and 14 acres of playing-fields.

Contemporary Birthdays.

Oct. 31, 1872. Sir E. J. Russell, F.R.S.
Nov. 1, 1857. Prof. John Joly, F.R.S.
Nov. 1, 1876. Capt. Henry P. Douglas, R.N.
Nov. 4, 1855. Prof. Frederick Orpen Bower, F.R.S.
Nov. 5, 1876. Prof. Harold B. Fantham.
Nov. 5, 1848. Dr. James W. L. Glaisher, F.R.S.

Sir **John Russell** was born at Frampton, Gloucestershire, and educated at Aberystwyth and the Victoria University, Manchester. Head of the chemical department, Wye Agricultural College, from 1901 until 1907, he afterwards joined the staff of the Rothamsted Experimental Station (Lawes Agricultural Trust), succeeding Sir Daniel Hall in 1912 as director. Sir John is the author of important works on general agricultural science, and on soil biology.

Prof. **John Joly**'s scientific career has throughout been connected with the University of Dublin. Early he was a demonstrator there of civil engineering and afterwards of experimental physics, while for the past twenty-nine years he has occupied the chair of geology and mineralogy. Since 1901 Prof. Joly has been one of the editors of the *Philosophical Magazine*. President of Section C (Geology) at the British Association's Dublin meeting in 1908, he gave an address on "Uranium and Geology." The Royal Society awarded him a Royal medal in 1910 for his researches in physics and geology. Later the Geological Society allotted him its Murchison medal in recognition of his inquiries respecting the thermal properties of minerals, the relations of radioactivity to geology, and age correlations of the earth. Prof. Joly has made important contributions to the subject of colour photography; also to the theory of biological processes, such as the ascent of sap in vegetation. He is Hon. LL.D. Michigan University.

Capt. **Douglas**, hydrographer of the Navy since 1924, was engaged in Admiralty survey work from 1897 until 1910; afterwards he was Superintendent of Charts. He is the inventor of various appliances used in navigation.

Prof. **Bower**, emeritus professor of botany in the University of Glasgow, was born at Ripon. Educated at Repton, he graduated at Trinity College, Cambridge. Following teaching work in botany at the Royal College of Science, South Kensington, lasting until 1885 (the courses were held in Huxley's laboratory), Prof. Bower removed to Glasgow. In 1909 he was awarded the Linnean Society's gold medal, and in the following year the Royal Society allotted him a Royal medal, both in recognition of distinctive and unremitting services to botanical science.

Prof. **Fantham** was educated at King Edward's School, Birmingham, the Mason College there, University College, London, and Christ's College, Cambridge. Sometime lecturer in parasitology at the School of Tropical Medicine, Liverpool, he became demonstrator in biology at St. Mary's Hospital Medical School, London, and afterwards went as assistant to Prof. Nuttall at Cambridge. In 1917 he was appointed to the chair of zoology in the University of the Witwatersrand, South Africa.

Dr. **Glaisher** was born at Lewisham. Educated at St. Paul's School, he passed into Trinity College, Cambridge (of which he is a fellow), graduating second wrangler. Author of many original papers in pure mathematics, and editor of two mathematical journals, the Royal Society awarded him its Sylvester medal in 1913. Dr. Glaisher has been twice president of the Royal Astronomical Society.

Official Publications Received.

BRITISH AND COLONIAL.

Western Australia. Annual Progress Report of the Geological Survey for the Year 1925. Pp. 37+7 plates. (Perth: Fred. Wm. Simpson.)

Publications of the Dominion Astrophysical Observatory, Victoria. Vol. 3, No. 9. The Velocity Curves of 12 Lacertae and the Radial Velocities of 48 Stars. By William H. Christie. Pp. 209-223. Vol. 3, No. 10: Four Double-Lined F-Type Spectroscopic Binaries. By W. E. Harper. Pp. 225-245+1 plate. Vol. 3, No. 11: Three Spectroscopic Binary Orbits. By J. S. Plaskett. Pp. 247-264. Vol. 3, No. 12: The Orbits of Two Double-Lined Spectroscopic Binaries. By W. E. Harper. Pp. 265-273. (Victoria, B.C.)

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 21st October 1926. Pp. 42. (Newcastle-upon-Tyne.)

India: Live-Stock Statistics, 1924-25. Report on the Second Census of Live-Stock, Ploughs and Carts in India, held between December 1924 and April 1925. Pp. 8. (Calcutta: Government of India Press.) 2 annas; 3d.

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein), for the Year ending 31st December 1925. Pp. 24. (Kirstenbosch, C.P.)

Animal Breeding Research Department, the University, Edinburgh. Report of the Director for the Year April 1st 1925 to March 31st 1926 (being the 5th Annual Report). Pp. 28. (Edinburgh.)

The National Institute for Research in Dairying: Its Work and Needs. By the Staff of the Institute. Pp. 52. (Shinfield, Reading.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 25: Photo-electric Measurements of Illumination in relation to Plant Distribution, Part 1. By Dr. W. R. G. Atkins and Dr. H. H. Poole. Pp. 277-298. (Dublin: Royal Dublin Society; London: Williams and Norgate, Ltd.) 2s.

FOREIGN.

Sitzungsberichte der Physikalisch-medizinischen Sozietät zu Erlangen. Herausgegeben im Auftrag der Sozietät von Oskar Schulz. 56 und 57 Band, 1924, 1925. Pp. xx+404. (Erlangen.)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 17, Part 2. Contributions to the Knowledge of Abscission and Exfoliation of Floral Organs. By Prof. Isawo Namikawa. Pp. 63-131. Vol. 18, Part 2: Erster Beitrag zur Ichneumoniden Japans. Von Toichi Uchida. Pp. 43-173+Tafeln 6-10. (Sapporo.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 350: Report on the Readjustment of the First-Order Triangulation Net of the Western Part of the United States. By Oscar S. Adams. Pp. 9. (Washington, D.C.: Government Printing Office.) 5 cents.

The Institution of Electrical Engineers. List of Corporate Members, and of Non-Corporate Members (Graduates, Students and Associates) of the Institution, including a List of Names arranged Geographically. (Corrected to 1st September 1926.) Pp. 367. (London.)

List of Members of the Institution of Civil Engineers. Addresses corrected to 1 July 1926. Pp. 315. (London.)

The Institution of Mechanical Engineers. List of Members, 1st May 1926. Pp. 438. (London.)

Publication No. 586: Recent Improvements in the Design and Construction of Surveying Instruments. Pp. 11. (London: Cooke, Troughton and Simms, Ltd.)

Wild-Barfield High-Temperature Electric Furnaces for the Heat Treatment of High Speed Steel and General Purposes requiring Temperatures up to 1400° C. (Section K.) Pp. 8. (London: Automatic and Electric Furnaces, Ltd.)

Photo-micrographic Apparatus and Accessories. (Reference: Mikro 401.) Pp. 107. (London: Carl Zeiss (London) Ltd.)

Publication No. 1: Astronomical and Optical Instruments. A History of the Foundation of the Company and of its Achievements in the British Optical Industry. Pp. 48. (Newcastle-on-Tyne: Sir Howard Grubb, Parsons and Co.)

Diary of Societies.

SATURDAY, October 30.

Institute of Metals (North-East Coast Local Section, jointly with Institute of British Foundrymen) (at Neville Hall, Newcastle-upon-Tyne), at 6.15.

Royal Society of Medicine (Study of Disease in Children Section) (at Children's Hospital, Birmingham).

MONDAY, November 1.

Royal Institution of Great Britain, at 5.—General Meeting.

Royal College of Surgeons of England, at 5.—C. H. Shattock: Demonstration of Scrotal Tumours.

Society of Engineers (at Geological Society), at 5.30.—Miss A. Ashberry: Some Products of a Small Machine Shop.

Child-Study Society (at Central Hall, Westminster), at 6.—Sir M. E. Sadler: Sandford and Merton.

Institution of Automobile Engineers (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—G. F. Mucklow: The Effect of Reduced Intake-Air Pressure and of Hydrogen on the Performance of the Slow-speed Solid Injection Engine.

Aristotelian Society (at University of London Club), at 8.—Prof. C. Lloyd Morgan: Objects under Reference (Presidential Address).

Society of Chemical Industry (London Section) (at Chemical Society), at 8.—Dr. H. Drake-Law: Artificial Colours used in Foodstuffs.

Royal Institute of British Architects, at 8.30.—Presidential Address.

Tuesday, November 2.

Royal Society of Arts (Dominions and Colonies Section), at 4.30.—Sir Stanley Bois: The Importance of Rubber in Economic and Social Progress.

Royal Institution of Great Britain, at 5.15.—Dr. G. W. C. Kaye: The Acoustics of Public Buildings (Tyndall Lectures) (1)

Mineralogical Society (Anniversary Meeting), at 5.30.—Dr. L. J. Spencer, with a Chemical Analysis by E. D. Mountain: Schultenite, a New Mineral, from South-West Africa.—Dr. L. J. Spencer, with a Chemical Analysis by E. D. Mountain: Aramayoite, a New Mineral, from Bolivia.—Miss Kathleen Yardley: (*a*) X-ray Examination of Aramayoite, (*b*) The Structure of Baddeleyite and of Prepared Zirconia.—W. Binks: The Crystalline Structure of Zircon.

Zoological Society of London, at 5.30.—Col. S. Monckton Copeman: Exhibition of Photographs of the Nest and Eggs of a Californian Humming-Bird.—Dr. G. M. Vevers: Report on a Hippopotamus recently born in the Society's Gardens.—H. B. Cott: Observations on the Life-Habits of some Batrachians and Reptiles from the Lower Amazon; and a Note on some Mammals from Marajó Island.—W. E. Le Gros Clark: On the Anatomy of the Pen-tailed Tree-Shrew (*Ptilocercus lowii*).—O. W. Richards and G. C. Robson: The Land and Freshwater Mollusca of the Scilly Isles and West Cornwall.—M. A. Smith: The Function of the 'Funnel' Mouth of the Tadpoles of Megalophrys, with a Note on *M. aceras* Boulenger.

Institution of Electrical Engineers (North-Western Centre) (at 17 Albert Square, Manchester), at 7.—W. J. Medlyn: Chairman's Address.

Royal Photographic Society (Pictorial Group), at 7.

Institute of Metals (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. L. Aitchison: Light Alloys.

Röntgen Society (at British Institute of Radiology), at 8.15.—Dr. N. S. Finzi: Research in Radiology.

Wednesday, November 3.

Electrical Association for Women (at 15 Savoy Street), at 3.—W. C. Jeary: The A B C of Electric Lighting (Lecture).

Philosophical Society of England (at 128 Piccadilly), at 4.30.—W. Pavitt: Birth Stones and their Talismanic Virtues.

Geological Society of London, at 5.30.—S. S. Buckman: Jurassic Chronology. III. Some Faunal Horizons in Cornbrash.

Institution of Electrical Engineers (Wireless Section), at 6.—Prof. C. L. Fortescue: Inaugural Address.

Institution of Heating and Ventilating Engineers (at Caxton Hall), at 7.—W. R. Fretwell: Small Hot-Water Supply Systems.

North-East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—N. G. B. Thomson: The Trend of Technical Progress in Relation to the Design and Construction of Ships.

North-East Coast Institution of Engineers and Shipbuilders (Middlesbrough Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—C. T. S. Arnott: Electricity as applied to Iron and Steel Works and Mines.

Society of Public Analysts and other Analytical Chemists (at Chemical Society), at 8.—Dr. W. R. Schoeller and C. Jahn: Investigations into the Analytical Chemistry of Tantalum, Niobium, and their Mineral Associates. VI. The Precipitation of the Earth Acids by Sodium Compounds.—A. E. Parkes: A Simple Method of Testing for the Presence of Sulphites in Foods.—J. W. H. Johnson: A Critical Review of the Methods of Analysing Waters, Sewages, and Effluents, with Suggestions for their Improvement.

Institution of Chemical Engineers (at Royal Society of Painters in Water Colour), at 8.30.—Annual Reception.

Royal Microscopical Society (Biological Section).

Thursday, November 4.

Royal College of Physicians of London, at 5.—Dr. F. G. Crookshank: The Theory of Diagnosis (Bradshaw Lecture).

Royal College of Surgeons of England, at 5.—Prof. G. Elliot Smith: The Significance of Anatomy (Thomas Vicary Lecture).

Royal Institution of Great Britain, at 5.15.—Sir T. W. Edgeworth David: Antarctic Exploration Past and Future (1).

Child-Study Society (at Royal Sanitary Institute), at 6.—Mrs. H. L. Holland: Religion and the Child.

Institution of Civil Engineers (Birmingham District Association) (at Chamber of Commerce, Birmingham), at 6.—H. H. Humphries: Chairman's Address.

Institution of Electrical Engineers, at 6.—J. R. Beard and T. G. N. Haldane: The Design of City Distribution Systems, and the Problem of Standardisation.

Institution of Automobile Engineers (jointly with Royal Aeronautical Society) (at Royal Society of Arts), at 7.—G. F. Mucklow: The Effect of Reduced Intake-Air Pressure and of Hydrogen on the Performance of the Slow-speed Solid Injection Engine.

Society of Chemical Industry (Bristol Section) (at Bristol University), at 7.30.—Dr. Bush: (Paper by).

Chemical Society, at 8.—Dr. C. K. Ingold and P. G. Marshall: The Structure of the Benzene Nucleus. Part V. Some Meso-derivatives of Anthracene.—W. Wardlaw and R. L. Wormell: The Isomerism of Molybdenyl Monochloride.—R. F. Hunter: The Unsaturation of Heterocyclic Ring Systems. Part I. The Benzthiazole and 1:2 Dihydrobenzthiazole System.—R. F. Hunter and H. Morland: The Unsaturation of Heterocyclic Ring Systems. Part II. The 2-imino 4-keto Tetrahydrothiazole System.—G. M. Dyson, H. J. George and R. F. Hunter: The Inhibitory Effect of Substituents in Chemical Reactions. Part I. The Reactivity of the Nitrogen Atom in Substituted Arylamines.

Institute of Metals (London Local Section) (at Royal School of Mines), at 8.—Dr. A. G. C. Gwyer: The Structure and Properties of the Aluminium-Silicon Alloys.

Institution of Mechanical Engineers (at Manchester).—H. L. Guy: The Value of Increased Steam Pressure for Power Generation.

Friday, November 5.

Royal Astronomical Society (Geophysical Discussion), at 5.—Capt. H. Shaw and E. Lancaster-Jones: The Eötvös Gravity Balance (Chairman—Sir Henry Lyons).

Institution of Mechanical Engineers, at 6.—Prof. E. G. Coker: Elasticity and Plasticity (Thomas Hawksley Lecture).

Society of Chemical Industry (Manchester Section) (jointly with Manchester Sections of Institute of Chemistry and Society of Dyers and Colourists and Manchester Literary and Philosophical Society) (at Manchester), at 7.—Dr. L. Lilienfeldt: The Chemistry of Cellulose.

Royal Photographic Society (Pictorial Group), at 7.—J. G. Harper: (Address).

Photomicrographic Society (at 4 Fetter Lane), at 7.—Capt. J. W. Bampfylde: The Investigation of Failures in Steel Material.

North-East Coast Institution of Engineers and Shipbuilders (Graduate Section) (jointly with Institution of Electrical Engineers) (at Newcastle-upon-Tyne), at 7.15.—A. Robinson: Recent Methods of Measurement.

Junior Institution of Engineers, at 7.30.—R. Lowe: Steel Castings and their Relation to Mechanical Engineering.

Saturday, November 6.

Royal Institution of Great Britain, at 3.—Rev. E. M. Walker: The Study of History (1).

PUBLIC LECTURES.

Saturday, October 30.

Horniman Museum (Forest Hill), at 3.30.—Miss M. A. Murray: Seed-time and Harvest in Ancient Egypt.

Sunday, October 31.

Guildhouse (Eccleston Square), at 3.30.—Prof. H. H. Turner: The Fight against Fear.

Monday, November 1.

Gresham College, at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on November 2, 3, and 4.)

Royal Society of Arts, at 8.—Sir Robert Greig: Deficiency Diseases of Animals in Relation to Public Health (Chadwick Lecture).

Wednesday, November 3.

Royal Institute of Public Health, at 4.—Dr. H. M. Vernon: Ventilation in Relation to Health.

Thursday, November 4.

King's College, at 5.30.—J. E. Barnard: The Application of Microscopical Methods to Medical Research.

University College, at 5.30.—P. Hopkins: The Motivating of Conduct.

Friday, November 5.

King's College, at 5.30.—Prof. W. T. Gordon: Swiney Lectures on Geology. (Succeeding Lectures on November 8, 12, 15, 19, 22, 26, 29; December 3, 6, 10, and 13.)

Saturday, November 6.

Horniman Museum (Forest Hill), at 3.30.—C. Daryll Forde: Weather Forecasts and the Weather.

Sunday, November 7.

Guildhouse (Eccleston Square), at 3.30.—Dr. W. H. Eccles: The Influence of Wireless on Modern Life.

CONGRESSES.

October 30.

Regional Survey Conference (at Royal Society of Arts), at 10 A.M.

October 30 to November 11.

Pan-Pacific Science Congress (at Tokyo).

November 4 to 7.

Journées médicales de Montpellier (at Montpellier).

November 15 to 18.

International Conference on Bituminous Coal: New Developments in Utilisation (at Pittsburgh).—Dr. F. Bergius: The Transformation of Coal into Oil by Means of Hydrogenation.—Prof. F. Fischer: Liquid Fuel from Water Gas.—Dr. C. H. Lander: The Present Status of Low Temperature Distillation of Coal in England.—Dr. R. Lessing: Coal and its Mineral Matter.—G. M. Gill: English Developments in Carbonisation of Coal in Gas Works.—H. Nielsen: The L. and N. Process.—General G. Patart: The Production of Methyl Alcohol from Coal.—M. R. Campbell: Our Coal Supply, its Quantity, Quality, and Distribution.—A. C. Fieldner: The Practical Value of Fundamental Research on Coal.—J. M. Weiss: Coal Tar Disposal.—C. J. Ramsburg: A Continuous Water Gas Generator.—Prof. S. W. Parr: Fundamental Studies on Coal as Related to Carbonisation Problems.—C. V. McIntyre: Development in Low Temperature Distillation of Coal at Fairmont, W. Va.—W. H. Trent: Some New Uses for Pulverised Coal.—Dr. W. H. Fulweiler: Utilisation of Bituminous Coal in the Manufacture of Water Gas.—Dr. H. C. Porter: Economic Aspects of the Pre-treatment of Coal for Smokeless Fuel.—H. Kreisinger: Powdered Fuel for Power Purposes.—R. M. Crawford: The Recovery of Phenols from Fuel Tars.—H. A. Brassert: Utilisation of Heat in Modern Steel Plants.—Dr. L. C. Jones: Coal in Relation to the Production of Fixed Nitrogen.—O. P. Hood: Smokeless Fuel.—Dr. W. P. Runge: The McEwen-Runge Process for the Low Temperature Distillation of Coal.—S. R. Church: The Utilisation of Coal Tar Products.—E. Piron: The Piron Coal Distillation Process.—O. Monnett: The Smoke Problem of Cities.—L. F. Laucks: The Greene-Laucks Process.

SATURDAY, NOVEMBER 6, 1926.

CONTENTS.

PAGE
West African Development.—II. 649
Echoes of Tennessee. By J. C. H. 652
Prehistory in Britain. By M. C Burkitt . . 652
Surfaces, Molecules and Ions. By N. K. Adam . 653
Transmission of Stimuli in Plants 654
Our Bookshelf 655
Letters to the Editor:
Welsh Romani.—Dr. John Sampson, Prof. R. L. Turner 657
Science and Psychical Research. — Sir Bryan Donkin; A. A. Campbell Swinton, F.R.S.; Sir Arthur Conan Doyle 658
The Electrical Charges from Like Solids.—Prof. P. E. Shaw 659
Origin of Yolk in the Eggs of Scolopendra.—Prof. Vishwa Nath and Tasdique Husain . . 660
Kammerer's Alytes.—Prof. E. W. MacBride, F.R.S. 661
The Anomalous Flocculation of Clay.—H. B. Oakley 661
The Anomalous Dilatation of Invar.—Prof. F. Zernike 662
Biological Research in the Tropics.—Dr. J. S. Dunkerly 662
Magnetic Storms and Wireless Communications.—Sir Joseph Larmor, F.R.S. 662
Aspects of Physical and Mental Inheritance. By Prof. R. Ruggles Gates 663
The Relation between Velocity of Wind and Water. By Dr. Vaughan Cornish 665
Mars in 1926. By Dr. W. H. Steavenson . . 666
News and Views 668
Research Items 673
The State and Industrial Research Associations. By J. W. Williamson 676
Sir Charles Parsons and the Steam Turbine . . 678
The Magnetic Storm and Aurora of October 14–15, and Associated Solar Activity 679
University and Educational Research . . . 680
Societies and Academies 681
Official Publications Received 683
Diary of Societies and Public Lectures . . . 683

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

West African Development.[1]

II.

IT is 134 years since William Pitt, speaking of Africa, said: "We may live to behold the natives of Africa engaged in the calm occupation of industry, in the pursuit of a just and legitimate commerce. We may behold the beams of science and philosophy breaking in upon the land." The material vision is fulfilled, but the beams of science and philosophy have not yet penetrated the veil of mists and obscurity in which our administration is enveloped. We have been in trading relationship with West Africa for more than three hundred years; the British Crown has been directly responsible for the administration of a great part of its territories since 1886; the native races in the British zones are among the most intelligent races of Africa: but we have been content to leave the education of its peoples to missionaries, with the result that an inordinate number of native lawyers, preachers, and clerks have been created, but practically no men trained in science or its application.

Tropical Africa is a country with vast potential agricultural resources. It already supplies the world with enormous quantities of raw materials—oil-seeds, rubber, fibres, grains, cocoa, coffee, tea, tobacco, and timbers. But over the greater part of the territory under British control they are being produced with a maximum of waste. Practically nothing has been done to improve native methods of crop production. "The plough is as yet unknown to the natives of West Africa and cultivation is done with the hoe." In spite of the fertility of the soil, "Nigeria imports large quantities of rice and wheat flour to make up some of the deficiencies in its local food supply. The Gold Coast imports much rice and even tinned foods for native consumption." Oil-seeds and oil-nuts are still exported in their raw state, instead of their essential oils being extracted locally. Where the natives extract the oil by their own methods, as in the palm-oil industry, "it is calculated that, quite apart from the deterioration in quality produced by the native method, not less than 50 per cent. of the oil is largely lost in the processes." As in East Africa, many of the tribes practise shifting cultivation, with consequent deterioration and desiccation of the soil and the destruction of forests—a serious danger where forests constitute a bulwark against the encroachment of the desert. In the Gold Coast Colony "little or nothing has been done in the way of manuring" on the cocoa lands.

As regards husbandry, very little has been done to assist the natives to improve the quality and the quantity of their domestic stock, practically all the labours of the veterinary departments being devoted to the prevention and cure of disease. There are large areas in Sierra Leone free from tsetse fly, but no attempt has been made to introduce cattle. The researches of the French and the Belgians in the adjacent territories into the breeding of types of cattle immune from trypanosomiasis seem to be unknown to us, although Mr. Ormsby-Gore mentions the fact that there are a few thousand head of a small type of non-humped forest cattle in Southern Nigeria, uniformly healthy, apparently unaffected by the tsetse fly with which they are frequently in contact.

---

[1] Continued from p. 616.

It was the existence of this immune type in Fonta-Djalon, Upper Guinea, Upper Gambia, and the Lower Saloum which led the French to investigate the relation between species, the size of species, and immunity, and to the interesting discovery that susceptibility to trypanosomiasis in all types of domestic or semi-domestic stock increases with their size. Further, it was established that the native herdmen had made use of this fact to produce, by crossing the immune species with the larger zebu (humped) varieties of cattle, the Djakore or Bambara species of cattle which retain much of the original resistance. On these bases crossing experiments were carried out in the Belgian Congo, with marvellous results, according to M. Roubaud, the chief of the laboratory of the Pasteur Institute.

Another aspect of animal husbandry is also emphasised: "Research in the mineral, as well as the vegetable, nutrition of stock appears to be well worth undertaking. The whole question of crossing, selection of bulls, and the improvement of herds is ripe for examination." In regard to plant products, it is recommended that each of the four territories should maintain a central research station, to which should be attached experimental farms, and connected with the principal agricultural training college for natives. The research carried out at these stations "should be co-ordinated not merely in West Africa, but with the similar research which is being carried on in Trinidad and at Amani in East Africa." Scientific workers will welcome the statement: "If we are to develop our tropical possessions we must realise the value of the scientific staff, both in the laboratory and in the field, and we must provide careers in the agricultural departments in the Colonies which will attract personnel possessed not only of high technical qualifications, but of capacity for leadership and ability to inspire others."

Mr. Ormsby-Gore, while recommending a research policy, makes no recommendation as to the priority of research. A fairly comprehensive programme of investigation is laid down, particularly in regard to human, animal, and plant diseases, and the breeding of improved varieties of domestic stock and plants, but what is lacking is a definite recommendation for the allocation of a specific sum to research. What is wanted in tropical Africa is a fund similar to that at the disposal of the Department of Scientific and Industrial Research in Great Britain, which would not depend upon the vagaries of the local directors of agriculture or the local governors. Such a fund might be created by the apportionment of a percentage of an export tax on palm-oil, cotton, cocoa, or any other of the principal products.

The need for further research in tropical diseases and the measures to be taken to secure a healthy and increasing population are emphasised, but not overemphasised. In the absence of vital statistics, it is impossible to determine whether the population o West Africa is increasing, or stationary, or declining Mr. Ormsby-Gore states that the general impression appears to be that the native population is increasing but very slowly and imperceptibly. Where there are statistics available regarding the native population as in certain parts of South Africa, it is proved that the rate of increase of native population is steadily diminishing. Contact with the white races apparently has this inevitable effect. Generally speaking, it can be said that in spite of the energetic methods adopted to stamp out disease, in spite of the knowledge we have acquired of the diseases which afflict the African populations and the means by which they can be prevented, the native population over the whole o tropical Africa is either stationary or declining in numbers. Bodily disease is not the only determining factor in this result. A psychological factor has to be taken into account. Rivers and others have attributed the decline of primitive populations to the loss o interest in life following upon the breakdown of thei institutions, the suppression of their customs, and the atrophy of native arts and crafts on impact with ou different institutions and different culture. We are confronted, therefore, with the dual task of disseminating knowledge of the means of preventing disease and getting the natives to apply it, and of arousing interest in new activities to replace those which have been lost

The identifiable diseases which take the greates toll of human life and energy in West Africa are malaria dysentery, yaws, yellow and blackwater fevers, sleeping sickness, and leprosy among tropical diseases, and plague, venereal diseases, smallpox, and tuberculosi among the general afflictions of mankind. Many o these diseases could be dealt with at village dispensaries if trained dispensers were available. Mr. Ormsby-Gore rightly stresses the need for the provision of centre where natives can be trained in the diagnosis and treatment of the commoner complaints, and for native sanitary orderlies whose duties would include th destruction of the breeding-places of mosquitoes, both anophelines and Stegomyiæ, the destruction of rats, supervision of the general sanitation of towns and villages, the prevention of water pollution, and the notification of disease. These subordinate medical and sanitary staffs should not be drawn exclusively from the better educated coast natives, but, so far as possible, from every tribe in the interior. "A native is prepared to trust a European medical officer; he is also prepared to pay attention to a man of his own race, but he is not prepared to extend the same confidence to the African from another tribe." Even if he were, it is obviously desirable that knowledge of disease and its prevention should be possessed by some members of every tribe. We must help to supplant the 'medicine man' by the medical man drawn from the same tribe.

Emphasis is also laid on the need for training women for maternity and child-welfare centres. The infant mortality rate is grievously high in western as in all parts of tropical Africa, and the high proportion of still-births to births is one of the most deplorable features of tribal life. For the high-mortality rate malnutrition is to be held responsible, but the number of still-births and abortions must be attributed to the prevalence of venereal disease and malaria. It seems fairly well established from the recent researches of Mr. Buxton in Melanesia that malaria is one of the principal determining causes of abortion and still-births. There is no reference, however, to these recent researches in the report before us. The difficulties in finding women sufficiently well educated to undertake the work of maternity and infant welfare are due to the neglect of female education. "The comparatively small provision which has been made for the education of girls as compared with the provision made for boys is very noticeable throughout West Africa." Mr. Ormsby-Gore's plea for going slow in this matter is not one which will commend itself to any well-wisher of West Africa. There is an urgent need for immediate and even precipitate action directed towards raising up a well-educated class of women. Reading the report, one feels that Mr. Ormsby-Gore overestimates the value of hospitals where surgical operations can be carried out, and underestimates the possibilities of schools for the native infants and adults where much could be done to build up the necessary outlook on disease. The creation of a large number of hospitals, which he advocates, while there are very few schools, is as wise as the present habit in Great Britain of spending large sums of money on the maintenance of sanatoria for consumptives but doing practically nothing to destroy the slums which provide the greater number of patients for the sanatoria.

A tremendous importance is attached by Mr. Ormsby-Gore to the need for greater transport development. He instances the remarkable progress made in the export of ground-nuts following the construction of the railway to Kano. Between 1910 and 1925 the exports of this crop from the Kano-Zaria district rose from 1910 tons to no less than 127,000 tons. He shares with Sir Frederick Lugard the belief in the productive capacity of the peoples to make any railway pay, and in the civilising influence of the railway. A considerable part of the report is devoted to detailed consideration of a railway, road, and harbour programme, but only passing reference is made to the need for systematic research into the possibilities of the flexible track vehicle. This type of vehicle, which is already in an advanced stage of development, and has been used by the Empire Cotton Growing Corporation for the transport of cotton from remote areas, possesses the inestimable advantage that it can traverse roadless country. It is a road-maker rather than a road-breaker. If improved, it would enable every part of the tropics, however remote, to be brought within the reach of regular transport services, and thus not only free for productive work thousands of labourers at present engaged in the wasteful system of head-porterage, but would also save the country the expense of making metalled roads, which are expensive to make and more expensive than a railway to maintain.

The report as a whole will repay the closest study by scientific workers. They have every reason to be grateful to Mr. Ormsby-Gore for re-emphasising the urgent necessity for applying the methods and results of science to the problems of tropical development, both in administration and production. A vast field of research is indicated, a field which it may be hoped will be surveyed with the least possible delay. Scientific workers must realise that they have a special responsibility in the matter. The knowledge which can be gained from scientific research is probably the most important factor in the full realisation of the potentialities of the vast British tropical possessions, and it is essential therefore that funds should be forthcoming immediately for the initiation of a bold programme of research. There is not the least excuse for Great Britain to lag behind other Colonial powers in this respect; there is every reason for it to lead the way. It is not enough for Mr. Ormsby-Gore to produce a report which will establish his reputation as the most far-sighted younger statesman of the day. His observations, his vision, and his recommendations must be appreciated by the nation, and this will be possible only if the scientific community assist the nation to a fuller understanding of the value of scientific research in every sphere of national and imperial endeavour.

Echoes of Tennessee.

Evolution and Religion in Education: Polemics of the Fundamentalist Controversy of 1922 to 1926. By Prof. Henry Fairfield Osborn. Pp. xiv+240. (New York and London: Charles Scribner's Sons, 1926.) 7*s.* 6*d.* net.

ECHOES of the Fundamentalist controversy continue to travel across the Atlantic. The present volume consists of a collection of articles and addresses by Prof. H. F. Osborn dealing with the situation created by this strange revival. It is a phenomenon very difficult to cope with, being a product of popular education and democratic government. The only cure is more education of the right sort, but the Fundamentalists are striving to capture the educational machine. Prof. Osborn is aware that a mental atmosphere prevails not very favourable to scientific truth. "I hold," he says, "that the press and the movies are by far the most potent influences upon conduct in America at the present time." He regards the sum of press influence as morally good but intellectually bad, "because it creates what I call the jazz mind and a disproportionate sense of relative values."

The trouble with people at a certain stage is not only that they cannot appreciate evidence, but rather that they have positively no sense of spiritual or religious values. To attach religious value to the historicity of the myths in Genesis is a mark not only of intellectual, but also of religious, myopia. At this stage, one is either a Fundamentalist or a Secularist; it does not greatly matter which, for the two are correlatives. The tragedy of the situation, as Prof. Osborn points out, is that this recrudescence of superstition has broken out just at a time when the conceptions of men of science have become anti-materialistic. He himself says (p. 91): "If I have made a single contribution to biology which I feel confident is permanent, it is the profession that living Nature is purposive."

One remark of Prof. Osborn's seems to us especially noteworthy: "In my opinion religion and science will unite to control the future of mankind. This will be a simplified religion and a reverent science" (p. 177). But what is a "simplified" religion? Apparently Prof. Osborn hopes to get people to agree upon "a simple, elemental, and more or less primeval teaching on which all men, except those who persuade themselves that they are atheists, agree." It would include the Ten Commandments, the Lord's Prayer, the Sermon on the Mount, and "passages from the teachings of St. Paul and other missionaries." But this is the eighteenth-century chimera of natural religion in a new dress. Prof. Osborn overlooks the fact that these enshrinements of religious and moral teachings are based on a definite philosophical outlook, not always formulated, but capable of quite definite formulation.

This 'hang theology' attitude will not work—at least not for long. If the specific Christian view of God goes, the Christian value-scheme will follow, and carry along with it Christian ethics. This strikes us as a surrender. The strength of the Fundamentalist lies in his quite definite scheme of belief; and unless the Modernist or man of science can offer something equally definite and equally religious, he will neither win nor deserve to win. The future will be divided between the Fundamentalists and the Secularists, who alike know what they believe and why they believe it. There is no room for a vague religiosity, at least in a democratic country like America.

We have left ourselves very little space for estimating the more definitely scientific aspects of the book. Indeed, its excellence here should be beyond criticism. Prof. Osborn speaks throughout with the directness, lucidity, and easy freedom of the specialist and experienced teacher. Especially interesting is his exposure of the Fundamentalist misrepresentation of evolutionary teaching as deriving man's descent from apes. "The entire monkey-ape theory of human descent is a pure fiction," he says. The human line of descent is entirely independent of the apes; it is to a common ancestor that the two may be traced. This, perhaps, is all one to the Fundamentalist, in whose arguments caricature and invective take the place of facts and logic. We may hope that the perusal of this book may abate some Fundamentalist prejudices, at least in the case of those whose minds are still capable of reflection. We think that Prof. Osborn has done a public service to his countrymen in preparing and publishing it; it cannot always have been congenial work for a disinterested student of science who stands above the clamours of controversy.

J. C. H.

Prehistory in Britain.

Proceedings of the Spelæological Society for 1925. No. 3, Vol. 2. (University of Bristol.) 3*s.*

WHEN the editor of NATURE asked me to review the above work, I was particularly pleased to do so. It has always been a source of satisfaction to me personally that I was partly instrumental in turning the attention of the Spelæological Society of the University of Bristol, shortly after the War, towards prehistoric investigations. Previously, though the Society and its predecessor bore an honourable record for researches on underground water-ways, etc., little serious prehistoric work had been attempted. The work of the 'Spelæos' has barely received the recognition it deserves; most people would be astonished to see how much material has been already collected and classified in the last few years; a visit to the Society's museum—housed in the new buildings of the University of Bristol—has become a necessity for all prehistorians. The difficulty has been that a few years ago—rightly or wrongly—the Society decided to publish its own *Proceedings* instead of combining with one of the older societies for this purpose. Folk as a rule are rather suspicious of new provincial publications of this kind, and it is to combat these suspicions in this particular case that this review is written.

The Society started its prehistoric explorations by having two pieces of rare good luck. I often wonder if my friends the 'Spelæos' realise how fortunate they were! Avelines Hole has proved a most important find of late Palæolithic date, and has yielded a rich and interesting collection of flint implements, not to speak of a harpoon—one of the very few found in Britain—and several portions of human skulls. The second 'plum' was the Keltic Age cavern, and this was certainly no small discovery. Although starting off straight away with these first-class sites, members rose to the occasion and very creditable excavations were undertaken and duly published. Lately attention has been turned northwards and investigations started in the Wye valley; of course, Mendip—the first love—is by no means being neglected.

The present *Proceedings* contain a most attractive series of papers; mostly they are concerned with the various activities of the Society, but one or two articles on more general matters by outside contributors are included. The contents comprise: A fifth report on Rowberrow cavern, a third report on excavation of Mendip Barrows, a second report on excavations in the Wye valley, and a note on a Roman site on Bedminster Down; a short account of Guy's Rift, Slaughterford, follows, with a detailed description by Mr. L. H. D. Buxton of the early Iron Age skull found there. Other articles include: A study of certain caves in the north in relation to the ice ages by Messrs. L. S. Palmer and L. S. Lee, a survey of Upper Palæolithic industries from some Mendip caves by Mr. J. A. Davies, a note on the Upper Palæolithic in Britain by Miss D. A. E. Garrod, and a study of flint-flaking by Mr. H. Warren.

Among so much that is interesting it is rather invidious to pick out any special paper, but it is clearly impossible here to discuss such a long table of contents. Perhaps readers will be especially interested in the reports on Rowberrow cavern and the investigations in the Wye valley. The 'Spelæos' started work at Rowberrow several years ago—their first publication on the subject was in the *Proceedings* for 1920–21. Thanks to outside financial assistance, it has been possible to proceed on a large scale and the present (fifth) report gives a very complete picture of the various cultures found there. Quite a number of flint implements occurred, but it has been found that, though a late Neolithic industry is present, they mostly date to more recent periods—some being even Roman in age. Of course, it has been realised for some time past that the introduction of metal into the British Isles did not lead to the complete eclipse of all flint work, and that many of the surface finds are comparatively recent in date, but it is always satisfactory to have fresh confirmation, especially when a definite stratigraphy occurs. The discovery at Rowberrow of pigmy tools—though without, of course, the Tardenoisean burin—in late Neolithic layers is also interesting and confirms the assertions of H. Warren, who claims that some geometric pigmies in Essex are certainly not earlier in time than the late Neolithic and may even date to an early metal age.

Somehow or other the Wye valley seems to have been rather neglected by prehistorians. So long ago as 1919, in a note in the first *Proceedings* of the Society, I urged that attention should be turned to this favoured valley. The results of two seasons' work merely whet the appetite for more. King Arthur's cave—originally excavated in the 'seventies—has naturally first attracted the diggers, and it is surprising what they have obtained from what appeared at first sight a completely emptied chamber. But the whole district is simply riddled with caves and rock-shelters, and it will be astonishing if further investigation in future years does not bring to light other and still more interesting 'King Arthur's caves.'

The current *Proceedings* forms a notable publication, and the Society is to be indeed congratulated: archæologists can no longer afford to neglect its activities.

M. C. Burkitt.

Surfaces, Molecules and Ions.

An Introduction to Surface Chemistry. By Eric Keightley Rideal. Pp. viii + 336. (Cambridge: At the University Press, 1926.) 18*s.* net.

That the cohesive forces which hold solid and liquid masses together, and produce the phenomena of capillarity at their surfaces, are ultimately identical with the forces producing chemical change, is an idea which has been latent in studies on capillarity since their inception. But the growth of this idea into a living theory, with power to inspire and guide many researches into the structure of surfaces, the surface properties of molecules, and the mechanism of evaporation, solution, and catalysis, has been delayed until the last fifteen years. Dr. Rideal's book is probably the first in any language to attempt a presentation of all the modern developments of this idea. After an introductory chapter on pure liquids and their surface energy, the author presents Gibbs' adsorption equation—the reappearance of much of the original proof is to be welcomed—and plunges into the most recent work on surface films on liquids. A chapter on liquid-liquid interfaces includes information on emulsions and suggestions for bridging the gap in our knowledge between the theory of capillarity and of solution; solid-gas interfaces are treated with reference to crystal structure and to recent work on catalysis; adsorption, surface reactions, crystallisation, and disintegration are included under solid-liquid interfaces, and the section on electrification deals with the adsorption of ions, the double layer, cataphoresis, the Donnan equilibrium, and other subjects. There are two concluding chapters on the most important points in the theory of colloids, including the theory of Brownian movement, the charge on colloidal particles, and the structure of gels. The effects of adsorption in its manifold forms are traced through a great variety of phenomena.

The book is an able survey of an extensive literature full of interest at the present time. It is written with a keen enthusiasm and abounds in well-chosen references and in original suggestions. Its conception and plan are excellent. But close reading reveals that it is not particularly trustworthy as a text-book, and that it suffers from lack of thorough and critical digestion of the material and from hasty revision. For example, in the table of cross-sections of organic groupings on p. 77, values appear for $-\text{NC}$ and $\text{CONH}\phi$, neither of which has been measured, and there are several other mistakes besides. On p. 129 the formula for the rate of growth of tarnish films on metals, as limited by the slow diffusion through the film already formed, is given without proof, and wrongly. It is not quite fair to the uninitiated reader to expect him to recognise the physical factors at work in this phenomenon from a misprinted formula, and no further explanation than that it is "the ordinary diffusion law." Elsewhere a thermodynamical argument is based on the hysteresis of the contact angle as if it were a reversible phenomenon, although it has been shown to be frictional in nature and irreversible; Harkins' 'oriented wedge' theory of the inversion of emulsions is given without noticing that its author has brought forward evidence very damaging to its simple form; and the theory of the very important 'maximum bubble pressure' method for determining surface tension is dismissed with an approximate formula and the remark that it "corresponds closely with that of the drop-weight method," which is scarcely a correct indication of the actual state of these theories. Sugden's development of the first of these methods ought to have been at least mentioned, as it gives not only the most accurate theory at the present time, but also an apparatus which, on the grounds of convenience and accuracy combined, is probably the best now available for ordinary use. Sometimes the author seems merely to have handed his notes to the printer, as when on p. 295 a hypothesis is given and the fact of its having been tested, a few words necessary for grammar are omitted, and the result of the test is not stated; and the nickname "McLewis" surely should not be used in print.

Some blemishes are, however, inevitable in a pioneer work on a rapidly growing subject, and the reader who will consult the original literature to which this book introduces him, when he needs fulness and accuracy, will find the book invaluable. It is alarming that, only a few months after the appearance of the book, it is already seriously out-of-date on some points fundamental to the theory of surface films. The book is likely to be found readable by fully trained students of physical chemistry; other scientific readers may find that the demands made on a previous knowledge of current technical terms and mathematical symbols are too heavy. Those who, like the reviewer, are already engaged in investigations on the subject will find it indispensable; and we may look confidently for fresh students to be attracted as a result of reading it.

N. K. ADAM.

Transmission of Stimuli in Plants.

The Nervous Mechanism of Plants. By Sir Jagadis Chunder Bose. Pp. xix + 224. (London: Longmans, Green and Co., Ltd., 1926.) 16*s*. net.

ALL the recent work on cell respiration and nutrition leads to the conclusion that a real similarity exists between these processes in the plant and animal organisms. This being the case, it would seem possible that the mechanism of the transmission of stimuli may also be fundamentally the same in both. The problem of transmission in the plant has not received so much attention as that in the animal, on account of the comparative difficulty of dissecting plant tissues for experiment, but nevertheless a considerable number of theories have been put forward to explain the few known facts. Broadly speaking, the theories hitherto produced fall into two classes: those which attempt an explanation on a mechanical basis and those which incline to the idea of chemical stimulation. Sir

Jagadis Bose introduces a new conception—that of 'physiological excitation.'

None of the older theories has been sufficient to explain all the facts and the extreme rapidity with which a stimulus is effective in *Mimosa pudica* and other sensitive plants: these, when not completely ignored, have always been a stumbling-block. It is therefore of interest that in the present work, Mimosa has been chosen for the subject of the fundamental experiments.

Briefly, Sir Jagadis Bose claims to have found that in Mimosa there exists a definite nervous system which he believes is in practically every way identical with that of the animal. He repeats on this plant most of the classical experiments on animal nerves and nerve-muscle preparations. By means of the most ingenious apparatus he identifies the phloem with the actual conducting tissue; he demonstrates the falling of the leaflets under various stimuli, the time between the application of the stimulus and the response varying with the distance of the leaflet from the point of excitation. He finds that the falling leaflets are confined to the stimulated side except when the stimulus (usually electrical) is intense, when the response travels up one side and down the other; this is taken as evidence for two unilateral conducting strands meeting at the apex of the leaf. The latent period and the rate of transmission of the stimulus have also been measured, and it is found that the phenomena of make-and-break electrical stimulation are the same as in animal tissues.

Mimosa was chosen for these experiments on account of its rapid and definite reactions, but this class of plant stands alone in the vegetable kingdom, and it is doubtful whether theories based entirely on such experiments as these could be applied to all plants. An electrical reaction corresponding to the action current of an animal nerve is said to have been demonstrated for several plants.

In view of the need of confirmatory evidence and of the hostile criticism which this work is likely to evoke from orthodox botanists, it is greatly to be regretted that the experimental conditions are not given in greater detail. We have no doubt that every reasonable precaution was used, but it is hard to reconcile the observation that temperature has a very definite effect on the rate of transmission with entire absence of any attempt to control it in other experiments. Apart from any effect on the plants, the conditions must surely have been very carefully controlled when dealing with such very sensitive apparatus; the reflecting galvanometer used in some of the experiments gave a deflexion of 1 mm. at a distance of 1 metre for a current of 10^{-10} amperes.

Sir Jagadis Bose is to be congratulated on the way in which he has treated the problems and on designing so many instruments for exact measurement. It is difficult to believe, however, that he will succeed in demonstrating in plants a central nervous system, the presence of which he seems to suspect.

Our Bookshelf

Citrus Diseases and their Control. By Prof. Howard S. Fawcett. With Sections on Oriental Citrus Diseases by H. Atherton Lee. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xii+582. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 25*s*. net.

A large amount of valuable investigation has been carried out during the last twenty years on the etiology and control of citrus diseases in the main producing areas, but no book embracing the results of this work as a whole had been offered to the industry. This deficiency is very adequately met by Fawcett and Lee's volume.

The elder author's work, first in Florida and later in California, has established his name as that of the foremost citrus pathologist, and the book is necessarily, in no small measure, a record of his own investigations, adapted in a clear practical way to the needs of the California and Florida growers.

Lee's first-hand acquaintance with diseases in the Philippines and in parts of China and Japan, the recognition of those present in the Mediterranean region, Australia, South Africa, and the West Indies, and the extensive bibliography, make the work useful also to pathologists.

The arrangement of the matter follows customary lines, and the numerous illustrations are mostly from photographs showing the macroscopic characters of the lesions; many of the plates, in colour, appear strikingly true to Nature. In the treatment of the diseases definitely proved to be caused by parasites, enough is said, doubtless, of the micro-organisms concerned to satisfy the curiosity of the practical man. A number of new terms are proposed, with the view of furthering uniformity in the international nomenclature of plant diseases. These terms, like some which have already been gaining ground, such as gummosis, psorosis, and verrucosis, are based on some salient character of the lesion or gross appearance. The three terms mentioned indicate the difficulties involved: verrucosis is caused by a definite parasite; the cause of psorosis is unknown; gummosis may be due to a number of things, including five parasites at least, so the name of the parasite must be added to define the particular case (Pythiacystis *gummosis*, Diplodia *gummosis*, Botrytis *gummosis*, etc.). Among the rather strange-sounding new terms may be mentioned cancrosis for citrus canker and rubellosis for the pink disease of the tropics, both caused by specific parasites; foliocellosis (frenching or mottle-leaf), endoxerosis (internal decline of the lemon fruit), adustiosis (red blotch), and oleocellosis (oily spot) are non-parasitic diseases.

The Useful Trees of Northern Nigeria. By H. V. Lely. Pp. xii + 128 + 120 plates. (London: The Crown Agents for the Colonies, 1925.) 10*s.* net.

Mr. Lely has rendered a service to African forestry by the preparation and publication of his descriptive account of 128 of the useful trees of Northern Nigeria. This book will be helpful not only to his colleagues but also to forest officers in other African colonies, to which many of the trees described extend their range. The author's method may be commended to the consideration of others who, we hope, will follow his example; as he expresses it, his aim has been to describe and illustrate the material as it appears to be and not only as it actually is from the scientific point of view, avoiding botanical terms except where they have no alternative. Technical descriptions can always be provided by the compiler of a flora, working at home, but information such as that supplied by the author of the work under review can only be given by 'the man in the field.'

If other colonial forest officers will follow Mr. Lely's lead, by giving us illustrated accounts of the dominant trees of their areas, it will be of great assistance to their colleagues and successors, and will help to prevent many erroneous determinations such as are now so commonly met with. Such accounts would tend also to bring to light the still too numerous species not yet identified botanically, and would furnish us with much-needed information as to the 'habit' of the various species discussed.

A few slight corrections ought, perhaps, to be noted for the benefit of African forest officers. The genus Lophira has been retained by Mr. Lely in the Dipterocarpaceæ instead of in the Ochnaceæ, to which family it is now referred. The genera Eriodendron, Ceiba, and Bombax are now usually separated from the Malvaceæ to form a distinct family, the Bombacaceæ; *Eugenia guineensis* is now generally placed in a separate genus, Syzygium, as *S. guineense.* Sir David Prain's revision of the African species of 'Afzelia' under the generic name Pahudia appears to have been overlooked, for *Pahudia africana* (Sm.) Prain appears as *Afzelia africana.*

We sincerely hope that Mr. Lely will feel encouraged to continue the good work until all the trees of his region have been described and figured.

J. Burtt Davy.

Synonymy of the British Non-Marine Mollusca (Recent and Post-Tertiary). Compiled and Annotated by A. S. Kennard and B. B. Woodward. Pp. xxiv + 447. (London: British Museum (Natural History), 1926.) 20*s.*

This work is almost devoid of readable matter, but is nevertheless of fundamental importance to all who are engaged in research on non-marine Mollusca or on the Pleistocene deposits. It gives a list of all the genera, sub-genera, and species (recent and post-Tertiary), with bibliographical references, together with the etymology of the names adopted, and the geological range of the species in Great Britain. The names used are those which, in the opinion of the authors, most nearly accord with the requirements of the International Rules of Zoological Nomenclature. 172 species of gasteropods and 37 of lamellibranchs are recorded, most of which are found fossil in the Pleistocene, and some in the Pliocene deposits. About 16 per cent. of the species are extinct in Great Britain. Some idea of the immense labour involved in the preparation of this work can be formed from the bibliography, which occupies 54 pages.

Memoirs of the Geological Survey, Scotland. The Economic Geology of the Central Coalfield of Scotland. Area 5: Glasgow East, Coatbridge and Airdrie; with Chryston, Glenboig, Greengairs, Slamannan, Caldercruix and Salsburgh. By Dr. C. T. Clough, L. W. Hinxman, W. B. Wright, E. M. Anderson, and R. G. Carruthers; with contributions from Dr. R. Kidston, Dr. G. W. Lee. Second edition, with additions by M. Macgregor. Pp. x + 171 + 13 plates. (Edinburgh and London: H.M. Stationery Office; Southampton: Ordnahce Survey Office, 1926.) 5*s.* net.

This memoir is a new edition (with corrections and additions) of that on the same area, first published in 1916. In addition to minor corrections and amplifications, Chapter ii. dealing with the Carboniferous Limestone series, in which certain important coal seams occur, has been almost entirely rewritten, whilst there have also been some changes in Chapter iii. dealing with the Millstone Grit. It is evidently of great importance that, as fresh information is available, works such as these should be kept up-to-date and amplified where necessary.

Erde und Weltall. Von Svante Arrhenius. Aus dem Schwedischen übersetzt von Dr. Finkelstein. Pp. vii + 342 + 2 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 12 gold marks.

This is a German translation from the Swedish; it is a combined and revised version of the two earlier works by the author, published in 1906 and 1915. The book deals only with the solar system, with special reference to the earth and geophysics (including atmospheric physics and climatology). It is written in picturesque and discursive style, and there are numerous small illustrations. Many references are made to very recent work.

Solutions of the Examples in a Treatise on Dynamics of a Particle and of Rigid Bodies. By S. L. Loney. Pp. vi + 240. (Cambridge: At the University Press, 1926.) 17*s.* 6*d.* net.

Prof. Loney has here provided complete and concise solutions to the examples of his well-known treatise on dynamics, which will be very useful to teachers and to those advanced students of applied mathematics who are sufficiently mature to know the legitimate use of such a key.

Physische Erdkunde: die Gestaltung der Erdoberflache. Von Prof. Dr. Richard Lehmann. Pp. vii + 240. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1925.) 12·50 gold marks.

This is a text-book of physical geography, of the usual type. The processes of development of surface features are described at length, and the illustrations are numerous. The earth's thermal state is mentioned, but radioactivity is not.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Welsh Romani.

I HAVE just read Prof. Turner's review of my "Dialect of the Gypsies of Wales" in NATURE of August 28, and trust you will permit me to make a few comments.

Prof. Turner refers to the "well-established rules of Gypsy," *i.e.* the phonetic correspondences between Sanskrit and Romani, but omits to mention that my book is the first to supply a full and systematic series of these phonetic equations, for the earlier lists of Ascoli and Miklosich are too incomplete to be of service. These equations have been deduced in the first place from examples where the correspondence between a Sanskrit and Romani word is indisputable, and afterwards applied to the elucidation of words the etymology of which is in doubt. Hence my etymologies, which he appears to assign to guess-work, have all been based upon a belief in that "constancy of sound-laws" which he charges me with ignoring. By no other method would it have been possible to arrive at such new derivations as *bār*, 'stone,' from Skr. vata; *bivan*, 'unripe,' from Skr. vimlāna; *lil*, 'book,' from Skr. likhita; *phabai*, 'apple,' by reduplication from Skr. phala, and many others I am therefore in agreement with Prof. Turner as to the principle that "a given sound in a given dialect will develop in the same way in all words in which it appears under the same conditions," and only question his application of this rule.

In the single example cited by Prof. Turner, namely, Rom. *šukār*<Skr. sukṛta, he emphasises his point by the statement that I give this derivation "without hesitation," although in the vocabulary I first quote Miklosich's śukra, following it by a doubtful "rather perhaps to be connected with Skr. sukṛta"; while in my chapter on the History of Romani Sounds (§ 130) I cite it with a prefixed query mark. My reason for connecting Gypsy *šukār* with Skr. sukṛta is the analogy of three other Romani words from the same Skr. √ kṛ, compounded with prefixes ending in a vowel, where the -k-, though intervocalic, remains. These are:

raker- (Gk. Gyp *vraker-*, Arm. Gyp. *pakr-*), 'to talk,' derived by Finck from Skr. prakṛ, Prākr. pakar- —an etymology which the Sanskritist Ernst Kuhn in 1909 hails as 'sehr glucklich,' explaining as it does the forms in Eastern and Western dialects,

pariker-, 'to thank'<Skr. pratikṛ, Prakr. paḍiker-;

dūrker-, *duriker-*, 'to foretell'<Skr. dūrikṛ. In stating dogmatically that Skr. sukṛta "would have become something like **suil*"—a word of singularly unGypsy-like appearance—Prof. Turner assumes that intervocalic Skr. -t-, if it survives, must necessarily have become European Gypsy -l-; but it might equally well have become -r- (§ 130, No. 3), *e.g.* Skr. pat->Prākr. paḍ->Rom. *per-*, 'to fall,'; Skr. prefix prati->Prākr. paḍi->Rom. *pari-*.

Prof. Turner's second adverse criticism arises, I think, from a misapprehension of the scope and purpose of my book. When in my vocabulary, appended to Romani words of Indian origin, I cite Sanskrit, Prākrit, and Hindi forms, I do so with very different degrees of reverence. Sanskrit in almost every case is quoted as the source in which we find preserved the primitive form of Gypsy words, while Prākrit serves mainly to illustrate processes of sound-change which are often identical with those found in Romani The Hindi words are in an entirely different category, and from the Gypsy viewpoint practically negligible. I supply them (as I explain in § 76) merely to indicate the usage in the central Modern Indian speech of to-day. But since the Gypsies had left India at least 200 years before the rise of Hindi and other vernaculars, these recent forms cannot have affected Romani.

Prof. Turner assumes that where the Hindi word is given by me I regard it in every instance as a true cognate. But this is not so. The distinction between tadbhavas (lineal descendants of Sanskrit words) and tatsamas (modern resuscitations from Sanskrit) is so well-known, and the examples in my vocabulary so obvious, that it would have been superfluous to have differentiated the two classes. He selects for rebuke (with judicious omissions which suggest that I try to connect a Romani word with a Hindi tatsama) the Gypsy *thulo*, 'fat.' In my vocabulary it appears thus: "*thulo*, adj. [Skr. sthūla, 'thick,' 'bulky,' 'gross'; Prākr. thulla; Hind. sthūl; Dard. tūla, tullo, tul, 'fat'],'' where the Hindi sthūl stands out prominently as an unmistakable tatsama. Hindi being historically out of account, it seemed to me to be of first importance to the student of Gypsy to direct attention to the fact that an inherited word, which has survived in Romani, should have been lost and artificially restored in the Modern Indian vernaculars. Prof. Turner, writing as though my book were designed as a text-book on Modern Indian dialects rather than a work on comparative Romani, says: "Such an attitude and such mistakes invalidate the whole of [my] comparative work"—a remark which sheds a curious light on the attitude of the "Junggrammatiker."

JOHN SAMPSON.

The University,
Liverpool.

THE main ground of my criticism of Dr. Sampson's book was that in it he pays little regard to the principle of the constancy of sound-laws. In his reply, however, he professes his adherence to this principle; and proceeds forthwith to deny it. For by this method, he says, he arrived at the new conclusion, among others, that *bār*, 'stone,' is derived from Sanskrit *vaṭa*. It is true that initial *v-* regularly becomes *b*, and that intervocalic *-ṭ-* regularly becomes *r*. So far, so good. But it is a well-established law that in European Romani Skt. *ă* followed by one consonant only becomes *e*, as appears to be admitted by Dr. Sampson on p. 44 of his book Therefore if *bār* is to be derived from *vaṭa*, a special explanation of the presence of *ā* (instead of *e*) is required: Dr. Sampson offers none, nor even indicates the need. He has already betrayed the principle of the constancy of sound laws. Actually this word is derived from a Middle Indian **vaṭṭa-* (cf. Pali *vaṭṭo*, 'round, rolling'), common in the N.W. languages, *e.g.* Panjabi *waṭṭā*, which Khowar *bŏrt* shows to be from earlier *varta-*.

I regret having seemed to ascribe to Dr. Sampson greater confidence in his etymology of *šukār* from *sukṛta-* than he expressed: by the words 'without hesitation' I intended to imply 'without directing attention to the phonetic irregularities involved in his etymology.' Nevertheless, he still stoutly upholds this etymology. But it behoves him, as a professed follower of the Junggrammatiker he sneers at, to explain why the word has *š* in all the dialects except the Greek (in which *š* usually appears as *s*). He neither solves, nor even poses, the problem. The retention of *-k-* he explains on the ground that it is an initial of the second member of a compound. That would be possible if the consciousness of its being a compound was retained up to the time when *-k-* ordinarily disappeared But the support he gives for this contention is weak, and still further accuses him of deserting the principle of constancy. He derives *raker-*, 'to speak,' from *prakaroti* (which does not mean 'speak,' but 'accomplish'): yet the regular correspondence for Skt. *pr-* is Rom. *pr-* (Asiatic, Armenian, and perhaps English Rom *p-*). He must therefore explain Engl. *r-*, Gk. *vr-* before he quotes this word in support, and this unfortunate lack not even Prof. Kuhn's "sehr glücklich" supplies. He derives *pariker-*, 'to thank,' from Skt. *pratikaroti*, but omits to explain why *a* appears instead of *e* in the first syllable. He derives *duriker-*, 'to foretell,' from Skt. *dūrīkaroti*, used by a scholiast on Pāṇini in the sense 'remove.' Obviously we have here not a descendant of Skt. *dūrīkaroti*, but a new Romani compound formed of two separate Romani words, *dur*(*i*) and *ker-*. Finally, he objects to my assumption that Skt. *-t-* would become *l*; and quotes *per-*, 'to fall,' from Skt. *patati* *Per-* is not derived directly from Skt. *pátati*, but from Middle Indian _*paṭati_ (cf. Pkt. *paḍai*), which has given rise to forms like Hindi *paṛnā*, while *pátati* is to be found in forms of the North-West, like Sindhi *pawaṇu*, Kashmiri *pyonu*.

In my review I quoted only one example of what I considered to be Dr. Sampson's neglect of the principle of the constancy of sound-laws, because in the space at my disposal I wished to deal with other and far more valuable aspects of his book. Nevertheless his pages abound in such examples. Lest I be accused of unfounded criticism, I select a few. *Niser-*, 'to go out,' said to be from Skt. *niṣkṛṣ-*, 'to drag out.' What has happened to the group *sk*, which becomes Middle Indian *kk*, and must remain in Romani as *k*? Skt. *niḥsarati*, 'he goes out,' provides a better etymology, which accords with Romani sound-laws. *Kam-*, 'to wish,' from *kāmayati*: yet *-m-* regularly becomes *v*; possibly from a form _*kāmya-_, but probably borrowed from Persian *kām*, 'wish'; Pehlevi *kāmītan*, 'to wish.' *Kerav-*, 'to boil, from *kārayati*, 'to cause to do,' despite the fact that Skt. *ā* regularly remains Romani *a* It is from a Middle Indian _*kaṭhati_ (cf. Pali *kaṭhito*, 'boiled'; Skt. *kvathati*, 'boils'). *Khino*, 'tired,' from Skt. *khinna-*, 'oppressed,' which would have given a Romani form with χ-: Miklosich's derivation from *kṣīṇá-*, 'worn out,' is correct, for *kṣ* becomes *kh*. *Gōrō*, 'non-gypsy,' from Skt. *guru-*, 'preceptor,' with irregular *ō* from *u*: why not (with regular phonetic change) from *gaura-*, 'light-complexioned' (cf. Hindī, *gorā*, 'European')? *Son*, continental *con*, 'moon,' from *candra-*; with irregular *o* from *a*, an unlikely development of the group *ndr* not otherwise attested: it is from Skt. *jyotsnā*, Pkt. *joṇhā*, which would regularly become Rom. *con*. *Thil-*, 'to hold,' is explained as derived from Rom. *ther-* (correctly attributed to Skt. *dharati*); but *-r-* does not become *l*, nor does *e* normally become *i*: on the contrary *-t-* does become *l*, and *ṛ* does become *i*, so that *thil-* looks like a formation from *dhṛtá-*, the past participle which has furnished Modern Indian with many present stems. *Dud*, 'light,' from *dyota-*: but *dy* becomes *j*, and *-t-* becomes *l*. *Cārō*, 'bowl,' from *caru-*: but *a* becomes *e*; why not from _*caṭṭa-_, H. *cāṭā*, 'bowl for sugarcane-juice'?

This part of Dr. Sampson's work is deserving of animadversion not because he makes mistakes in etymologies—that is, alas, the fate of all etymologers—but because in making them he does not pause to pose or to explain the phonetic irregularities involved. I say again that he has not been true to the principle of the constancy of sound-laws, and (what I did not say before) that he has as a necessary consequence been driven into guess-work. He upbraids me for not mentioning that his book is the first to supply a full and systematic series of the phonetic equations of Romani. I have tried to show that it does not do so.

The second point on which Dr. Sampson takes me to task is that I have wrongly accused him of comparing Sanskrit loanwords in Hindi with Romani words, as if they had been inherited Hindi words. He now says that it is clear that the Hindi words are borrowed, and not inherited; and he quotes § 76 in support. In this paragraph, however, there is no mention of *tatsama* or loanword, but only of Hindi cognates. By that most comparative philologists will understand inherited words, not literary loanwords. Further, Dr Sampson does not confine himself to quoting only loanwords in Hindi, but gives as many, if not more, inherited words Thus in the passage whence I took the particular example (taken from Part I., p. 52, not from the vocabulary, "with judicious omissions," as Dr. Sampson suggests) we may read: "*t'an tχan*, 'place,' S. sthāna, P. thāṇa, H. thān; *t'ulo*, 'fat,' S. sthūla, P. thulla, H. sthūl." Of these two Hindi words, one, *thān*, is inherited and strictly to be called cognate, the other, *sthūl*, is a loanword. Dr. Sampson says that he knows this (though he does not explain what value, if any, the quotation of the literary loanword has); but is he right to assume that all his readers also will know? What, finally, is his principle of selection? Why does he compare in consecutive lines *thùd*, 'milk,' with H. *dūdh* (inherited word), but *thuv*, 'smoke,' with H. *dhūm*, *dhūmā* (loanword). If it be, as he says above, "to direct attention to the fact that an inherited word, which has survived in Romani, should have been lost and artificially restored in the Modern Indian vernaculars," he is wrong; for the inherited word exists not only in the Hindi *dhuā̃*, but also in almost every other Modern Indo-Aryan language. There are, in fact, very few, if any, Romani words of Indo-Aryan origin which have not cognates in one or other of the living languages

No one more regrets the necessity for this criticism of Dr. Sampson's work than myself: for as a description of a particular Romani dialect, and as a most useful collection of other material, it is pre-eminent, and puts all students of Indo-Aryan in general, and of Romani in particular, under a great debt of gratitude to the author. But if he thinks that I considered it "designed as a text-book on Modern Indian dialects," I say at once—μὴ γένοιτο.

R. L. TURNER.

Science and Psychical Research.

I BEG space for a short comment on Dr. Tillyard's remarks in NATURE of October 23, so far as they concern my letter which appeared in the issue of October 2. Dr. Tillyard misrepresented what I said when he wrote that I had given my own interpretation of the words "super-normal phenomena." These were his own words, chosen by me because I regarded them as better fitting this discussion than either "subjects of psychical research" or "spiritualism." For I am aware that although psychical research does certainly include the study of most, if not all, of the phenomena alleged by many to be referable to some 'spiritual' origin, there are many psychical researchers who do not accept this explanation of alleged communications between the living and the dead, but prefer to interpret such communications, and others said to occur between living persons at a far distance from one another, by attributing them to an unknown power which was long ago named 'telepathy' by one of the founders of the Society for Psychical Research.

Dr. Tillyard, in his review of the "History of Spiritualism" in NATURE of July 31, says that psychical research purports to be the scientific study of what are called "super-normal phenomena"; and divides this study into two parts, calling the first 'physical,' the second 'mental.' In the mental part, however, are included practically all the various 'phenomena' known generally under the term 'spiritualistic.' Seeing that the present discussion has been mainly concerned with these phenomena, I desired to make it quite clear that I was dealing only with that department of psychical research which was concerned with such phenomena as may be strictly called 'ghostly.'

Touching Dr. Tillyard's call upon me to explain what 'trance' is, I reply that I do not know. But although he says he does not know the difference between trance and sleep he knows more than I do about this matter, for he states in NATURE of Aug. 28 that "Usually the medium is in deep trance and knows nothing of what is occurring." I have seen several 'occult' cases in which strange phenomena have occurred during a period when the medium, often invisible but sometimes not so, has been stated to be in trance, and have heard first-hand accounts of many similar cases. But I have never known or heard of any independent examination being made to test the medium's alleged condition. The phenomena produced at séances with trance mediums play an important part in the exhibitions of 'super-normal phenomena,' the reports of which excite popular curiosity and pervade the journalism of to-day.

BRYAN DONKIN.

I CAN find in Sir Arthur Conan Doyle's letter in NATURE of October 16 no explanation or withdrawal of his grave but, as I have shown, entirely untrue accusation that a statement that I made about him in the issue for September 25 was a "pure invention" on my part.

A. A. CAMPBELL SWINTON

40 Chester Square, S.W.1,
October 16.

MAY I add to—and I hope end—my correspondence with Mr. Campbell Swinton by saying that I regret that I used the term "pure invention" in alluding to one of his statements, since his conclusion was a natural one with the information which he then had at his disposal.

ARTHUR CONAN DOYLE.

October 21.

The Electrical Charges from Like Solids.

THE uncertainty as to the charges arising on insulating solids when rubbed together has ever provided perplexities for the investigator and pitfalls for the lecturer. I have shown in previous papers (*Proc. Phys. Soc.*, 1915, and *Proc. Roy. Soc.*, 1917 and 1926) that a clean solid, say glass, may have entirely different qualities according to the previous treatment of the surface. Ordinary dirt, adsorbed films, temperature change, and, in particular, strain left on the surface by the rough pressure of other solids, are variables which vitally influence surface electrification.

In the present brief note I want to direct attention to the charges found when two *like* solids are rubbed or struck together. Ebonite is very convenient for the purpose. Two rods of this substance are cut from the same sheet and mounted with sealing wax in glass tubes which serve as handles. The free ends of the ebonite are thoroughly but *lightly* scraped with a razor blade and then boiled for a few seconds in water. After drying and cooling, the ebonite surfaces are ready for use They behave as follows:

(1) Placing the rods across one another, one (*A*) is rubbed down the other (*B*). We find *A* charged $-^{ve}$, *B* $+^{ve}$. Discharge the rods over, ***not in***, a flame. Rub *B* down *A*. We find *B* charged $-^{ve}$, *A* $+^{ve}$. Thus the rods are identical in behaviour, the 'rubber' in each case becoming $-^{ve}$, the 'rubbed' $+^{ve}$.

When the surfaces behave alike, as above, we call them 'standard.'

There is a real distinction between 'rubber' and 'rubbed,' a much smaller area of the former than of the latter taking part in the rub; and of the two, the rubber attains at the rubbing point a higher temperature. Hence, the rubber is more likely to yield and be greatly strained under the tangential forces applied in friction.

(2) Continued rubbing brings about a change of effect; the rubber, gradually losing its strong $-^{ve}$ quality, becomes first neutral and then more and more $+^{ve}$. When in the neutral condition, the rubber may be $-^{ve}$ or $+^{ve}$ according as the rub is light or heavy. Also at this stage it is sometimes possible to obtain one charge, say, $+^{ve}$, from a direct stroke, $-^{ve}$ from a reverse

(3) By continuing the rubbing, the rubber becomes definitely $+^{ve}$ and remains so for the actual surface rubbed even after days of inaction. I propose to call the new state of surface, produced by rubbing, the 'strained' state.

(4) The strain can be removed by boiling the rods in water for a few seconds or more, according to the amount of strain. If both rods are considerably strained, it is possible by boiling each in turn for short periods to make first one, then the other $-^{ve}$, until finally both are restored to the pristine standard state of no strain. It should be remarked that after boiling the rods are allowed to cool before rubbing.

(5) If the rods have been brought by rubbing to the intermediate state (see (2) above), suppose one rod, *A*, is slightly $+^{ve}$ to *B*. Then warming *A* makes it $-^{ve}$ to *B*. Next, warming *B* makes it $-^{ve}$ to *A* again. The rise in temperature of the surface need be only, say, 50°, and can be done by the heat from a carbon glow lamp.

(6) Sharp glancing blows of one rod on the other, whether the surfaces be standard or strained, give rise generally to contrary, ***but unequal***, charges on the rods. The sum total charge is $-^{ve}$. If these impacts are oft repeated the sum total charge may be very great, and each rod may be $-^{ve}$.

In all these experiments the charges are considerable and can be easily observed with a sensitive gold-leaf electroscope.

The above behaviour of ebonite is found also with like specimens of caoutchouc, celluloid, shellac, resin, sealing wax, paraffin wax, charcoal, sulphur, glass, mica. I have found no exceptions to the rule, but that remarkable solid, caoutchouc, reveals its idiosyncrasies, in triboelectricity as in other well-known phenomena, thermal and elastic. In caoutchouc the rubber has a $+^{ve}$, not a $-^{ve}$, tendency due to rise in temperature.

Each material must be rendered standard as defined in (1) above, but the dual process of scraping and boiling, adopted with ebonite, is clearly not universally applicable.

From the above experiments three general principles, which I think are new, emerge:

(*a*) *Really identical surfaces charge one another according to a definite rule* (*Expt.* 1).

(*b*) *Friction between initially identical surfaces causes these to become strained, the strain being revealed by the nature of the charges arising, and by the fact that heating restores the surface* (*Expt.* 2, 3, 4, 5).

(*c*) *Rough impact between like bodies in general leaves them with unequal charges* (*Expt.* 6).

The earliest lessons inculcated in text-books on electricity are: first, that, to produce charges by rubbing, the two solids used must be different in nature; secondly, that the two charges are equal in amount and opposite in sign.

Both these principles, as we see, are erroneous, although the second one is true for the special case when the two solids are slowly rubbed, and not struck, together. In ebonite we find, after impact, a net $-^{ve}$ charge The equal $+^{ve}$ charge has therefore escaped to the air.

There is food for reflection in these results. Since solids of like chemical, and even physical, nature can charge one another, we have hope of explaining all those baffling results so well known to all who have carefully experimented in contact electrification. For these results show that the physical state of a solid surface, being liable to great variation, is a factor of prime importance.

If small defilements, or strains, or temperature changes be imposed on the surface, they concentrate just where, on the actual superficies, their influence may fundamentally affect the surface characteristics. Some investigators in the past, finding erratic results, losing patience, have even dared to describe the effects as 'fortuitous.'

No sound information in this subject can be garnered unless the specimens used are carefully cleaned and otherwise prepared.

Two rods of any insulator, *e.g.* glass, ebonite, caoutchouc, cut from the same sheet, and merely wiped with a duster, are almost invariably different in surface qualities; on rubbing, one will charge $+^{ve}$, the other $-^{ve}$.

There is one interesting speculation deducible from the principles enunciated above. The old problem as to the genesis of electric sand storms and dust storms in Nature may find a solution from the two principles (*a*) and (*c*). For here we have like particles striking together and giving rise to a net charge on the particles and an opposite charge in the air.

This class of research is simple-seeming. But those who have spent time on the subject will allow that it is very baffling; those who have not done so, will at least remember that despite great efforts by physicists the subject has not yet passed the pioneer stage. The most important point in the technique is the production of a standard surface for the material used. Then if, in any experiment, effects become involved or difficult of interpretation, it is easy to reproduce the standard surface and begin again. This principle is emphasised in a recent paper by Mr. Jex and myself (*Proc. Roy. Soc.*, June 1926). P. E. SHAW.

University College,
Nottingham.

Origin of Yolk in the Eggs of Scolopendra.

IN a previous paper (*Proc. Camb. Phil. Soc. Biol. Sci.*, October 1924) on the eggs of the centipede, *Lithobius forficatus*, one of us (V. N.) described two kinds of yolk, albuminous and fatty. The albuminous yolk is preceded by nucleolar extrusions of a remarkable type, and its origin seems to be associated with them, although no evidence could be adduced that they are *directly* transformed into the albuminous yolk. It was further shown that the juxta-nuclear Golgi apparatus fragments into small granules and small crescent-shaped Golgi elements. The former grow in size and give rise to the fatty yolk.

Miss S. D. King (*Scientific Proc. Roy. Dub. Soc.*, vol. 18) confirms the above account of the association of the albuminous yolk with the nucleolar extrusions, but in her opinion the albuminous yolk arises directly from the nucleolar extrusions. With regard to the Golgi apparatus, she admits that it fragments into small granules. Furthermore, she describes fatty yolk, but "the origin of this fatty yolk is doubtful, but it may possibly be connected with the Golgi apparatus, although no evidence in support of this theory has been discovered." In our opinion Miss S. D. King is doubtful about the origin of fatty yolk from the Golgi apparatus, because "both Mann-Kopsch and Da Fano material was studied, but the latter gave such favourable results that it was used *almost exclusively*" (italics ours). Now, it is well known that the Da Fano method fails to show fat in finished slides, while the Golgi apparatus is preserved. On the other hand, the Mann-Kopsch method preserves both Golgi apparatus and fat, and thus enables one to study the transformation of the former into the latter. Furthermore, Flemming-without-acetic, which Miss King has used, shows fat, but not the Golgi apparatus, at least in the egg of Lithobius.

In view of the above conflicting evidence, it was thought desirable to work out the origin of yolk in the eggs of the centipede, Scolopendra. Our observations on the eggs of this centipede strongly confirm the earlier observations of one of us on *Lithobius forficatus*. At the very beginning of the growth period of the egg of Scolopendra, the nucleolus buds off round bodies into the cytoplasm. This process lasts for some time, until at a particular stage it ceases and the nucleolar extrusions in the cytoplasm completely disappear. The extrusions do not fragment in the cytoplasm as they do in the case of *Lithobius forficatus*. After the disappearance of the extrusions there is a long pause, later, albuminous yolk puts in its appearance, and seems to arise *de novo* in the cytoplasm, as is the case in spiders (Von Bambeke, *Arch. de Biol.*, 1897, and Nath, NATURE, May 15, 1926), although the possibility remains that the material of the nucleolar extrusions which have disappeared may contribute towards the formation of the albuminous yolk. At this stage the egg has assumed a large size and the nucleus lies just below the egg membrane. The mitochondria are granular and form a ring all round the nucleus in the youngest egg, which, however, is thicker on one side. They increase in number and ultimately fill up the whole egg.

The behaviour of the Golgi apparatus is remarkable. In the youngest eggs it consists of a few juxta-nuclear rings and crescents. In Mann-Kopsch preparations the rings appear like vacuoles with a sharp chromophilic rim and a central chromophobic area (idiosome). The crescents also show a distinct idiosome material. The Golgi elements increase in numbers, so much so that the whole egg is full of them. The vacuole-like Golgi rings swell up and are directly transformed into the fatty yolk spheres which contain free unsaturated fat, as is shown by their blackening in Flemming-without-acetic, and their quick decolorisation in turpentine, both after Mann-Kopsch and F. W. A. When the fatty yolk spheres are blackened by osmic acid they appear solid, but when they are being decolorised in turpentine they appear like vacuoles with a black rim and clear contents exactly like the Golgi rings. Gradually the black rim also becomes colourless and the sphere remains as a clear white vacuole. An exactly similar process takes place in the eggs of spiders also. Furthermore, we find that the fatty yolk spheres are never smaller than the Golgi rings, as should be the case if they were to arise *de novo*. Again, they appear only after the Golgi rings have increased both in numbers and size.

Lastly, we wish to emphasise the fact that in all eggs in which the Golgi apparatus is said to give rise to yolk (for reference see NATURE, May 15, 1926), such yolk is *always* fatty. This in itself is confirmatory of the above view, because the Golgi material is supposed to be a lipoid combined with a proteid.

A full account will be published later.

VISHWA NATH.
(Bhupindra Research Laboratory,
Patiala.)
TASDIQUE HUSAIN.
(Government College, Lahore.)

Central Research Institute,
Kasauli (India),
September 9.

Kammerer's Alytes.

MAY I be permitted to reply briefly to Dr. Noble's letter on Kammerer's Alytes which appeared in NATURE of October 9? There are several questions involved: first, whether Dr. Noble was right in his statement to the British Association in 1925, that Kammerer's specimen did not show a genuine nuptial pad, because the characteristic glands were absent, and that the glands, not the spines, were diagnostic of these pads.

Champy, in his paper on the subject, states that the nuptial glands are merely the normal skin glands enlarged, and this is confirmed by Dr. Przibram's letter to NATURE of August 7.

Secondly, Dr. Noble makes the statement that the glands in Kammerer's controls shown in America were the same size as those in the sections of the pad.

This statement I can readily accept. I have photographs before me as I write both of Kammerer's earlier sections, sent to Bateson in 1919, and of his later ones exhibited in Cambridge in 1923. In the former the cornification of the epidermis is not so strongly developed as in the latter, and the disparity in size between the glands in the sections through pad and control is slight. In the latter, as stated, the glands in the pad are double the size of those in the control and the cornification is very strong. Kammerer obtained many of the modified males and reared them through several generations, and the acquired peculiarities became intensified in later generations.

As to the date at which the Alytes specimen was 'faked,' there are two passages in Dr. Noble's description which completely give his case away. His letter suggests that Dr. Kammerer perpetrated a wicked fraud on the scientific world. Dr. Noble could find no spines on the specimen in Vienna, and saw blackened patches on *both* hands: I saw spines and have a photograph of them, and on one of the hands I saw no blackened patch whatever.

Dr. Noble's reference to the large-eyed Proteus shows that he fails to grasp its bearing on the question. I consider it the most wonderful object ever exhibited to a scientific audience. The larval Proteus does not, as Dr. Noble suggests, possess an eye: it has, like other blind cave-animals, only the embryonic rudiment of one. If Dr. Noble can find other 'casual' examples of blind cave-animals developing large eyes, I shall be glad to hear of them.

Both the Alytes and the Proteus specimens are examples of the same phenomenon—a phenomenon termed by Prof. Semon 'ecphory'; that is, the revival of ancestral features by the reinstating of the ancestral environment. This process required for its completion five or six generations in Alytes and in Proteus only one, but it is essentially the same thing in both; and to try to represent the skilled experimenter who produced the Proteus as a clumsy trickster seems to me to be both unjust and unworthy.

I do not propose to discuss the merits of the inheritance of acquired characters in the present issue, but as Dr. Noble seems unconscious of the rising tide of Lamarckism, let me point out that Kammerer's conclusions are being confirmed by workers dealing with quite different animals, the last and most spectacular of these confirmations being the paper on the inheritance of habit by rats, read at the Oxford meeting of the British Association by Prof. William McDougall.

If Dr. Noble will forgive me for lapsing into his own expressive American, let me gently entreat him "to get on the band-waggon." Habit as the chief factor in evolution and the inheritability of acquired habits are accepted by leading systematists, palæontologists, and embryologists. Every year adds to the recruits, and I hope that Dr. Noble will join them. If he does, I am sure that he will "get the bulge" on many of his countrymen.

E. W. MACBRIDE.

Royal College of Science,
South Kensington, S.W.7.

The Anomalous Flocculation of Clay.

SOME further experiments have been performed in these laboratories which clear up the discrepancies between the experiments described in a previous letter on the above subject (NATURE, May 1, p. 624) and those of Messrs. Kermack and Williamson (NATURE, June 12, p. 824).

The following table gives the times required to flocculate a 0·1 per cent. purified clay suspension at various concentrations of sodium and calcium chlorides and hydroxides:

Concn. Ca'' ion.	Time required for flocculation.		
	$Ca(OH)_2$	$CaCl_2$.	Two equivalents of chlorides to one of hydroxide.
0·001	7 hours	14 min.	6 hours
0·002	28 min.	10 ,,	32 min.
0·003	2 ,,	7 ,,	12 ,,
0·004	1·5 ,,	6 ,,	4·5 ,,
0·005	1·5 ,,	6 ,,	3·5 ,,
0·010	1·5 ,,	6 ,,	1·5 ,,
0·014	1·5 ,,	6 ,,	1·5 ,,
Concn Na ion.	NaOH.	NaCl.	NaCl : NaOH = 2 : 1.
0·05	2 hours	13 min.	2 hours
0·1	32 min.	13 ,,	32 min.
0·2	22 ,,	14 ,,	24 ,,
0·5	20 ,,	17 ,,	17 ,,
0·9	15 ,,	18 ,,	14 ,,

These results show that calcium hydroxide is a less powerful coagulant than calcium chloride, and actually tends to stabilise a suspension containing the latter salt, provided that the time of flocculation is longer than about twelve minutes.

If the concentration is such that coagulation takes place in 6 minutes or less, then calcium hydroxide flocculates more rapidly than the chloride at equivalent concentrations.

The results for sodium, on the other hand, suggest that even this latter effect should not be called anomalous, as at a concentration 0·9 normal, sodium hydroxide was definitely a better flocculant than sodium chloride, while with the chloride-hydroxide mixture, this effect started at a concentration of 0·5 normal.

A preliminary experiment with a 0·1 per cent. suspension of highly purified amorphous silica gave the following results :

	Concentration required to flocculate in 1 hour.	
	Sodium.	Calcium
Chloride .	No flocculation in 10 hr in 1 N solution	No flocculation in 10 hr. in 1 N solution
Hydroxide .	0·13 N.	0 0015 N.

Thus both sodium and calcium hydroxides were far better flocculants than the corresponding chlorides. The writer suggests that if the term 'anomalous' must be used, it should be applied to the coagulation of silica by electrolytes rather than to the coagulating powers of calcium and sodium salts.

H. B. OAKLEY.

Wellcome Tropical Research Laboratories,
Khartoum, September 20.

The Anomalous Dilatation of Invar.

IN *Arkiv f. Mat., Astron. o. Fysik*, vol. 19 B (1925), Messrs. C. Benedicks and P. Sederholm gave a short account of dilatation measurements of invar in which they claim to have found a new property of this well-known material. Raising the temperature of an invar wire quickly by 50°, they find the coefficient of expansion has sensibly the normal value, *i.e.* 13×10^{-6}, at the first moment of heating. After 3 minutes a contraction sets in, a steady state being reached after 12 minutes.

In order to repeat their experiment, I cut a strip 120 × 1·5 × 1 mm. from an old piece of invar forged out to 1 mm. thickness, and drew this into a wire of diameter 0·5 mm., 60 cm. long. This was clamped at one end, stretched with a force of 1 kgm. or less by a spiral spring at the other end, and heated to 50° C. by passing a current through it. A micrometer microscope focussed on a scratch near the free end enabled changes of length to be measured to within 1μ.

No trace of the new effect was found. The wire took its final length in any case 10 sec. after starting the current, as well as after cutting it off. The cold drawn wire contracted 10μ on heating ; after annealing at a red heat it expanded 6μ (coefficients approximately $-0{\cdot}5 \times 10^{-6}$ resp. $+0{\cdot}3 \times 10^{-6}$), which shows that the wire was indeed the best quality of invar.

The above-mentioned authors detected by metallographic methods the existence of a second phase in invar, and then looked for an effect of a possible heterogeneous transformation on the thermal expansion. May I suggest that such an effect was found long ago by the exhaustive researches of M. Guillaume, in the form of a small thermal hysteresis which lasts for half an hour at 100° and a few days at 40° ? These times would seem more probable for a transformation in the solid state than 12 min. at room temperature.

As Mr. Benedicks used a wire only 8 cm. long, it may well be that a lag of some kind in his measuring arrangement—about which he gave no details—is responsible for his result.

F. ZERNIKE.

Physical Laboratory,
The University,
Groningen.

Biological Research in the Tropics.

DURING the months July to September this year I was enabled to do some research work on protozoan parasites at the Imperial College of Tropical Agriculture in Trinidad, B.W.I., thanks to the generosity of the governing body in granting me free facilities there.

As I feel that the possibilities of the College as a centre for tropical research are not sufficiently known to biological workers at home, I venture to direct attention to the fact that for research workers in almost any branch of tropical biology, there is no more convenient place for headquarters than the College. Though, of course, its teaching activities deal more exclusively with agriculture, the governing body and the Principal, Dr. Leake, were most generous in allowing me facilities for prosecuting my research, which was not connected directly with agriculture.

At the present time the only tropical research laboratory easily accessible to British workers is the one at Kartabo, British Guiana, run by Mr. Beebe under the auspices of the New York Zoological Society. Trinidad has the advantage of involving a shorter journey, and the biological worker will find large laboratories, which will soon be very well equipped, thanks to the new government grant. But, of course, the main point of importance to the biologist in the tropics would be the abundance of tropical forms, and here Trinidad compares favourably with other West Indian islands, as it is the most tropical of them all, and the flora and fauna are more South American than West Indian in affinities. There are large tracts of primitive forest which are under government control and form wonderful collecting grounds.

To a worker who can spend only a short time in the tropics, the presence of an expert staff such as that at the Imperial College of Tropical Agriculture can be invaluable, especially when backed by the valuable entomological, etc., collections which the College possesses. The College works in happy unison also with the Department of Agriculture, where again one found the most able and ready assistance on the part of the local experts, including my friend Mr. Urich, who possesses an unrivalled knowledge of the island fauna.

On these grounds, and on others which are too numerous to enumerate here, I wish strongly to urge that biologists who desire to do tropical research could not do better than obtain permission to work at this College, permission which, I have no doubt, will be granted in all suitable cases.

J. S. DUNKERLY.

The University, Manchester.

Magnetic Storms and Wireless Communication.

IT was reported a few days ago that communication with Canada, by the new beam system of rays of short wave-length, had been completely blocked by a magnetic storm. Why should this be ? The fluctuations of magnetic force are but slight, and one might expect the rays to arrive by an altered path. May we assign a deeper and more fundamental cause ? That the magnetic storm is itself due to an incursion of free electrons into the upper atmosphere, in such numbers as to upset all the ray-paths and twist them out of regularity. The number of foreign electrons need not be very great. The only alternative seems to be oscillation of the magnetic field, so rapid as to be comparable with the time of transit of the ray : which is very unlikely.

JOSEPH LARMOR.

Cambridge, October 26.

Aspects of Physical and Mental Inheritance.[1]

By Prof. R. RUGGLES GATES.

ONE of the most striking facts in modern biology is the discovery that hereditary differences commonly behave as independent fixed units, handed on generation after generation according to various characteristic but simple laws. The differences so transmitted may be large or they may be very minute, but they in some way maintain their identity throughout the welter of events which constitute the passage from one generation of adults to another: that is, the maturation of the germ cells and the development of the individual. Clearly a physical difference maintained in successive generations among individuals developing in the same environment must be due to an initial difference in the germinal material. Such differences are, moreover, as a rule equally inherited through either the egg or the sperm in crosses. The only structural materials in the germ cells of higher organisms which fulfil these requirements for transmission are the chromosomes.

These minute bodies in the nucleus evidently constitute the essential nexus between generations, in so far as the widespread Mendelian differences are concerned, but in plants certain characters may be controlled by plastids in the cytoplasm. It has furthermore been proved in certain plants and animals that visible differences in the chromosomes are accompanied by external differences in the resulting organism. Just as the cell theory of organic structure long ago emerged into fact, so the chromsome theory of inheritance has become a fact. This does not mean, however, that the chromosomes alone are concerned in inheritance.

An abundance of evidence from many sources leads to the view that the chromosome is a complicated structure composed of smaller units. The theory that these units or genes are arranged in linear fashion in the chromosomes, has been connected chiefly with the name of Morgan, because of his extensive studies of heredity and mutation in the fruit-fly, Drosophila; but its origin is really much older. While this theory of linear arrangement is not yet established, it may be said that no other reasonable theory has yet been put forward to explain the phenomena of crossing-over which have been so extensively investigated in this fly, and to a lesser extent in various other organisms.

We have, then, a picture of the chromosomes as containing large numbers of differentiated areas or groups of particles which, while in the uncompacted state, activate and control or determine the growth and differentiation of the cytoplasm and hence the development of the individual. Such conceptions are necessary to explain the unitary behaviour in inheritance of innumerable characteristics in man as well as in other organisms.

While, however, the units must be abstracted and considered separately for purposes of investigation, yet they form the elements of an extraordinarily complicated system and they cannot exist apart from it. Eyes may be blue or brown, and the difference is inherited as a unit, but the blue eye can only develop as a part of the whole system to which it belongs.[2] Here I am in fundamental agreement with the views expressed by Dr. Myers. Just as the developed character cannot exist apart from the organism to which it belongs—you cannot separate the serration from a leaf margin or the shape of the nose from that organ—so in the germplasm the various structural elements making up the configuration, though each produces its own effect through chemical action or structural arrangement, are interdependent in the system to which they belong. Mendelian inheritance consists in the substitution of one such unit for another which occupies the corresponding position in the architecture of the germplasm.

The phenomena of heredity are made possible by these structural arrangements within the organism, the body being composed of cells each with its nucleus, that nucleus containing two sets of chromosomes of corresponding structure, one derived from each parent. Thus are we woven out of the warp and woof derived by mitotic division from two parental sex cells, making a garment infinitely finer in texture and more intimately blended in its structural elements than any fabric. Yet the fact remains that these elements maintain their identity and usually segregate out again sharply when new germ cells are formed.

The orderliness of development in its minutest details, the interrelations and interfunctionings of the chemical and structural elements as they arise, impress every biologist deeply with their regularity and stability. The phenomena of individual development are thus as remarkable in some respects as those of evolution itself. In heredity all these potentialities of the organism must pass over the very narrow bridge of the two germ cells, one of which contributes little more than a nucleus. How this miracle of orderly development is accomplished we can only dimly picture in detail. But the ubiquitous facts of heredity continually emphasise the amazing orderliness of development.

It is sometimes stated that the clear-cut segregation which is so characteristic of Mendelian heredity applies only to abnormalities, and that normal racial and specific differences do not follow such laws. The fact that related species often differ visibly in their chromosome equipment certainly leads to many departures which may more or less completely obscure Mendelian phenomena in crossing. De Vries formerly took up the position that species and varieties differ in their behaviour on crossing. But there is nothing in the more recent work to show that such differences as exist are really fundamental in our present point of view, although they are certainly important. Variety differences are often single sharp units, while specific differences are more apt to represent accumulations of many, often multiple, differences, or chromosome differences which have come about in other ways than by simple Mendelian mutations. Interspecific sterility, however, all too frequently prevents crosses being made from which evidence of the nature of the differences could be obtained. There is some evidence, however, both in animals and plants, that in related species the germplasm is similarly constituted.

---

[1] Contribution to a joint discussion on "Heredity in its Physical and Mental Aspects," before Sections D (Zoology), H (Anthropology), and J (Psychology) of the British Association at Oxford on August 9.

[2] That this does not necessarily include the whole organism is shown by the recent tissue culture work of Strangeways and Fell, in which eye rudiments excised from embryo chicks continued their development.

In the case of man, there is no evidence that the process of inheritance of racial characters differs in any important respect from that of abnormalities. In eye colour—a typical racial character—blue and brown have long been regarded as a Mendelian pair, and while different degrees of brown exist, there is evidence that each segregates sharply from blue. In my book "Heredity and Eugenics" the inheritance of a large number of abnormalities was considered, each following its own Mendelian law.

More recently I have considered the inheritance of racial differences[3] in man. Here multiple factors appear often to be characteristic, as in skin colour and stature. But everything indicates that inheritance of stature and cephalic index follows the same rules as the inheritance of size and shape in other organisms. Present knowledge indicates that the size factors in man differ in no important respect from those of rabbits or even of plants. Moreover, there is every indication that in interracial crosses, where stature and cephalic index are usually regarded as racial diagnostic features, the laws of inheritance of these differences are exactly the same as within a single human family. The more recent investigations indicate that far too much importance has been attached to cephalic index as a racial character, and the same is true to a lesser extent of stature. But it will be some time before a satisfactory analysis of head shape in terms of size and shape factors can be attempted.

Turning now for a moment to mental inheritance, I do not propose to discuss any of the philosophical views of the relations between mind and body, although I am inclined to adopt some such interpretation as that of Lloyd Morgan, namely, that the life of the organism can equally be viewed as a system of physiological or of mental events, without solving or attempting to solve the problem of their interrelations the one to the other. But from the biological point of view, as Prof. Dendy wrote, "It is only in so far as they are related to the brain [I should prefer to say the nervous system] that the discussion of the inheritance of mental characters can have any meaning." The analogy which is sometimes drawn between heredity and memory is really an attempt to explain the less obscure by comparison with the more obscure, or from the point of view just expressed it represents a jump from the physiological to the mental interpretation instead of adhering consistently to one or the other.

In one sense mental and physical inheritance are on exactly the same basis, for in both cases inheritance can only be determined by comparing parents with offspring or the latter with each other, and noting similarities and differences. Such comparisons lead to the clearest evidence of mental inheritance. But it should be recognised that observation of the fact of inheritance is one thing and explanation of how it comes about is quite another. Owing to the difficulty of defining and determining mental characters, progress in the study of mental inheritance has been retarded. Probably few psychologists would now deny the fact of mental inheritance, but biologists must look to them for an analysis of the mind which will enable us to determine what are the units which are really being inherited. Psychologists themselves are only beginning to consider these questions. McDougall's work has been most useful in the preliminary analysis of mental differences from a biological point of view.

When Galton began his studies of mental inheritance the faculty psychology was current, and he naturally made use of its conceptions. But now that the conception of the mind as made up of faculties has become obsolete and various other methods of analysis have taken its place, we still need an analysis of the mind which will be more biological in its characterisation. McDougall writes of the "structure of the mind," but scarcely in the sense in which a biologist would hope to see the term used.

There appear to be two possible lines of approach to a biological analysis of the mind from an hereditary point of view: (1) By the study of mental evolution; (2) by comparison of the mentality of related individuals. As regards mental evolution, the study of animal behaviour shows that increasing complexity of the nervous system is paralleled by increasing mental complexity or powers of reaction. This is clear to any one who compares, for example, a Paramœcium, a starfish, and an ape. Elliot Smith has pointed out in some detail how the mental evolution of man himself has taken place through increasing complication in the structure of the fore-brain. The mind has become an instrument for the recognition, confluence and co-ordination of relationships.

That many mental differences are the result of germinal variations arising in the nervous system is indicated by such extreme cases as (*a*) tumbler pigeons, (*b*) a race of goats which becomes partially paralysed when frightened,[4] and (*c*) in man, feeble-mindedness. It is questionable in how far any other source of mental variations is required to explain mental evolution. The cases cited are semi-pathological, but the smaller, normal differences which have been less studied are likely to show similar origin and hereditary behaviour.

There are no doubt many ways in which the human mind can be analysed and its elements classified; but I believe it will be found with mental, as with physical, inheritance that the only way to determine what are the inherited units is by comparing the mentality of parents with that of their children and relatives. The difficulties of such comparison are of course increased by the facts of proximity and imitation. But the *differences* which appear will often be more significant than the similarities. We have already seen that studies of physical heredity require that the organisms should develop in a similar environment. Obviously the same is true of mental inheritance; but as individuals develop they choose their own mental environment according to their inherited tastes and aptitudes. In the biographies of great men it often appears that escape from their early environment was their only means of finding self-expression for their inherited mental qualities.

---

[3] "Mendelian Heredity and Racial Differences," *Journ. Roy. Anthrop. Inst.*, 56, 468-482, 1926.

[4] It appears not improbable that the 'death-feigning' instinct of certain insects and other animals has arisen in a similar way through germinal variations in the nervous system.

From the point of view I am expressing, mental inheritance is just as real as physical inheritance, and a suitable mental environment is just as necessary for the development of mental characters as a suitable physical environment is for the development of physical characters. Further, the mental environment is extremely complex and intimate in the way it impinges upon the developing individual. One of the remarkable things about organisms, however, is the stability they often show under altered conditions of development, and this appears to be as true of mental as of physical characters. Mental tests apparently show that inherent intelligence, for example, does not develop or grow with the growth of the individual.

Another method by which mental inheritance has been studied is by the comparison of the mentality of identical twins. Galton, the pioneer in this field, cites many remarkable cases of such similarity, in some of which the twins were separated. More recently, many cases have been studied in some of which the separation took place at an early age, making it possible to study the effects of differences in upbringing upon the mental development and the innate abilities. While the mental environment is by no means negligible, and is often profound in its effects on the early development of the mentality, yet it seems clear that innate, *i.e.* inherited, differences persist, which are little if at all affected by the circumstances of life.

There is another matter which, I believe, adds greatly to the complexity of human behaviour. In 1923 I first suggested that when the individual is germinally heterozygous for a pair of contrasted character traits, they may both come into expression in his activities at different times. Indeed, this appears more likely than that there should be complete dominance of a mental character over its allelomorph. I am now looking upon traits of character as different methods of reacting in given circumstances. Since every one is doubtless heterozygous for many such character differences, this would help to account for some of the complexities as well as inconsistencies in human behaviour. Cases of multiple personality are possibly to be explained as more extreme examples of the same kind.

Finally, I should like to reiterate that what is most required now in the study of mental inheritance is an analysis of the mind by psychologists from an inheritance point of view. Psychologists have been so engrossed with the mind as such in its manifold activities that they appear to have neglected the kind of comparative psychology of individuals which is necessary for this purpose.

The Relation between Velocity of Wind and Wave.

By Dr. VAUGHAN CORNISH.

MANY years ago an investigation was begun by me to determine the relative velocity of wind and wave in deep water when the former has operated for a sufficient time to produce a constant condition, and with sufficient sea-room. The results are given in the *Quarterly Journal of the Royal Meteorological Society* for April last, and, at the invitation of the Editor of NATURE, some of the points of interest are brought together in this article.

The relation between velocity and period of deep-sea waves given by the ordinary formula for waves of infinitesimal height, namely, velocity in statute miles per hour = period in seconds multiplied by 3·493 agrees with that observed for ocean waves of conspicuous dimensions[1] sufficiently for the discussion of phenomena so numerous and irregular.

By timing the rise and fall of spots of spent foam upon the water, it is possible to determine from on board ship the period of both the wind-waves and of swell running at the time, whether crossing or concurrent. Employing this method I have never recorded waves with a speed greater than that of the wind, as has been done by other observers, an anomalous result which I attribute to mistaking a heavy swell for the wave when they are concurrent. Observations on a river at turn of tide, when the foam-spots were carried by the current first down-wind and then up-wind, have shown that their wind-drift is small relatively to the other magnitudes concerned.[2]

In the course of a voyage between Trinidad and Ushant, in very deep water all the time and free from considerable currents on every day but one, the speed of the waves was compared with the average speed maintained by the wind *for one hour or more*, as recorded by a Robinson anemometer fully exposed upon the bridge. When there was no crossing swell to interfere with the development of the waves, their speed was only 1·85 statute miles per hour less than that of wind, which had a sustained average velocity of 20 miles per hour. Thus there was blowing over the wave-crests only a 'light air,' the 'force 1' of Beaufort's scale, sufficient to drift the smoke issuing from a chimney but not strong enough to give direction to a wind-vane.

When hove-to in the Bay of Biscay in the storm of December 21, 1911, I determined the speed of the waves as 47·15 miles per hour, when the velocity of the wind, according to the logged Beaufort number, was 52·5 m.p.h. During the exceptionally stormy winter of 1898–99, when I was living within sight of the beach of Bournemouth Bay, the greatest period of a long-sustained series of breakers was 19 seconds, corresponding to a speed in deep water of 66·4 m.p.h. This was recorded on the afternoon of December 29. Gales in the North Atlantic from December 25 to December 29 were logged at 11 and 12 of Beaufort's scale, which correspond to wind velocity of 68 and greater than 75 miles per hour respectively. The greatest wind velocity on land during this winter, as recorded by instruments, was 70–76 miles per hour sustained for one hour.

The breakers above referred to, which were 139 in number and occupied three-quarters of an hour in arrival, were preceded in the morning by five groups of a few breakers with longer period, corresponding to a deep-water speed of 69·5 m.p.h. The interval between the beginning of the first and the end of the last was 52 minutes, which strongly suggests that they were waves from the squall-struck portions of the stormy sea which outran their neighbours. The time occupied in arrival by the individual groups was from 1 to 2 minutes, which is normal for the duration of a short squall. The figures so far given suggest that the maximum speed of waves is somewhere about $\frac{8}{10}$ths that of the wind as maintained for one hour, and that a squall lasting for a minute or two can speed-up waves which have already been developed. Once when the waves were flattening down in a dying storm in the North Atlantic, I actually saw a travelling squall increase by some feet the height of the few waves subject to its force.

---

[1] See the author in *Jour. Roy. Soc. Arts*, Nov. 1, 1912, "Ocean Waves," and the *Field*, Feb. 13 and 27, 1915, "The Measurement of Waves at Sea."

[2] See papers by the author, British Association Report, Section A, Birmingham meeting, 1913, "On a Simple Method of Determining the Period of Waves at Sea," and *Q. J. Roy. Met. Soc.*, Apr. 1926, "Observations of Wind, Wave and Swell on the North Atlantic Ocean."

The observations during the fine-weather voyage on which an anemometer was used provide important evidence of the effect of crossing swell in hampering the development of waves by wind. The restriction of height was palpable to the eye. The restriction of speed was measured. With no swell, or with a concurrent swell, as in the Trades, the speed of the wave was only 1·85 m.p.h. less than that of the wind, but with a swell following obliquely the difference was 3·725 m.p.h., and when crossing at right angles or meeting the waves, 7·2 miles per hour.

A result of practical importance to seamen and meteorologists emerged from the observations on days of crossing swell. When this was oblique to the waves the curl, or break, on the water was considerably deflected and therefore ceased to be a trustworthy indication of the direction of the wind.

The following explanation is suggested of the effect of swell to hinder the wave-making action of wind. When there is no swell and the waves have attained considerable steepness a series of travelling eddies is established in the adjacent air with permanent undulations above, and this arrangement nurses the waves. If, however, a swell be also running, the pattern of the inequalities changes all the time, continually deforming the superimposed air, and making its action irregular. If the swell meet the waves, the pattern undergoes rapid change, and the rhythmic action of the wind is greatly hindered; if it follow the waves their pattern changes slowly and the rhythmic action of the wind is less impaired. When the swell cuts squarely across the waves the surface is patterned in cups and cupolas instead of ridges and furrows, which tends to set up air-whirls with vertical instead of horizontal axis, a condition which imposes an additional hindrance to wave-making.

The extent to which swell kept down the waves when crossing obliquely or squarely suggests that the rapid rise of waves on large lakes is not solely due to peculiarities of local winds but is aided by the fact that no residual swell hampers the action of the wind, as usually happens when it comes on to blow at sea. There is one condition at sea, however, when the development of waves is more rapid than in lakes, namely, when it comes on to blow in the direction of the swell already running and with a speed greater than that of the swell. This was the condition which so quickly created the huge regular waves of December 21, 1911, in the Bay of Biscay.

OBSERVATIONS BETWEEN TRINIDAD AND USHANT.

(Speed of wind as maintained for about one hour measured by Robinson anemometer.)

DIFFERENCES OF SPEED BETWEEN WIND AND WAVE, GROUPED ACCORDING TO DIRECTION OF SWELL.

Direction of swell.	Character of swell.	Date of observation (1914).	Amount by which speed of wind exceeded that of wave.	Average difference of speed in statute miles per hour.
Concurrent with waves	High, quick period, slow progression	Feb. 18	1·2	1·85
		„ 19	2·5	
Following the waves obliquely	Quick period, slow progression	„ 20	3·9	3·725
		„ 21	3·3	
	Slow period, quick progression	„ 28 (P.M.)	3·3	
		Mar. 1	4·4	
One concurrent, one at right angles	That at right angles very slight	Feb. 23	3·1	3·1
One following obliquely, one at right angles	That at right angles very slight	„ 22	6·3	6·3
Swell at right angles, or meeting obliquely	High, with slow period and swift progression	„ 26	6·0	7·2
		„ 27	7·7	
		„ 28 (A.M.)	7·9	

Mars in 1926.

By Dr. W. H. Steavenson.

THE present apparition of Mars is, for observers in the northern hemisphere, the most favourable that has occurred for many years. The planet, which was at opposition on November 4, made its closest approach to the earth on October 27, on which date its distance was approximately 42,600,000 miles and its apparent diameter 20″·4. On August 22, 1924, the distance was 8,000,000 miles less and the apparent diameter so great as 25″·1 (practically the maximum possible), but on this date the planet, at its greatest altitude, was not more than 21° above the horizon of London; whereas, on October 27, 1926, it crossed the meridian at an altitude of 53°. This increase of 32° was more than sufficient to make up for the shrinkage in apparent diameter, with the result that observers in Great Britain have, in general, been able to obtain more satisfactory views than at the closer approach of two years ago. Not until 1941 will there occur an equally favourable combination of altitude and apparent diameter.

In 1926, as in 1924, it is the southern hemisphere of Mars that is presented most favourably for observation, and this always happens at close oppositions of the planet. The Martian season at the time of opposition was not, however, quite the same on each occasion. In 1924 the planet was most favourably placed for observation during the early summer of its southern hemisphere, whereas in 1926 the summer solstice of this hemisphere occurred more than two months before opposition, so that we have a satisfactory seasonal overlap in the observations made in the two years.

The results of this overlap have been very evident this year in the reduced size of the South Polar cap at the date of opposition, and also in the more advanced development of the usual seasonal changes in the dark markings. These changes, both of colour and intensity, are now firmly established facts, and can be predicted with considerable accuracy. But almost more interesting are those less regular changes of form and intensity which have not yet been found to conform to any definite law. They thus provide an element of variety in our observations of the planet, and, as they are often on quite a large scale, afford opportunities of useful and interesting work to the possessors of moderate-sized telescopes.

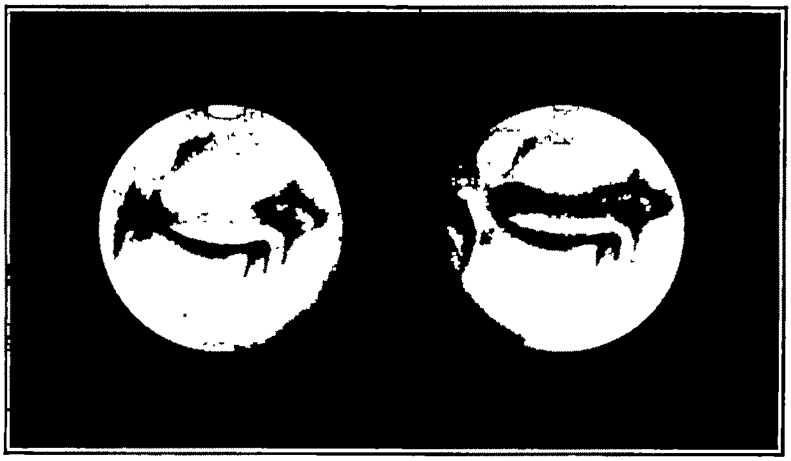


FIG. 1.—Aspects of Mars, September 1924 and October 1926, showing changes in the characters of *Sinus Sabaeus* and *Pandorae Fretum*

Several changes of this kind have actually occurred since 1924, and some of them have been sufficiently extensive to be visible with quite small instruments. Figs. 1 and 2 show two of the more conspicuous alterations that have so far been noted. Just below the centre of the disc in the two views forming Fig. 1 is a dark belt-like marking. This, the *Sinus Sabaeus*, is nearly always a conspicuous feature; but above it, and separated from it by a lighter strip, is another dark streak, known as *Pandorae Fretum*, which is subject to marked changes from time to time. It will be observed that, whereas in 1924 it was faint and tapered towards the left, it was in 1926 much darker and approximately of the same breadth throughout. So far as the increase in intensity is concerned, the change is partly of a seasonal character, though the darkening took place earlier in 1926 than in 1924. But in the latter year the marking never attained quite the same breadth, so that to this extent the change is anomalous. More striking still has been the change observed in *Solis Lacus*, shown in Fig. 2. This marking, which lies in a region often referred to as the "Eye of Mars," will be readily recognised on both sketches just above the centre of the disc. Irregular changes in the size and outline of the *Lacus* have occurred several times during the past century, but for some years now it has generally appeared roughly pear-shaped, with a thick 'stalk' connecting it with the dark areas on the left. It was of this shape in 1924, as indicated by the first sketch, but since then a complete transformation of its outline has taken place. This, as will be seen, has been brought about by a wide extension of the free end of the 'pear' in a northerly direction, and this extension is much deeper in tone than was any part of the marking in 1924. Further, minor changes in the neighbouring regions will also be noted.

A satisfactory explanation of such gross changes as these, affecting thousands of square miles of the planet's surface, cannot at present be advanced; but if we assume, as now seems reasonable, that the dark areas of Mars represent tracts of vegetation, it appears possible that the irregular effects observed are due to seasonal abnormalities, such, for example, as the occurrence of unusually wet or dry summers.

There is need, however, for more study before we can reach confident conclusions upon the matter. Fortunately, the observations necessary are not of great delicacy, being in fact well within the range of the instruments commonly at the disposal of amateurs. In the writer's opinion, much valuable time and trouble has been wasted in the past in attempts to observe and delineate the more minute details of the surface of Mars. Such fine detail can at the best be only imperfectly seen in common instruments, and there is room for much difference of opinion as to its precise nature. On the other hand, the extensive modifications of outline and intensity already described are quite beyond all question, and present to us a most interesting problem to which there is good hope of an ultimate solution. Observations made on these lines will increase in value with the lapse of time, and will for many years to come provide profitable work for much smaller instruments than were at one time thought necessary for a successful study of the planet.

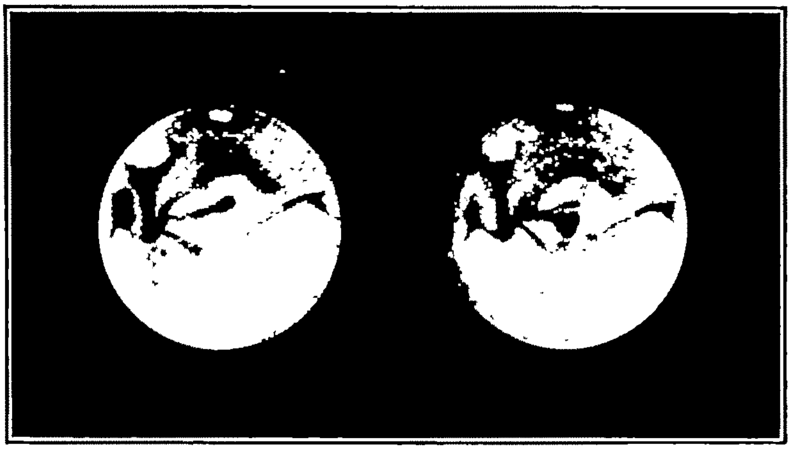


FIG. 2.—Aspects of Mars, October 1924 and October 1926, showing changes in the character of *Solis Lacus*.

News and Views.

LORD BALFOUR presided at the first meeting of the Imperial Conference Research Sub-Committee held on October 25. In his opening speech he re-emphasised the points made in Mr. Amery's address to the Empire delegates the previous week. Research is more important to the British Empire than to any other great power. The Empire in its different parts is confronted with a bewildering variety of problems of almost baffling complexity, the solution of which depends upon the success of the efforts of a considerable body of research workers and the effective co-ordination of their work. Reference was made to the co-ordinating machinery already developed, in which the Department of Scientific and Industrial Research, the Development Commission, the Medical Research Council, and the Royal Society participate. Much of the work undertaken by those bodies is of interest to the Dominions and Colonies, but it is an open question whether the existing machinery is adequate to the needs of the tropical countries of the Empire with their special needs and problems. Representatives of the Dominions followed Lord Balfour with accounts of the efforts being made in their respective countries to apply science to the solution of their particular problems, the representatives of Australia and New Zealand paying warm tributes to the assistance they had received from Sir Frank Heath during his recent visit. Mr. D. T. Chadwick said that the devolution of larger powers to the Provinces in India had been a serious obstacle to the effective co-ordination of research. Mr. Ormsby-Gore, who wound up the discussion, spoke of the isolation of the research workers in tropical colonies of Great Britain, their difficulties of inter-communication, and their dependence on the prosecution of research in the Dominions and Great Britain, and the more effective distribution of the results obtained. There is a scarcity of scientific investigators in the tropics, to remedy which he urged the provision of more highly paid posts such as would induce promising scientific workers to enter the Colonial Service.

AT the third meeting of this committee Mr. J. W. Dulany gave an account of the progress of research work in the Irish Free State. He was followed by Sir William Clark, Comptroller-General of the Department of Overseas Trade, and Dr. A. W. Hill, who described respectively the functions of the Imperial Institute and the Royal Botanic Gardens, Kew, in connexion with Empire research. The reference made to the potentialities of the Imperial Institute as a co-ordinating centre for imperial activities in scientific research is welcome in view of the sceptical attitude of some of the Dominion representatives regarding its work and functions expressed at the meeting of the Imperial Conference held in 1923. The Institute has been persistently starved for funds, the contributions of the Dominions and the Tropical Colonies having been niggardly in the extreme; its scientific staff has met with every kind of discouragement for years, having been inadequately paid, given no security of tenure, and forced to work with inadequate laboratory accommodation and equipment; and much of the work for which it was originally intended has been handed over to other bodies, *e.g.* the Imperial Entomological Bureau and the Imperial Mineral Resources Bureau. Nevertheless, it has a nucleus staff, the members of which have striven for years in the face of these various difficulties to investigate the problems in connexion with the utilisation of the plant and mineral resources of the Empire and to act as a clearing-house for Imperial researches. Properly endowed it could become a very important factor in the co-ordination of Empire research, and it is to be hoped that the awakening of the Dominions to the importance and meaning of scientific research means that they will be prepared to give this institution the support it deserves.

THE speech on Empire air transport by Sir Samuel Hoare, Secretary of State for Air, at the Imperial Conference on October 28, may be taken as giving the collective views of his engineering staff. It would be interesting to have individual opinions, and to compare their sum with their resultant. With regard to fighting forces, the need for aircraft is a *chose jugée*; every belligerent will acquire the most numerous and effective aircraft it can get, from its own or neutral industry, for scouting, bombing, and fighting. Civil air transport has been proved over so wide a range of conditions that its extension to an Empire network is practically a question of finance. Airship service in war seems to be ruled out by the restriction that an airship must never come within range of an aerodrome or an aeroplane carrier. With regard to civil transport by airship, the record of service is adverse to the hope that even lavish expenditure will maintain regular services over Empire routes, and a schedule of 2½ days to Canada, 5 days to India, 6 days to Cape Town, 11 days to Australia, and 13 days to New Zealand, seems to outrun present knowledge. The technical staff concerned is working hard to reduce the difficulties inherent in the design of these vast structures, lighter than the turbulent atmosphere which sustains and buffets them, but the increase of size and change of form, by which it is hoped to solve some of the problems, demands extrapolation far beyond previous experience.

FOLLOWING the address of the Secretary of State for Air to the Imperial Conference, interesting accounts were given by the Dominion premiers and the Under-Secretary of State for India of the development of the air services for which they are responsible. The progress which has been made since the last Imperial Conference appears to be most gratifying and opens up romantic possibilities. It was evident that these appealed strongly to Mr. Amery, who summed up the discussion. He drew a picture of the isolated white worker in the tropics making business calls in his own aeroplane and flying to a bungalow in the nearest hills for a week-end rest. He remarked on the potentialities of the aeroplane in connexion with forest, fishery, and geographical surveys. The use of aeroplanes for the extermination of insect pests in the American cotton plantations area opened up the possibility of its extended use to the extermination of the tsetse fly in Africa. He struck a welcome note when he mentioned the discoveries which have been made from the air of long-forgotten cities, an old sacrificial way to Stonehenge, and archæological treasures in Sind, remarking that the use of the aeroplane in archæological research, one of the least material of researches, is not unworthy of the notice of the British Empire.

THE first department of anthropology in Australia has just been established in the University of Sydney. Funds for this purpose have been provided by the Commonwealth Government and the Governments of the various Australian States. Prof. A. R. Radcliffe-Brown, for some years past professor of social anthropology in the University of Cape Town, has been appointed to the new chair and took up his duties at the beginning of July. Provision has been made for including anthropology as a subject for the B.A. and M.A. degrees, and it is also proposed to offer a diploma in anthroplogy similar to that offered at Cambridge. Plans are being made for a special course of training in anthropology to be given at Sydney to cadets entering the Administration of the Mandated Territory of New Guinea. Special courses are also being provided for officials in New Guinea and Papua, missionaries and missionary students, and others who are unable to attend the University for a year and therefore cannot take the full diploma course The Rockefeller Foundation has placed at the disposal of the Australian National Research Council a sum of money for anthropological research in Australasia. The funds to be released in any one year are to be determined by the amount contributed for anthropological studies from other sources with a limit of 20,000 dollars a year. The Australian National Research Council has appointed a committee on anthropological research to advise on the expenditure of these funds, and plans are now in active preparation for carrying out researches in physical anthropology and ethnology.

THE report on the excavations at Lubaantun, British Honduras, on behalf of the British Museum, recently presented to the Trustees, of which a summary appeared in the *Times* of October 28, makes interesting reading. It is more than likely that this site will prove one of the most important in Central America in its bearing on the obscure question of the origin and early history of Maya culture. Not only is the site the largest, but it is also probably the earliest of Maya centres. Its extent, and the number and size of its buildings, including the hillside terraces which aroused so much interest when first reported, demand a very high antiquity for the period of its inception The work must have been continued over a very long time as well as required the efforts of a numerous and highly organised population. Further, the pottery and the plaques and figurines from surface finds correspond with the artistic style of "Early Maya" on such early sites as Copan and Quirigua, obviously a product of a long period of development, so that when the lower strata at Lubaantun are excavated, discoveries illuminating for the early history of the Maya may be expected. In many respects the Lubaantun site has proved to be unique in Maya culture. Of the four styles of architecture found on the site, one style of building which employed huge blocks of stone, large enough almost to justify the title 'megalithic,' was not hitherto known in Central America, though it occurs in Peru; while a so-called 'in-and-out' style is new in American architecture.

SENATOR MARCONI gave a very interesting James Forrest lecture to the Institution of Civil Engineers on October 26, when he discussed radio communication, with special reference to waves of short wave-length—that is, to high-frequency waves. It is common knowledge that the ether is becoming very congested with radio waves of certain frequencies. It is necessary, therefore, in order to utilise radio communication to the utmost, to extend the range of commercial frequencies It was first pointed out that many uses can be made of radio waves, particularly in controlling mechanisms such as targets, torpedoes, and aeroplanes at a distance. It is probable also that electric power will soon be transmitted through the ether over moderate distances. The difficulty that has to be overcome is to project the waves in a parallel beam so as to minimise the dispersion and diffusion of the energy into space. A few years ago, radio engineers were much more confident about their formulæ than they are to-day. Applying them logically, they found it necessary to use very large amounts of power and enormous and expensive aerial systems to ensure communication to great distances. Consequently the high working costs prevented any substantial reduction in telegraph rates. Senator Marconi said that the whole theory and practice of the art is being revolutionised. Until quite recently long-distance transmission was carried on exclusively by employing wave-lengths lying between 8000 and 30,000 metres (37·5 to 10 kilocycles per sec.) The Post Office Station at Rugby, for example, uses waves having frequencies of 16 kilocycles per sec. The total power used at this station is 1400 kilowatts. Many similar stations are operating in other parts of the world, their cost being of the order of 500,000*l*.

FOR the last ten years Senator Marconi, with the help of Mr. C. S. Franklin, has been experimenting with high-frequency waves. In 1923 and 1924 very satisfactory results with waves having 3260 kilocycles per sec were obtained. It was found that the daylight range steadily increased as the frequency of the waves was increased, the absorption decreasing very rapidly the higher the frequency was made. These results, Marconi said, cannot be explained merely by refraction, as the signals received over world distances are thousands of times stronger than indicated by the refractive theory. The Australian tests showed that with 9370 kilocycles per sec. it was possible to communicate for more than 23 hours out of the 24. With these high-frequency waves the dimensions of the aerials and reflectors are reduced proportionately and very little power is required. The Marconi Company has been given the contract to make high-frequency stations for Imperial communications. At the Bodmin station for communicating with Canada, thermionic valves generate the necessary high-frequency currents of 11,500 kilocycles per sec. Communication with Canada at the rate of 2500 letters per minute over the whole circuit has been maintained for hours at a time With these waves 'atmospherics' interfere very little. Even thunderstorms in the vicinity of the receiving station only cause interference when they are inside the angle of the receiving reflector. The high-power low-frequency stations in Great Britain are receiving and transmitting to America at an average speed of twenty words per minute for 18 hours a day. The low-power high-frequency stations, however, can work at least five times as fast over the same distance and for the same time. We are yet a very long way from being able to utilise radio waves to anything like their full extent. Their range of usefulness can be very greatly extended, and this will occupy the attention of engineers for many years to come.

A VALUABLE survey of the development and present position of the chemistry of the proteins was afforded on October 28 to fellows of the Chemical Society, when Prof. S. P. L. Sørenson, of Copenhagen, delivered the Hugo Müller lecture. The work of Mulder, of Proust and Braconnot, of Liebig, of Cramer, and of Hopkins and Cole on the composition of protein substances was mentioned; Emil Fischer's view that they consist essentially of amino-acids united by –CO · NH– linkings for many years formed the general foundation of all such researches, but recent work invites a modification of that conception. Prof. Sørenson is of opinion that conclusive evidence in favour of Troensegaard's pyrrole-ring structure is lacking, although it is clear that linkings other than those of the simple peptide type are present. It is, in fact, highly probable that some part of the nitrogen is present in heterocyclic structures, probably diketopiperazine rings. The observation, however, that none of the usual proteolytic enzymes attack diketopiperazine, whilst polypeptides are readily decomposed by erepsin, supports Abderhalden's contention that the diketopiperazine section of the protein molecule probably exists in a labile, tautomeric form, a consideration which the lecturer discussed in some detail. Further, he said, it is absolutely necessary to submit to closer examination the question as to how compounds having the assumed structure will behave towards proteolytic enzymes before attempting to reach decisive conclusions regarding the constitution of protein substances. Such investigations are being carried on by Waldschmidt-Leitz and his collaborators.

PROF. SØRENSEN turned next to the problem of the characterisation of individual proteins, in which small differences in the elementary composition are of relatively great importance. So, also, it is essential to distinguish between integral constituents and adherent or loosely-bound substances. Linderstrøm-Lang has succeeded in obtaining casein fractions containing different amounts of phosphorus, naturally raising the question whether it is possible to prepare casein free from phosphorus, yet still able to give the rennin reaction. In egg-albumin the phosphorus content is practically constant, and that element appears to be intimately associated with the rest of the molecular complex; but only a small part of the coagulable phosphorus of the serum-proteins is precipitable by alcohol. Hence it appears that the phosphorus is but loosely associated with the serum-protein complexes. Purification of the two proteins concerned by precipitation with alcohol at – 4° gives results entirely in harmony with this conclusion. Prof. Sørensen's estimate of the molecular weight of the egg-albumin molecule is 34,000, corresponding with about 380 nitrogen atoms. By the application of electro-analysis to egg-albumin solutions, it is possible to reduce the phosphorus content to a value not far removed from that required if one phosphorus atom is present in such a molecule. Similar results have been obtained by long-continued storage in ice.

THE Zentralanstalt für meteorology and geodynamics at Vienna was founded in 1851, at the instance of the Vienna Academy of Sciences; the seventy-fifth anniversary of the Institute therefore falls this year, and at the suggestion of the Director, Dr. F. M. Exner, the Academy has celebrated the event by issuing a *Festschrift* dedicated to the Institute. The volume, of about 200 pages, contains 13 papers by Austrian and German geophysicists, among the authors being Ficker, Exner, W. Schmidt, A. Wegener, Defant, Conrad, and A. Wagner. Wegener describes observations of twilight bows and zodiacal light made in Greenland in connexion with J. P. Koch's expedition of 1912–13; the last twilight bow appeared to be produced by the atmosphere at a height of not less than 700 km., an elevation unparalleled among atmospheric phenomena except by the aurora. The other papers, too numerous to summarise, are mainly meteorological, but there is one relating to variations of seismic activity in regions of folding, and another on the influence of the earth's rotation on the course of rivers.

THERE are now two international organisations which deal with meteorology: the International Union of Geodesy and Geophysics and the International Conference of Directors. By mutual arrangement, the former concerns itself only with the scientific side of meteorology, while the practical application is left entirely to the latter. The Conferences of Directors are held every six years, and at each a number of Commissions is appointed to deal with various aspects of practical meteorology, membership of which is not limited to members of meteorological services. Eight such Commissions met in Zurich on September 13-20. The British representatives were: Dr. G. C. Simpson, president of the Commission for the Réseau Mondial; Lieut.-Colonel E. Gold, president of the Commission for Synoptic Weather Information; Dr. C. Chree, president of the Commission for Terrestrial Magnetism and Atmospheric Electricity; Sir Gilbert Walker;

Sir Frederic Stupart (Toronto); Mr. C. J. P. Cave; Mr. C. Stewart (Pretoria); and Mr. R. A. Fisher. Afterwards the International Meteorological Committee met in Vienna on September 23-28 under the presidency of Prof. van Everdingen (Holland). The following are amongst the chief decisions reached: A system of visual gale warning signals, for day and night, was adopted for all national services, and agreement was reached as to the conversion of velocities read on anemometers into Beaufort Numbers for weather telegrams. The International Cloud Atlas—prepared in 1895 by Messrs. Hildebrandsson, Riggenbach, and Teisserenc de Bort—has for some time been out of print; a new atlas is to be prepared which will contain a new set of photographs and the proposed changes, for the consideration of the Conference of Directors meeting in 1929. An anonymous donor has generously provided funds for the purpose. Throughout its history the International Meteorological Committee has had no permanent staff and no funds. All secretarial work and the publication of the reports of the meetings have been undertaken by one or more of the national meteorological offices. It has now been decided that the time has come to establish a secretariat to look after the records of the Conference, Committees, and Commissions, to arrange the meetings, and to publish the records.

SCIENCE Service, the endowed organisation that supplies scientific news to ephemeral publications in the United States, has made a new departure by issuing its "Weekly News-Letter" in printed form to individual purchasers. The copy before us contains sixteen pages (10¾ in. × 8¼ in.), more than six of which are occupied by matter relating to the Service and by 'fillers,' the arrangement being such that any article can be cut out without damaging any other. To facilitate the indexing of cuttings, each article bears a key-word above the title and a date at the end. The price is the very moderate one of 5 dollars per annum, or 10 cents per copy, but teachers, professors, librarians, and club-leaders may obtain each issue for 6 cents. The idea of penetrating the class-room is good, and the matter should be useful for enlivening the teaching of science and geography. In style, the articles and notes are crisp and restrained, and although in some articles the language could have been simplified, as a whole they are better written than the scientific news items that occasionally appear in our daily press. They are, however, somewhat marred by the headings, which betray the inaccuracy born of sensationalism and the love of alliteration. Thus, the title "Ice Cream from Crude Oil" is chosen for a description of recent work on the use of certain petroleum constituents as raw material for making edible fats and other natural products; and an article entitled "Fighting Forest Fires with Weather Service" contains nothing about combating fires, but is an interesting account of work undertaken by the U.S. Weather Bureau in forecasting atmospheric conditions that favour the occurrence and propagation of forest fires (which are stated to do 16 million dollars' worth of damage every year). In a country like Germany, and to a less extent the United States, a publication of this kind should find a good market; in Great Britain, where scarcely a single scientific periodical is to be seen on a railway bookstall, or in a bookseller's shop, its chance of success would be very small.

THE opening meeting of the Illuminating Engineering Society on October 26 was, as usual, devoted to reports of progress and exhibits of novelties in lamps and lighting appliances, photometric instruments, etc. The summary of progress during the vacation presented by Mr. L. Gaster contained several interesting items of news, such as the references to the inclusion of provisions requiring sufficient and suitable lighting in the new Factory Bill now before Parliament, and to the formation of an Illuminating Engineering Society in Holland. The address also summarised experiences during Mr. Gaster's recent visit to the Continent, where illuminating engineering is being keenly studied. In view of the widespread propaganda on lighting and the efforts being made in all countries to develop the commercial exploitation of illuminating engineering, the need for the maintenance of a scientific and impartial attitude on the part of the illuminating engineering societies in the various countries was strongly emphasised. Another lengthy report, read by Mr. J. Y. Fletcher, surveyed progress in electric lighting during the past year. Afterwards there were a number of interesting exhibits. Developments in lighting on the railways were dealt with by Mr. S. G. Elliot (Underground Railways), and Mr. A. Cunningham (Southern Railway). A new form of daylight-factor meter was shown by Mr. H. Buckley of the National Physical Laboratory, Teddington, and the latest model of the Holophane Lumeter photometer by Mr. H. Allpress. Other exhibits included the new Sheringham reflector yielding a light visually resembling daylight in colour, the internally frosted electric incandescent lamps, and some pleasing forms of decorative lighting units of the enclosed type.

WITH the control over epidemic diseases which has been obtained in recent years, and with the increasing proportion of elderly persons in the population, cancer has come to be one of the most important killing diseases. On September 20 and the following days, an international conference, organised by the American Society for the Control of Cancer, was held at Lake Mohonk, New York State, and was attended by representatives from most European countries. The various papers and discussions brought out nothing of a very novel character, but they made clear the steady advance which is being achieved in diagnosis and treatment, and in an understanding of what cancer is. The results were issued to the public in the form of an agreed statement which should be helpful. The conference says that cancer (1) is not contagious or infectious, (2) is not hereditary, and (3) can, so far as is at present known, be controlled only by attention to personal hygiene and by early diagnosis and treatment. The interest and co-operation of the lay public have done much to improve general healthiness; we may hope that equally good results will follow in dealing with cancer.

DR. RUDOLF ABEL, professor of hygiene, University of Jena, delivered two lectures under the Chadwick Trust on October 19 and 20, taking as his subject "The Development and Present State of Public Health in Germany." The lecturer first described the bad hygienic conditions formerly prevailing in Germany. It was only after the foundation of the German Empire in 1871 that practical care of health was developed, and the conversion of Germany from a mainly agrarian State into an industrial one, with the development of the towns that followed this change, took place without disaster, thanks to the improvements in sanitary conditions which had likewise been proceeding. Public Health administration and legislation were then discussed. The Medical Officer of Health in Germany is a State official paid by the State, but the cost of hygienic institutions and sanitary work is borne by the community. During the last fifty years the death-rate has diminished more in Germany than in England, so that now the two countries are nearly on a level. As regards infectious diseases in Germany, notification of and inquiry into the cases, isolation and disinfection, are very similar to those obtaining in England. The campaign against tuberculosis is carried on by means of dispensaries, visits to the family, sanatoria and hospitals, and by education of the people on a large scale. Venereal disease increased much during the War, but is being dealt with by free consultations and treatment. Alcoholism diminished during the War owing to shortage of alcoholic beverages, but has since shown a recrudescence and is being combated by licensing regulations, clinics, and temperance societies. Maternal and child welfare is being cared for by special legislation, and infant mortality is declining, though it is still higher than in England. Industrial hygiene has been regulated in detail by many legal enactments. Housing conditions are not good in German towns; there is much over-crowding and a great shortage of accommodation. Very much is also being done for the social welfare of the poorer classes.

PROF. W. J. HUSSEY, Associate of the Royal Astronomical Society, Director of Detroit Observatory, Ann Arbor, U.S.A., died very suddenly on Thursday last, October 28, in London, at sixty-four years of age. He had arrived from America a few days before, and was to have sailed the next day for South Africa, where he was to have set up a 27-inch telescope on a site to be chosen—probably Bloemfontein.

THE Norman Lockyer Lecture of the British Science Guild will be given in the Goldsmiths' Hall (by kind permission of the Goldsmiths' Company) on Tuesday, November 23, at 4 P.M., by Prof. J. S. Huxley, who will take as his subject "Biology and Human Life." Tickets for the lecture may be obtained on application to the Secretary, British Science Guild, 6 John Street, Adelphi, London, W.C.2.

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 25 the following officers and new members of council were elected: *President*, Sir James Alfred Ewing; *Vice-Presidents*, Dr. W. B. Blaikie, Sir Robert Blyth Greig, Prof. T. H. Bryce, Prof. E. T. Whittaker, Dr. James Currie, Dr. A. Crichton Mitchell; *General Secretary*, Prof. R. A. Sampson; *Secretaries to Ordinary Meetings*, Dr. A. Lauder, Prof. W. Wright Smith; *Treasurer*, Dr. J. Watt; *Curator of Library and Museum*, Prof. D'Arcy W. Thompson; *New Members of Council*, Mr. J. W. Peck, Dr. J. Ritchie, Prof. R. Stanfield, Dr. A. L. Turner, Dr. G. W. Tyrrell.

THE sum of 400*l.* is allocated in each calendar year by the Institution of Petroleum Technologists to the advancement of research in petroleum technology and its basic sciences, and the Council is prepared to receive applications for assistance from this fund. Applicants proposing to engage in research in a university institution must be recommended by the professor under whom they propose to work. Applications from full members of the Institution require no additional support. Applications for grants from this fund must be received by the Secretary not later than December 1. Application forms may be obtained from the Secretary of the Institution at Aldine House, Bedford Street, Strand, London, W.C.2.

MESSRS. Automatic and Electric Furnaces, Limited, 173-175 Farringdon Road, London, E.C.1, inform us that they have a complete series of lantern slides, illustrating electric furnaces for hardening, tempering, carburising, annealing ferrous and non-ferrous metals, glass, etc., together with component parts of such furnaces, automatic temperature controls, and wiring diagrams, connected with various forms of circuits. These slides are available for the use of engineering societies and other technical associations.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer on electrical engineering at the Government Technical Institute, Insein, Burma—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (November 15). A Physicist to the Radio-Therapeutic Department of the Cancer Hospital—The Secretary, Cancer Hospital, Fulham Road, S.W.3 (November 20). A mistress of mathematics and science in the training department of the Dow Hill Girls' School, Kurseong, Bengal—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (November 27). A lecturer in physics in the Queen's University of Belfast—The Secretary (December 4). A junior technical officer at an Admiralty Experimental Establishment, with good practical knowledge of the design, manufacture and testing of wireless telegraph apparatus, and small alternating and direct current appliances—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. An assistant chemist under the Empire Cotton Growing Corporation for soil investigations in the Sudan—Dr. E. M. Crowther, Rothamsted Experimental Station, Harpenden.

Research Items.

The Rainmaker among the Lotuko, S. Sudan.—In *Sudan Notes and Records*, Vol. 8, No. 2, Prof C. G. and Mrs. Seligman have published notes on material relating to social organisation collected among the Lotuko of the Southern Sudan in the winter of 1921–1922. The Lotuko are organised into a number of independent territorial groups, each including a number of villages and divided into clans. At its head is a rainmaker (*Kobu*, fem. *nobu*), who is commonly referred to as "Sultan" by any Arabic-speaking Lotuko. He is the religious as well as the temporal head of the community. Both parents of a rainmaker should "have rain," though individuals with rain descent on the male side only have attempted to set up as rainmakers. They are not confined to any particular clan, but vary in different localities. Yet the clan gains prestige from his membership and his seat is looked upon as the headquarters of the clan. This tends to a territorial grouping of clans. A male rainmaker succeeds to the office on the death of his father, but a female cannot perform rain ceremonies until she is married to a rainmaker. A pool, Itaraba, has a sacred character and is associated with a semi-mythical rainmaker who is said to have lived five generations ago. In this pool live the crocodiles who are the deceased rainmakers of the Igago clan. A gourd of its water plays an important part in the rainmaking ceremony.

Gypsy Marriage in England.—Mr. T W. Thompson, who has been engaged in investigating gypsy marriage customs for some years, publishes in the *Journal of the Gypsy Lore Society*, Series 3, Vol. 5, Pt. 1, the results of a detailed analysis of a number of records of marriages contracted in some of the leading gypsy families in the nineteenth century. From these it is deduced that descent in the direct line and common parentage are bars to matrimony, notwithstanding a case of marriage to a granddaughter, and one of a half-brother and sister. There has been a number of cases of marriage between uncle and niece, and aunt and nephew, the latter less frequently, and usually uncles have preferred their brothers' to their sisters' daughters. The mating of first cousins has been exceedingly common in some families, and first cousins marry more frequently than second cousins. There is also a marked preponderance of ortho-cousin over cross-cousin marriages, which reflects a definite tendency towards marriage within the family circle. On the other hand, certain southern groups seem to show a preference for cross-cousin marriage, and generally with daughters of a mother's brother rather than a father's sister. It is suggested hypothetically that the Indian proto-gypsies possibly practised a two-clan exogamy, such as actually exists among Indian nomads classed as 'gypsies,' and that on quitting India they had a marked tendency to wed near kindred. Further, that while sojourning on the upland stretches between India and Armenia under the influence of Iranians and Arabs, they weakened the hold of exogamy and strengthened the tendency to alliances between close blood relatives. Polygyny occurs sporadically and the marriage of two or more brothers to two or more sisters is specially common. Further, a polygynist's wives have more often than not been sisters. Formerly it may have been usual to wed a deceased wife's sister and for a young widow to wed a brother-in-law; also it may not have been permissible to wed a younger sister before an elder. In addition to the sororate and the levirate there is evidence for the custom which exists among the Santals of India by which a man might cohabit with his wife's sisters before their marriage.

The Insect Fauna of the Dutch East Indies.—Two recent supplements to *Treubia*, the official zoological journal of the scientific institutes at Buitenzorg, are of special interest to entomologists. The supplement to vol. 6 (April 1926) is devoted to an extensive monograph of the Tabanid flies of the Dutch East Indies by Dr. J. H. Schuurmans Stekhoven, jr. This work forms a bulky volume of 552 pages with 18 excellent three-colour process plates of representative species. The fact that certain Tabanids play a significant part in the transmission of the disease known as 'surra' has evidently prompted the large amount of study and collecting that has been entailed in the production of this important monograph. It is probable that *Tabanus striatus* is the most prevalent mechanical transmitter of that disease in the East Indies, but it is very uncertain whether or not other species and genera of these blood-sucking flies may also be implicated. Altogether 266 species of the family are fully described in this work, and many are new to science. The supplement to vol. 8 (July 1926) consists of a very detailed study of the immature stages of Malayan Thysanoptera by Mr. H. Priesner. This work forms, unquestionably, one of the most careful and accurate accounts of the post-embryonic forms of those insects that has so far appeared anywhere. The abundance of material at his disposal has enabled the author to construct family, generic, and specific keys to the identification of both primary and secondary larvæ, while his descriptions are greatly enhanced in utility by the 16 plates illustrating numerous structural features.

The Respiratory Exchange of the Mussel.—In a very interesting paper in the *Biochemical Journal* (vol. 20, No. 4, 1926, p. 289) Mr. J. R. Bruce describes an apparatus by means of which he studied the gaseous metabolism of a stock of common mussels, *Mytilus edulis*, L., kept in a large concrete tank at the Marine Biological Station, Port Erin. For the experiments, equal samples were taken from the stock at fifteen roughly equal periods between March 1925 and April 1926; oxygen was determined by Winkler's method and carbon dioxide by an indicator method elaborated by the author. It was found that the oxygen requirements rose and fell in close agreement with the rise and fall of the temperature during the year, and also, though to a slighter extent, depended on the oxygen pressure. By making corrections for variations in these two factors, a third variation in oxygen intake was made evident which followed closely the reproductive cycle, there being an increase of 30 per cent. per unit weight of wet tissue between July and March, the period in which the reproductive reserves (largely glycogen) are being built up after the depletion consequent on the spawning of the previous spring. A point of the greatest interest is furnished by the disparity between the respiratory quotients at different periods, it being at its lowest in June and July and rising to a maximum in March. This is apparently associated with the changing chemical composition of the tissues during the period when glycogen is being stored, the drop from March to May corresponding to the period of fat formation preliminary to spawning in May.

The Mechanism of Geotropic Curvature.—We are still 'in the dark' as to the mechanism which is responsible for the different geotropic curvatures manifested by shoot and root, and recently another suggestion has come from Polish sources. F. Tondera directs attention to the early work of Kraus, who showed that the amount of water in the tissues on the upper and lower side of a horizontal axis may be different, and suggests that the gravitational influence on sap distribution will be different upon the cortex of a root, from which water is moving inwards to the stele, and the cortex of the shoot, which is evaporating water and receiving a fresh supply moving outwards from the stele. He concludes that as a result the gravitational effect upon a horizontal root may reinforce and increase the natural sap movement on the upper side of the root and the lower side of the shoot, thus causing downward (positive) geotropic curvature in the first case and upward (negative) curvature in the second. His paper in the *Bulletin International de l'Académie polonaise des Sciences et des Lettres*, 8 B, 1925, contains very little experimental evidence; but the theory recalls in some respects the suggestion recently put forward by Ricôme in the *Rev. Gén. de Botanique*.

THE ROCKS OF JAN MAYEN.—The first comprehensive collection of rocks from the hitherto little known island of Jan Mayen was made by Mr. J. M. Wordie in 1921. This material has now been studied petrographically by Dr. G. W. Tyrrell, and the results, together with seven new analyses, are recorded in the *Trans. Roy Soc. Edin.* (vol. 54, Pt. 3, No. 19, Oct 2, 1926). The most abundant rocks appear to be trachybasalts with subsidiary trachytes and ankaramite (ultrabasic olivine basalt), and they occur as lava-flows or small intrusions. Trachyandesites and plateau-basalts are also known, but so far only as blocks and pebbles in a volcanic conglomerate. The only previous analysis of first-class importance was made by Dr. H. F. Harwood of a trachybasalt described by Prof. A. Holmes in 1918. The new analyses now recorded show that the suite as a whole is of mildly alkalic character with titanium dioxide ranging up to nearly four per cent. Holmes's deduction of a richly titaniferous belt in the Brito-Arctic Province stretching from Greenland to the Hebrides thus receives further support. The original magma appears to have been of trachybasaltic composition, differentiation having produced sub-magmas of trachytic and ultrabasic extremes. The specimens of plateau-basalt seem to be more ancient than the exposed lavas and they probably represent the underlying basement of the island.

SPANISH PETROLOGY.—The Iberian Peninsula consists structurally of three main tectonic features: a central plateau of pre-Cambrian and Palæozoic rocks which were extensively invaded by granites towards the close of the Carboniferous; a southern Betic Cordillera of folded rocks; and a similar northern folded belt forming the Pyrenees and Cantabrian Mountains. Hitherto little has been known of the chemical characters of the Carboniferous granites, but in a recent paper this deficiency is made good by Dr. H. S Washington (*Journ. Wash. Acad. Sci.*, Sept. 19, 1926). All the specimens studied, of which four have been analysed, are simple biotite granites of approximately average composition, the uniformity in this respect being especially noteworthy. The later igneous rocks of the folded and faulted borders are strikingly different, as they include a wide variety of alkaline, mostly soda-rich, types. It is pointed out in a comparative survey that a similar contrast between granitic horsts and alkaline peripheral regions is shown by many other areas, such as the Canadian, Brazilian, and Fenno-Scandian shields. The distribution of soda rocks around older granites is regarded as unfavourable to the hypothesis that they are derived from basaltic magmas by assimilation of limestones.

WEATHER IN SAMOA.—The report of meteorological observations for 1923 made at the Apia Observatory has recently been received. Magnetic, meteorologic, and seismic observations are given in detail. Magnetic disturbances were not numerous during the year, and those which occurred had little effect upon the declination. The mean air temperature for 1923 was 26°·08 C., while the normal for the years 1890–1923 is 25°·78 C. The total rainfall in 1923 was 3772·6 mm. and the normal is 2688 mm. The abnormal rainfall was largely due to the unusual precipitation during March, when rain was general throughout the Samoan Islands; at Alsisa the fall for the month was 117·82 in. (2993 mm.). This unusually heavy precipitation was the result of a circular storm which originated to the south-west of Samoa and was considered by residents to have been the most severe in twenty-five years. It caused general damage to roads and public works and resulted in considerable reduction of the copra output for the year. Of 119 earthquakes 79 were local and had their epicentre within 100 km. of the observatory; six earthquakes were reported as felt by people living in Apia and vicinity. Between June 1 and December 31 eighty-one balloons were sent up, and thirty-nine of these were followed to a height of 5 kilometres or more. The greatest altitude observed was 21 kilometres, on December 19. Grateful acknowledgment is expressed of substantial grants from the Carnegie Institution of Washington and from the British Admiralty.

INVAR STEEL BALANCE BEAMS.—The issue of the *Proceedings of the Physical Society of London* for August 15 contains a paper by Mr. J. J. Manley on the properties of a precision balance with beams of invar steel, which was shown by Messrs. Oertling at the Exhibition of Apparatus held by the Physical and Optical Societies in January last. The great rigidity of the beam reduces the bending under load and gives a sensitivity independent of the load. The small coefficient of expansion of invar was not found to make the resting point of the beam independent of temperature, and Mr Manley attributes this to relative movements of the knife edges themselves. The magnetic field has its effect on the beam, but any error due to this may be eliminated by using Gauss's method of double weighing. In the discussion of the paper, Mr. Gould stated that the effect of temperature changes on the invar steel balance of the National Physical Laboratory was of the same order of magnitude as that found for balances with gun-metal beams as usually made.

THEORY OF AIRSCREWS.—Recent developments in vortex theory in its application to airscrews has enabled the behaviour of a propeller under normal working conditions to be examined, but the theory breaks down in the vortex ring state and in part of the windmill brake state. Some recent empirical extensions of the theory based on general theoretical arguments have provided some information regarding the general nature of the characteristic curve. These are embodied in a report by H. Glauert (Aeronautical Research Committee, R. and M. No. 1026, H.M. Stationery Office, 3*d*. net). The experimental data are analysed to determine the form of the characteristic curve for those regions for which the vortex theory is inapplicable or inaccurate. An empirical form of the characteristic curve has been determined fitting the experimental data and connecting up with the theoretical curves in the propeller and windmill brake state, but its precise form will remain somewhat uncertain until further experiments are available from an open jet tunnel. Further developments along these lines are clearly indicated in the near future.

Supraconductivity.—W. Meissner, *Zeit. für Physik*, vol. 38, p. 647, 1926, has recently examined the low-temperature resistance of single crystals of cadmium, gold, and zinc, and of very pure specimens of iron, nickel, platinum, and silver in the form of wires. Although measurements were made at temperatures so low as 1·3° absolute, no indication of the phenomenon of supraconductivity was found with any of these metals. It thus appears that supraconductivity may only be exhibited by a particular group of metals, although it is still possible that at temperatures lower than 1·3° absolute the above metals may exhibit it.

The Molecular Weights of the Proteins.—Analytical and physical-chemical methods indicate that the proteins have very large molecular weights, *e.g.* the smallest, of egg albumin, is approximately 34,000 Recent work on the lowering of the freezing-point of phenol had yielded values between 200 and 600, and it was suggested that these values represent the true molecular weights of the units of a large aggregate which is stable in water but dissociates in phenol. This hypothesis does not agree with analytical evidence, and it is disproved by some experiments of E. J. Cohn and J B. Conant, described in the July issue of the *Proceedings of the American National Academy of Science* They found that the freezing-point depression depended on the method employed to dry the protein, and they therefore made use of the system phenol + anhydrous calcium chloride + hydrated calcium chloride. This has a sharp melting-point unaffected by small amounts of water and by the proteins, and it is concluded that no evidence exists for dissociation into units of low molecular weight

Moisture and Surface Action.—The current number of the Royal Society's *Proceedings*, 112, A 762, contains a communication by Prof. W. A. Bone, embodying the principal results of an inquiry, begun in 1908 and continued up to the present date, to determine whether or no moisture have any specific influence upon the combustion of carbonic oxide at a heated surface. The surfaces tried were: 1. Refractory firebrick at 500° C. 2. Granular nickel oxide at 200°. 3 Granular copper oxide at 210°. 4. Gold gauze at 240°. 5. Silver at 360°. 6. Porous porcelain at 500°. The experiments have been carried out with the exceptional care and caution characteristic of all Prof. Bone's work. It appears that the immediate consequence of progressive drying is always to increase the effect of the surface, presumably by removing the film of water molecules by which action is retarded. The ultimate effect, which is usually observed only after a prolonged drying, is to diminish greatly or even stop combustion. Although the ultimate effect of drying the metallic surfaces was practically to stop combustion, on readmitting moisture the activity of the surface was in time restored. The effect on porcelain was peculiar: ultimately not only was the influence of the catalyst greatly diminished but also it was not regained on reintroducing moisture.

A Wide-Field Binocular Microscope.—The advantages of binocular vision in microscopical work has led to an increased use of the binocular instrument, which consists of two juxtapositioned microscopes complete in themselves, by means of which the object is seen with a true stereoscopic effect The introduction of a Porro erecting system to each of the two body tubes gives the further advantage that the image is viewed in its true position and not inverted or reversed. We have recently seen a specimen of a wide-field binocular microscope of this type which has been put on the market by Messrs. Bausch and Lomb, Ltd., of 37 Hatton Garden, London, E C. The instrument is provided with 2 pairs of eyepieces and 3 pairs of objectives, by means of which magnifications varying from 7, with a field of view of 25·4 mm., to 30, with a field of view of 8 mm., can be obtained. Each objective is provided with centering screws, and each pair is mounted in a substantial base. The achromatic eyepieces have a very high eye-point, which permits prolonged observations to be made without undue fatigue The microscope may be detached from its horseshoe base and placed directly on any surface which it is desired to examine. It may also be mounted on the end of a counter-balanced horizontal arm, which is capable of swinging round a vertical rod attached to a solid base or clamped to a bench. By means of these attachments, the microscope may easily be brought into position over a large area under examination. The instrument is thus adaptable to a great variety of circumstances and its range of usefulness for examining specimens under comparatively low magnification is almost unlimited.

Heat Conduction in Steel.—It is so generally believed that a fine-grained metal is essentially isotropic, that a paper by C. Benedicks, H. Backström, and P. Sederholm on "Anomalies in Heat Conduction as investigated in Spherical Steel Specimens," read at the Stockholm meeting of the Iron and Steel Institute, is of more than usual interest. The variation in the temperature gradient of uniformly heated steel spheres in different directions is so great as 1 : 8·5; the electrical resistivity, however, showed variations in different directions not exceeding the ratio 1 : 1·05. These variations in the thermal conductivity, of quite a different order of magnitude from those in the electrical conductivity, are probably connected with irregularities in the macrostructure. The thermal conductivity of a solid metal must represent two independent phenomena, (1) purely thermal, and (2) thermo-electrical. The latter involves eddy currents having such directions as to facilitate heat transfer by the Thomson effect. This part of the heat conductivity must be high for a metal possessing (*a*) a high electrical conductivity, and (*b*) a high Thomson coefficient. If a considerable part of the heat conductivity of, say, carbon steel is due to an inner thermo-electrical heat transfer, even small heterogeneities will thus be able to exert considerable influence on these thermo-electric currents, and may easily direct them into special preferential paths. From a practical point of view, there are two items to be specially considered. On one hand the transfer of heat in a massive steel piece will cause temperature irregularities of a possibly unfavourable character, especially as regards corrosion. On the other hand, the total heat transfer increases considerably with increasing dimensions of the metallic object on account of this electrical heat convection. In spite of the scarcity of available data, it seems justifiable to range the added dissolved elements in steel in the following order, so far as their influence on the thermal conductivity is concerned: Nickel, manganese, hardening carbon, aluminium, silicon, indicating that the thermal conductivity of iron is lowered least by 1 *atomic* per cent. of nickel, more by magnesium, and so on. Cementite carbon exerts only a slight influence.

The State and Industrial Research Associations.[1]

By J. W. Williamson, Secretary, British Scientific Instrument Research Association.

1. When in 1916 the Government of the day set aside a sum of 1,000,000*l*. to be expended in promoting scientific and industrial research, the Committee of the Privy Council for Scientific and Industrial Research, on the advice of its Advisory Council, decided that the sum should be expended in grants in aid to industrial research associations to be established for the purpose of conducting research on a co-operative basis. There were those who suggested that the best way of ensuring an extensive application of scientific research to industrial problems was to subsidise existing research agencies, whether in the universities and technical colleges or elsewhere; or to establish and endow in the country one or more research institutes after the type, say, of the Mellon Institute of Industrial Research in the U.S.A.

I think it will be granted by most, if not by all, of the members of this Conference that the decision actually taken was the wisest course; for one thing, because it was the only scheme which promised to secure the continuous co-operation in research of the industries presumed to be in need of research, and to get science domiciled in those industries. The experience of the last eleven years goes to show that it is only through some such agency as the industrial research associations that in many industries, though perhaps not in all, a real fusion of scientific knowledge and industrial experience and—what is equally important—a working co-operation of the scientific workers and the manufacturers can be effected.

2. There was, however, one principle laid down by the Committee of the Privy Council for the promotion of Scientific and Industrial Research, the body responsible for the administration of the million fund, which needs special examination to-day. It was stated, almost as though it were axiomatic, that the Government grant to the research associations, as and when they were established in accordance with the scheme, must be limited to a definite period, after which the associations must be independent of State financial aid. The period originally chosen was a period of five years, afterwards extended, for many research associations, to ten years.

If, as I am inclined to think, the limitation of the Government grant to a definite period of time was a policy deliberately adopted as being based, or assumed to be based, on certain accepted principles of political economy or in accord with recognised limits of State action, then I submit that experience has shown this policy to be of doubtful wisdom.

3. It is important at the outset to be quite clear as to the function of Government in this particular field of industrial research. It all depends whether the persuasion of the industries as to the value of research is put in the first place and the carrying out of industrial research in the second, or whether the extension of industrial research is put in the first place and the persuasion of the industries as to its value in the second. The first view leads directly to the principle of grant for a limited period; the second view implies some continuity of grant.

It is noteworthy that in regard to what is called 'pure' scientific research the Government adopts the second view. The grants to universities and kindred bodies, largely intended for 'pure' scientific research, are regarded as permanent in character. There is no suggestion that they should be limited to a period sufficient to persuade any persons or bodies of the value of 'pure' scientific research. It is the same with regard to education grants generally. No responsible person to-day suggests that Government grants for education should be continued only so long as may reasonably be necessary to persuade parents generally of the value of education. In these instances the Government regards it as a primary and paramount duty to ensure that, in one, 'pure' scientific research is carried out, and, in the other, that education is given. The appreciation by the sections of the community concerned of the value of pure research or of education is a secondary, though an important, consideration. It is worth remark here that much of the work of the research associations belongs to the categories of pure research and education.

Moreover, in certain fields of industrial research, as, for example, fuel, food, and forest products, the Department made no question that it was properly the duty of the State to finance wholly such 'national' researches. There was not the slightest squeamishness about expending the taxpayers' money on such researches; and rightly so, for the taxpayer, *quâ* citizen, is an ultimate beneficiary of the results of such research.

4. In that region of industrial research assigned to the research associations, however, the emphasis was the other way. The policy was designed apparently with the main object of convincing manufacturers of the value of scientific research by subsidising the research associations for such a period as could reasonably be estimated to be needed to bring conviction. In so far as it succeeded in that period in convincing the industries that it was worth their while to bear the whole burden of research the scheme succeeded; in so far as it failed to do this the scheme itself failed.

It was probably felt that to commit the State to a permanent subvention—or at least a subvention not limited in time—of industrial research, in those particular fields of industry covered by the research associations, would come too near to subsidising those manufacturers who were members of the associations at the expense of the rest of the community. I do not seek to impugn the validity of such a principle or to weaken the force of such a healthy feeling, especially in these days, but I think that in this case certain factors have been overlooked, or at least have not been taken fully into account.

5. In the first place, it has to be recognised that it is impossible by scientific research to benefit the particular manufacturers who are members of the research association related to a given industry without conferring benefits, though to a less degree, on other manufacturers in the same industry who are not members of the association, and without benefiting also the community as a whole by the increased efficiency of the industry concerned, directly attributable to the research work done. I am not here hinting at any leakage of confidential information, though it is generally agreed that the period during which information of value can be kept confidential is limited. I am referring to those general processes of industrial diffusion which are always in operation. New ideas have a way of getting into the air. It is a well-known experience that increased efficiency on the part of some firms in an industry has stimulating effects on, and tends to raise the efficiency of, the rest of the firms in

---

[1] A paper entitled "Should the Government Grant to Research Associations be limited to a Period of Years?" read at a Conference of Research Associations on July 22.

that industry. To carry the matter further, the raising of the standard of efficiency in one industry has inevitably beneficial reactions on many other industries. These consequences are not limited in time but are continuous, and, I submit, there is ample justification, on purely business grounds, for asking the taxpayer to contribute continuously, so that this fertilising stream of research may continue to irrigate the particular fields of industry concerned, to the taxpayers' ultimate benefit

6. In the second place, it has to be remembered that in many cases the contribution of the manufacturer to the research association of which he is a member is only a part of the contribution which he makes to scientific and industrial research. Many of the manufacturing firms have research departments of their own. In some cases the sums annually expended to maintain and develop these private research departments are much greater, even by many times, than the annual subscription to the research association. Moreover, and this is especially important, the work of the research associations has tended, and will tend more, to stimulate further expenditure on these private research departments. I may mention, for example, that one firm, a member of the research association with which I am connected, testified, after only two years' experience as a member of the association, that the work of the association had given them increased confidence in their own research work so that they had doubled their annual expenditure under that head.

No doubt other research associations could bring forward similar testimony. This consideration may not apply as yet, in the same degree or to a like extent, to all the industries covered by the research associations; it is perhaps only well marked at present in those industries which have always had intimate relations with science. But the important point to be borne in mind is that, if the research association scheme is to develop all its capacities, such an experience must ultimately be a common experience in all the industries that support co-operative research. If and as the research associations become stable and vigorous institutions in our industrial organisation, the manufacturers will be led to increase the quota of their contributions to research, notwithstanding that, so far as the actual subscriptions to the research associations are concerned, they might continue to be on a pound-for-pound basis.

7. There is, therefore, no need for those who are responsible for directing the national policy as to research associations to feel that, if the Government continues indefinitely to support the research associations on, say, the pound-for-pound basis, they are subsidising one section of the community without ensuring collateral and proportionate benefits to the community as a whole. Nor need they fear that the continuous grant of the Government's annual pound will result in the manufacturers restricting their expenditure on research to an equal amount. The grant in aid would be dynamic. For every pound expended by the Government to subsidise the research associations on, nominally, a pound-for-pound basis, there would be a steadily increasing expenditure by the industries on research, both absolutely and relatively to the grant in aid.

It is by that method and along those lines that the industries can be best persuaded, *ambulando*, to increase continuously their expenditure on research, and thus to realise in substance the whole object of the research associations scheme. I submit, from the considerations already advanced and from others which will follow immediately, that to rely on the continuity of grant to bring about naturally and, as it were, automatically increased expenditure by industries on scientific research, is likely to be more effective in the long run than the method now adopted of giving grants for a limited period on a descending scale, so as at the end of the period to throw on the industries concerned the whole financial burden of supporting the research associations.

8. There is another aspect of the question which must make us doubt whether the proposal to cease grants to the research associations after a limited period is wise in the national interest. At present, and so long as Government makes grants in aid to research associations, Government has full knowledge of all that the research associations are doing; it has wide powers of regulation and control; it has numerous and recurring opportunities of co-ordination; it has powers to act, in the national interest, so that important results of research may not be confined too exclusively to any one industry where they are of actual or potential value to other industries; and, generally, through the Department of Scientific and Industrial Research, it acts as the focus and centre of the work of all the research associations.

The Department of Scientific and Industrial Research has shown, by sympathy and insight, how it is possible to reconcile the exercise of these powers of control, regulation, and co-ordination with the freedom and elasticity necessary to the research associations individually if their work is to be of productive value. If and when Government grants to research associations cease, these functions of Government must cease too, or at least be so curtailed as to lose their virtue, the consequences must be that the direct advantages now accruing to the Government services by the present *liaison* between Government and the research associations will be lost; the advantages to the nation as a whole, resulting from the power of the Government, through the Department of Scientific and Industrial Research, to secure correlation and co-ordination in important areas of industrial research, will disappear; and even the researches into 'national' problems, such as fuel, food, and forest products, must lose something when contacts between the Department of Scientific and Industrial Research and the research associations are broken. The very structure of our industrial system may be profoundly modified by the work of the research associations and the Government, by cutting itself adrift from these developments, be ignorant of their character and scope and be powerless to influence them.

It is worth notice here that the late Prof. Alfred Marshall, the distinguished economist, raised a cognate argument in his "Industry and Trade," first published in 1919. Referring to the research associations, and after pointing out that they are "wholly constructive," he says:

"But the experience of the ages shows that associations set up for constructive purposes are in danger of being turned to destructive ends: and therefore it may perhaps be to the public interest that some limited contribution should be made from public funds to the support of such associations, partly in order to facilitate the intervention of public authority in case an association should develop anti-social tendencies."

I have not time to examine the interesting implications of this passage, and I must be content to let the quotation speak for itself.

9. Another serious consequence of a divorce of the Government from the research associations, such as must necessarily follow from a discontinuance

of grants in aid, would be the weakening of the principle of co-operation. The research associations scheme is a scheme based on the conception that in scientific research, no less than in trade, there is a vast area in which the work needed to be done can be done effectively only by co-operation. One of the strongest arguments for such co-operative research is that, by its means, researches of vital importance to the respective industries can be undertaken, though they may be of a nature and extent which would make it impossible for any individual firm to undertake them. It is true that, theoretically, the research associations would still be free to undertake such researches even if Government grants ceased and relations with the Department of Scientific and Industrial Research were severed. In practice, however, there can be little doubt that the loss of the Government grant and the severance of relations with the Department of Scientific and Industrial Research would tend to discourage the research associations from undertaking these larger researches into problems not, at first sight, promising immediate benefits to the industry. When the industry has to find all the money for co-operative research, there will naturally be a tendency on the part of the industry to concentrate more and more on research work deemed likely to bring immediate or early benefits to the industry, and to postpone to a never-coming to-morrow those wider investigations which might not seem to promise results of immediate industrial value. It is because the continued association of the Government with the research associations helps the research associations to develop to the fullest extent all the capacities of co-operative research—because, shortly, the co-operative research is not fully co-operative without the co-operation of the Department of Scientific and Industrial Research — that the policy of putting a definite term to grants in aid is, in the national interest, mistaken.

10. The Advisory Council in its report to the Committee of the Privy Council for the year 1916–17 (Cd. 8718, p. 16) stated that there seemed to be room in the industrial world for three methods of financing research. "There is research which the individual firm finds it remunerative to undertake at its own expense. Secondly, there is research which is financed on a co-operative basis; and lastly, there is research which must be financed by the State if it is to be done at all." I submit that, in the national interest, the phrase "financed on a co-operative basis" should be interpreted as including the continuous financial co-operation of the State.

I do not pretend in this paper to have done more than to have touched lightly a few of the points that must arise in a discussion of this important matter. I hope, however, that I have said enough to show that the principle of limiting State aid to research associations to a definite and comparatively short term of years is neither axiomatic nor sacrosanct, but, judged from the national interest, and even by that criterion alone, of dubious value.

Sir Charles Parsons and the Steam Turbine.

THE presentation of the Kelvin Medal to Sir Charles Parsons, and the delivery of the James Forrest Lecture on "Radio Communications" by Senator Marconi, took place on October 26 at the Institution of Civil Engineers. The assembly was the largest ever seen at the Institution; and among those present was the Italian Ambassador. In presenting the medal on behalf of the Kelvin Medal Award Committee, Sir William Ellis, the president of the Institution, referred to the work of Sir Charles Parsons in the fields of scientific inquiry and the applications of thermodynamics, remarking that the medal commemorated the achievements of Lord Kelvin in those branches of science which are especially applicable to engineering. Reference was made to the scientific environment in which Sir Charles Parsons was brought up and to the work of his father, the Earl of Rosse, who in 1845 completed the famous reflecting telescope at Birr Castle, and later Sir William Ellis sketched the progress of the steam turbine with which the name of Sir Charles Parsons is so closely associated.

The acknowledgment of the gift of the medal by Sir Charles Parsons was followed by some reminiscences of great interest. He touched upon his boyish attempts to construct models of such materials as were available—a far better thing for a boy than playing with mechanical toys. One of his early inventions was a sounding machine with a glass tube closed at the end, somewhat similar to that of Lord Kelvin, but, said Sir Charles humorously, "I believe Kelvin's invention was made independently" Sir Charles also reminded his hearers of his experiments in making diamonds, which, however, when tested, proved not to be diamonds at all. He still thought something might be done in that direction. When engaged with the steam turbine, the financial and commercial difficulties were greater than the scientific and mechanical, and he recalled with pleasure the favourable opinion of the turbine expressed by Lord Kelvin on more than one occasion. It was a notable day in the history of the turbine when the turbo-alternator set supplied to Cambridge in 1892 showed an economy superior to the reciprocating engines of that time.

Sir Charles Parsons was born on June 15, 1854, being the fourth son of the third Earl of Rosse. A glimpse of his early surroundings can be obtained from the "Reminiscences" of Sir Robert Ball, who in 1865 became tutor to Sir Charles and his two brothers. After being privately educated he entered St. John's College, Cambridge, and graduated in 1876, being eleventh wrangler. Four years were then spent at the famous Elswick Works, where he came under the influence of Lord Armstrong, and in 1883 he became junior partner in the firm of Clarke, Chapman, Parsons and Co., of Gateshead, where he began his life's work on the steam turbine.

Many patents for rotary engines were taken out during the nineteenth century, but modern turbine work begins with those of 1884. First came the patent of the Swedish engineer, Gustav de Laval, for an impulse turbine, and this was followed by those of young Sir Charles Parsons. Of the patents of April 23, 1884, No 6734 was for "improvements in electric generation and in working them by fluid pressure," and No. 6735 was for "improvements in rotary motors actuated by elastic fluid pressure, and applicable also as pumps."

The pioneer Parsons turbine constructed was a double-ended parallel-flow machine, running at 18,000 revolutions per minute, driving an armature only 2¼ inches in diameter. This little machine was used in the Inventions Exhibition of 1885, and is now at the Science Museum, South Kensington By 1889, 300 turbo-generators had been constructed, the largest being 75 kilowatts. Soon after this the firm of C. A. Parsons and Co. was founded, followed a few years later by the Parsons Marine Steam Turbine Co. The year 1887 saw the construction of the first compound turbine; the year 1892 that of the first condensing turbine. From the 75-kilowatt set of 1889 the turbine gradually grew in size, sets of 3000 kilowatts being made in 1902, while to-day there are machines in use of 60,000 kilowatts. The development of the marine turbine is represented by the engines of H.M.S *Hood*, of more than 150,000 horse power. The first turbine-driven vessel was the *Turbinia*, and this was followed by the destroyers H.M.S.'s *Cobra* and *Viper*, the cruiser *Amethyst* and the battleship *Dreadnought*, and other vessels for commercial purposes.

The work of Sir Charles Parsons during the last forty years has often received acknowledgment. He has been a fellow of the Royal Society since 1898, and is an honorary doctor of science of six universities. From the Royal Society of Arts he has received the Albert Medal, from the Institution of Electrical Engineers, the Faraday Medal; and from the Franklin Institute of America, the Franklin Medal. In connexion with the award of the last, it was remarked that "it is no exaggeration to say that the work of Sir Charles Parsons has halved the cost of producing electric power, and reduced in still greater proportion the capital cost of generating machinery."

The Magnetic Storm and Aurora of October 14-15, and Associated Solar Activity.

THE magnetic storm which was recorded in NATURE of October 23, p. 603, was accompanied by a display of the aurora which, owing to cloudy skies over a large part of Great Britain, was not seen generally. It is therefore of added interest that Mr. W. B. Housman, of Seaton, West Cumberland, was able to secure eight photographs of the phenomenon, four of which are reproduced herewith (Fig. 1).

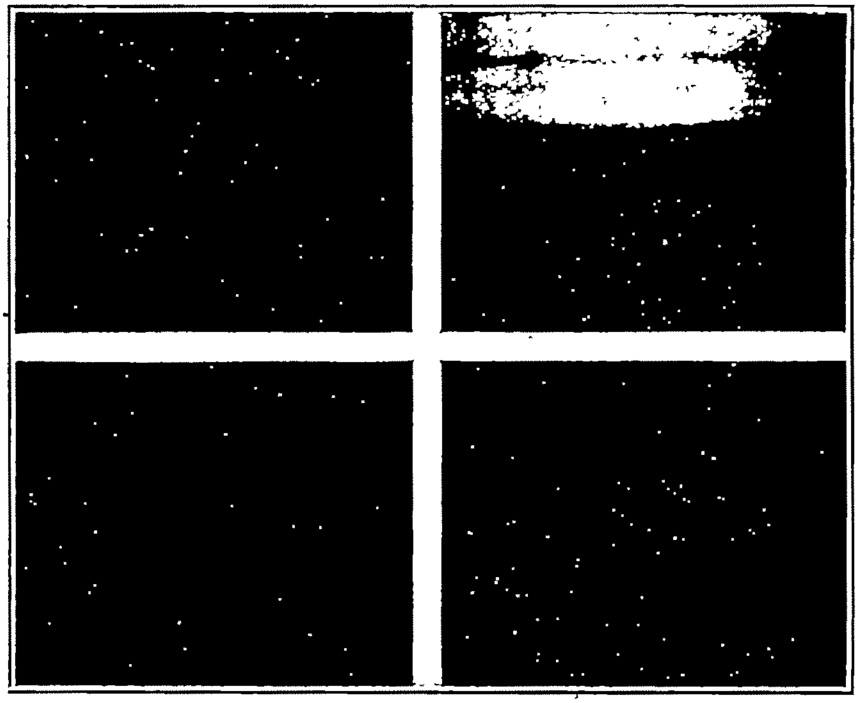


FIG. 1.—Aurora of October 14-15, 1926 From photographs by Mr. W. B. Housman.

It will be recalled that at Greenwich the commencement of a magnetic disturbance of moderate intensity was recorded on October 14 at 20 hr. This disturbance, which lasted for about 12 hours, was followed on October 15 at 19 hr. by another of considerable magnitude, the magnetograph traces showing a total displacement of more than 1° in declination. The two upper photographs of the aurora were taken at 1 h. 30 m. on October 15 during the precursory disturbance, and the lower photographs show the aurora on the evening of the same day at 22 hr., that is, about three hours after the commencement of the major disturbance. The photographs were taken with a camera with an aperture of 2 in. and focal length of 4 in., the exposures being from 10 to 15 minutes. In the upper photographs, taken with the camera pointed to left and right respectively of the centre of the auroral light, the constellation Lyra is seen on the left, and on the right the brilliancy of the aurora practically absorbs all the star trails, while the Scotch coast, 20 miles distant, is revealed by the light. The two lower views show the western extremity and the north-eastern region of the aurora on the following evening. Some details of the photographs are of course lost in reproduction.

Mr. Housman's remarks on the phenomenon may be quoted in full: "In all views taken, and particularly in these four, dark bands are to be seen running concentric with the auroral arc of light. They were noted visually, and are even more pronounced photographically, their position and persistent continuance suggesting a connexion with the aurora itself. The colours seen in this display were very beautiful. On October 14, 23 h. 30 m., G.M.T., the arch frequently shone with a rich crimson glow, and on October 15, about 22 hr. G.M.T., the N.E. end was quite a bright green. Orange and pale straw colour also appeared in the arch at different places simultaneously. On the night of October 15-16 the auroral green line was seen in a pocket spectroscope all over the sky except in the south-east, where moonlight was strong for a time."

It is known that there is a definite tendency for auroræ, as well as magnetic storms, to occur at intervals of about 27 days—the same interval in which the spot producing zones of the sun make one rotation as seen from the earth. Mr. Housman mentions that the recent aurora is apparently a return of a fine display seen on September 15; a recurrence of the phenomenon should therefore be looked for about November 11. Mr. Evershed in a letter to NATURE of December 29, 1921, p. 566, describes a sequence of disturbances lasting for six months, the mean period being 27·3 days. It is perhaps of interest to mention that at the time when the magnetic storm was most intense there were no indications, judging from the reception of the Annapolis time signals registered at Greenwich, that conditions for radio transmission were in any way abnormal.

As stated in NATURE of October 23 last, there were, at the time of the magnetic storm, four large spots on the sun's disc, none of which, however, from its telescopic appearance suggested any unusual activity. From a discussion of the occurrence of a number of magnetic storms, Mr. E. W Maunder found that the average position of spots, which were apparently related in some way to the disturbances, was about 14° west or 1 d. 2 h. past the sun's central meridian at the time of their commencement (*Monthly Notices, R.A.S.*, 64, 206). This would indicate, in the present instance, the group of spots with central meridian passage on October 13·7.

Mr. A. A. Buss states that this group showed pronounced spectroscopic activity, and particularly so on October 13, when observations at 13 h 30 m. indicated that very brilliant eruptive prominences were being shot out in different directions from the immediate vicinity of the chief spot. Considerable line of sight motions in the spectrum line *Hα* were also observed by Mr. Buss in connexion with the spot of central meridian passage, October 16·7. Another fact, probably merely a coincidence, but not to be entirely overlooked, is that the time interval between the preliminary and great magnetic disturbances is roughly equivalent to the difference in longitude between the leading and following spots of the third group with central meridian passage, October 11·2.

The recent magnetic storm is the fourth to be recorded at Greenwich during the present year. That of January 26-27 was described at the time as being the largest magnetic disturbance for five years. The progress of the sun's periodic activity may be readily gauged from the following table giving mean daily areas of sunspots, corrected for foreshortening and expressed in millionths of the sun's visible hemisphere. The year 1917 was the maximum for the last cycle.

Year.	Area.	Year.	Area.
1917	1537	1922	252
1918	1118	1923	55
1919	1052	1924	276
1920	618	1925	829
1921	420	1926	still increasing.

During the last eighteen months there have been 19 unusually large spots which have been recorded naked-eye spots in our astronomical columns. Two of these have coincided with two of the four magnetic storms. Three of the remaining large spots have coincided with moderate or active magnetic disturbances. Coincident with the few days near the central meridian passage of the remaining 14 spots, the magnets have shown slight or no disturbance at all. It is in connexion with the anomalies met with in the attempt to correlate magnetic storms with particular solar disturbances that the work of the Mount Wilson observers on sunspot polarities, and also that of solar spectroscopists in general, is of much importance.

University and Educational Intelligence.

CAMBRIDGE.—The following re-appointments have been made: Dr. C. G. Lamb, Clare College, to be reader in electrical engineering, and Mr. P. Lake, St. John's College, to be reader in geography; Mr. W. E. Johnson, King's College, to be Sidgwick lecturer in moral science, and Dr. H. Lamb, Trinity College, to be Rayleigh lecturer in mathematics.

At the recent matriculation, 1650 freshmen were matriculated.

For the sixth year in succession, Trinity College announces the offer of a Research Studentship open to graduates of other universities who propose to come to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be so much as 200*l*. a year if the pecuniary circumstances of the successful candidate require so large a sum. Applications must reach the Senior Tutor not later than July 1, 1927. The College also offers, as usual, Dominion and Colonial Exhibitions to students of Dominion and Colonial Universities who wish to come to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These exhibitions are of the titular value of 40*l*. but their actual value is such sum (if any) not exceeding the titular value as the College Council may from time to time hold to be justified by the exhibitioner's financial circumstances. If the financial need of an exhibitioner cannot possibly be met by payment of the full amount of his titular emolument, the Council may award him an additional payment. Candidates must apply through the principal authority of their university, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by July 1, 1927.

EDINBURGH.—Dr. David Bain has been appointed lecturer in technical chemistry in succession to the late Mr. Allin Cottrell, and Mr. J. Evans Gordon lecturer in the Department of Agriculture.

LEPLAY House Educational Tours Association has organised a Christmas vacation tour to Rome, which is open to all interested in archæological, historical, and sociological subjects. There will be a special course of lectures on ancient and modern Rome, and visits will be paid to museums, art galleries, etc., under the guidance of experts. The party will leave London on December 27, and return to London on January 11. Full particulars may be obtained from Miss Margaret Tatton, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

THE "Leicester, Leicestershire and Rutland University College," Leicester, offers in its prospectus for 1926–27 full preparation for the Arts, Science, Commerce, Law, and Music Degrees of the University of London. Although founded so recently as 1921, it had last year 126 (including 68 full-time) students, all preparing for degree examinations, and it is already able to point to a long list of academic honours obtained. In the session 1925–26 departments of chemistry and physics were inaugurated. During the first term of the current session a "co-ordinating course," consisting of one lecture by each lecturer in turn on biology, chemistry, classics, English, French, geography, history, mathematics, physics, is being given experimentally. Several important public lectures are announced. Hostel accommodation within the College precincts is available for women students, the fee for residence being 60*l*. per annum. The inclusive fee for tuition for any stage for a first degree in Arts or in Science is 25*l*. per annum. Such low fees are made possible by a substantial income (6000*l*.), from endowment. The College is not on the University Grants Committee's list of universities and university colleges, but it has received a grant from the City of Leicester. Should the scheme for an East Midlands University, mentioned in the article which appeared in our issue of October 16 on "English Provincial Universities," come to fruition, this college, as well as the Technical College, Leicester, would no doubt be a constituent part.

Societies and Academies.

SHEFFIELD.

Society of Glass Technology, October 20.—J. W. **French**: Glass annealing In any discussion of annealing the first question is the rate at which heat is dissipated by glass at the various temperatures of the annealing process. The other conditions determining the magnitude of the stresses that may be established in glass during the cooling process are: (2) The thermal expansion in contraction of the material; (3) thermal conductivity; (4) cohesion of the material; (5) the viscosity of glass; (6) the existence of a surface layer having properties different from those of the underlying material; (7) homogeneity of the glass; and (8) the form and dimensions of the glass. From the optical glass point of view, annealing means—(1) the raising of the temperature to a point just above that of the softening point of the hardest glass in the charge, and (2) the cooling of the plant at a rate which will not at any one point be sufficient to reintroduce stresses in any of the glasses.—E. A. **Coad-Pryor**: The economics of the annealing process. An account was given of experiments on which the Engineering Department and the Research Laboratories of the United Glass Bottle Manufacturers, Ltd., had been recently engaged at Charlton. In order to get the information on which to design a lehr on a sound theoretical basis, it was necessary to know the amount of heat taken into the lehr by the bottles and the heat lost through the lehr walls. Eventually heat was supplied to the lehr by means of the slats of the conveyer. During most of the period of testing, the lehr was running at about one-third of its maximum speed. The annealing was good throughout. When it was speeded up to its maximum rate, about 10 inches a minute, the annealing remained excellent, even on quart bottles. This speed represented an output of 450 gross of quarts per day, or about 40 tons of glass The lehr was fitted with a number of curtains to restrict draught up the tunnel. Once the curtains were adjusted to the correct setting, no further adjustments were required.—F. A. **Hurlbut**: A suggested improvement in the design of lehr conveyer.—E. **Meigh**: A new type of "fireless" lehr.

PARIS.

Academy of Sciences, September 27.—Henri **Jumelle**: Ravenea, Madagascar palm trees. There are seven species of Ravenea in Madagascar, of which detailed descriptions are given.—Jacques **Chapelon**: The emptying of a reservoir.—H. **Pécheux**: Researches on the dielectric constants of petrols and paraffins. Determinations of the dielectric capacity and its temperature coefficient for nine hydrocarbons ranging from petroleum spirit (density 0·655) to hard paraffin wax.—A. **Travers** and **Malaprade**: The constitution of the molybdates. The acid molybdates can be interpreted as being derived from two ions only, the tetramolybdic ion ($4MoO_3.O$) and the normal ion (MoO_4).

October 4.—A. **Desgrez**, L. **Lescœur**, and Mlle. S. **Manjean**: The influence of a current of inert gas on the decomposition of sulphide solutions. Application to mineral waters. Studies on the rate of removal of hydrogen sulphide by hydrogen from solutions of the gas alone, of sodium hydrogen sulphide, and of sodium sulphide, and of mixtures of these. The results find an application in the analysis of mineral waters containing sulphides.—Léon **Guillet**: The influence on the mechanical properties of copper and aluminium alloys of reduction of section produced by forging at a high temperature.—Maurice **Gevrey**: Certain properties of harmonic functions and their extension to the solution of linear partial differential equations.—Pierre **Humbert**: The equation of the prepotential plane.—Paul **Urysohn**: An example of an integral function taking on its circle of convergence an *ensemble* of non-measurable B values.—N. **Gunther**: An application of the universal functions of A. Korn.—A. S. **Besicovitch**: The fundamental geometrical properties of plane *ensembles* of linearly measurable points.—Alfred **Rosenblatt**: Certain irrotational movements of viscous liquids.—R. **Forrer**: The structure of the atomic magnet. The rotation and reversal of the multiplet.—**Verney**: An apparatus for the automatic control of furnaces. A description of an electrical apparatus by means of which a furnace can be made to follow any desired time-temperature curve.—Pierre **Bedos**: Some new reactions of the oxide of cyclohexene. Alkyl iodides react with cyclohexene oxide in sealed tubes at high temperatures (150°-190° C.), giving the addition compound, alkoxy-2-iodo-1-cyclohexane. A similar reaction is given by the acyl chlorides and bromides, esters of the orthochlor (brom) cyclohexanol being formed.—J. **Orcel**: The thermal analysis of the chlorites.—Mlle. Marcelle **Phillibert**: The opening of a special effusive *bouche* in the crater of Vesuvius.—Henri **Leenhardt**: Placosaurus.—Mme. Anna **Drzewina** and Georges **Bohn**: The antagonistic action of metallic silver and tin on living beings. The destructive action of metallic silver on Convoluta is reduced by the presence of metallic tin.—E. **Aubel**: Methylglyoxal considered as an intermediary in the course of the degradation of glucose by micro-organisms.—Constant **Mathis**: The virulence to man of the Spirochæte of the shrew mouse.—Auguste **Lumière** and Mme. J. **Enselme**: The suppression of anaphylactic shock by anæsthesia of the endo-vascular nerve terminations.—Charles **Lebailly**: Experiments on the virus of foot-and-mouth disease.

ROME.

Royal Academy of the Lincei.—Communications received during the vacation.—Gino **Fano**: Variety of binary forms of the seventh order.—Guido **Fubini**: Projective properties of surfaces of constant metric curvature.—Ferruccio **Zambonini** and Guido **Carobbi**: Presence of sodium and potassium fluosilicates among the products of the present-day activity of Vesuvius. In addition to ammonium silicofluoride, which occurs as cryptoalite, as a product of fumarolic activity on Vesuvius, and to the potassium salt, found as hieratite on both Vesuvius and the Island of Vulcano, malladrite, which is sodium silicofluoride, has now been detected on Vesuvius. Indications of the presence of further silicofluorides among the products of Vesuvian fumaroles have been obtained.—Ferruccio **Zambonini** and Silvia **Restaino**: Cerous-thallous sulphates. Investigation of the system, cerous sulphate—thallous sulphate—water demonstrates the existence of a third double sulphate, $Ce_2(SO_4)_3$, 4·5 Tl_2SO_4, hitherto unknown.—Luigi **Rolla** and Lorenzo **Fernandes**: The element of atomic number 61. Fractional crystallisation of the double salts formed with thallous sulphate by the sulphates obtained from commercial didymium oxide leads to fractions which, by study of their X-ray absorption spectra, are shown to contain the element of atomic number 61.—Giuseppe de **Lorenzo**: The *Elephas antiquus* of Pignataro Interamna in the valley of the Liri.—B. **Longo**: First results of the seeding of the 'flowerless' apple (*Pyrus apetala*, Munchh.).—Arnaldo **Masotti**: Uniform rotation of a pair of thin round cylinders in an indefinite perfect liquid.—Ubaldo **Barbieri**: Astronomical determination of latitude and azimuth made at Monte Settepani in 1911.—Maria Luigia **Paglianulo**: Rotatory and refractive dispersion of aqueous solutions of dextro-rotatory tartaric acid. The curves of refractive dispersion for tartaric acid solutions appear perfectly normal, but the derived curves similar to those previously employed with asparagine solutions exhibit a change of direction corresponding almost exactly with the maximum of the rotatory dispersion curves.—G. **Scagliarini**: Analogy of behaviour and isomorphism between cerium and thorium. The behaviour of the mixed oxides of the rare earth metals does not support the hypothesis that, in such oxides, ceric oxide forms part of a saline oxide. It is hence probable that the cerium is present in a condition of amorphous solid solution and that its solubility in acids depends on its condition of extreme subdivision. It may be, however, that when dissolved in other oxides, ceric oxide does not undergo that process of polymerisation which renders it insoluble when it is calcined either alone or in homogeneous mixture with other oxides. The same holds in the case of thorium dioxide. Further, in agreement with the positions of the two metals in the periodic system, the acetylacetonates of thorium and cerium are completely isomorphous.—G. **Scagliarini** and M. **Monti**: Additive compounds of halides of tin and titanium with organic bases (ii.). Stannic and titanic halides form additive compounds with hexamethylenetetramine together with one or more molecules of a solvent such as chloroform, bromoform, dichloroethylene, tetrachloroethane, etc. The composition of the complex compound obtained varies with the concentrations of the metallic halide and organic base in the solvent, and the colour of the product is usually deeper when the halide or the solvent preponderates over the base. Werner's theory does not furnish a satisfactory interpretation of these compounds.—Luigi **Mazza**: Products formed during the working of lead accumulators. Examination by means of the Debye-Hull method shows that the products formed during the charging and discharging of lead accumulators include lead, both in powder and in masses, lead sulphate, lead dioxide, various mixtures of these compounds, and other substances.—G. **Resegotti**: Crystallographic study of certain aromatic nitro-derivatives. 5-Methyl-2:6-dinitromethylhydrazobenzene crystallises in the prismatic class of the monoclinic system: $a:b:c=1\cdot27507:1:1\cdot37644$, $\beta=93°\ 30'\ 30''$; 5-methyl-2:4-dinitromethylhydrazobenzene: $a:b:c=0\cdot81915:1:0\cdot96209$, $\beta=93°\ 37'$ and α-methyl-α-phenyl-2:4-dinitro-5-chlorophenylhydrazine: $a:b:c=2\cdot8747:1:1\cdot4563$, $\beta=128°\ 3'$, also crystallise in the prismatic class of the monoclinic system.—M. **Sella**: Further facts relating to the migration of the tunny, ascertained by means of fish-hooks.—Antonino **Pais**: Influence of a hormonic stimulus, directed towards the testicles and ovaries, on the characters of the descendants

WASHINGTON, D.C.

National Academy of Sciences (Proc., vol. 12, No. 9, September).—G. A. **Miller**: Postulates in the history of science. Such postulates might make for progress. Postulate (*a*): in a modern work on the history of science, technical terms should be given only their modern meanings. Then the numbers which Napier first called logarithms are not logarithms in the modern sense, but serve some of the purposes of modern logarithms and were influential in their development. Postulate (*b*): a scientific concept must be clearly understood before its history can be presented satisfactorily.—H. J. **Ettlinger**: On the zeros of functions associated with a linear system of the second order.—Harry Merrill **Gehman**: Concerning irreducibly connected sets and irreducible continua.—Karl T **Compton**: Interpretation of deviations from Ohm's law. Bridgman has recorded small deviations from Ohm's law when currents of the order of 10^6 amp. per cm.^{2} traverse gold or silver films. Applying Thomson's doublet theory of conduction leads to improbable values for the magnitude of the atomic doublet. The experimental evidence is, however, consistent with the classical free electron theory.—R. C. **Gibbs** and H. E. **White**: Rubidium- and cæsium-like doublets of stripped atoms. Extrapolation of data available made possible the identification of various doublets of ionised rubidium, strontium, yttrium, zirconium, and cæsium, barium, lanthanum, cerium, præseodymium. They are relatively intense lines in the spark spectrum.—Walter A. **MacNair**: The fine structure of certain lines and energy levels of cadmium. Two different quartz Lummer-Gehrcke plates crossed with a quartz prism or grating spectrograph and a water-cooled cadmium arc were used.—F. A. **Saunders**: On the spectrum of argon.—A. Keith **Brewer**: Ionisation in reacting gases. The change of rate of thermionic emission and of chemical action with temperature follows the same general law. The rate and temperature of emission in certain oxidations are interdependent; above a certain point, a difference in the temperature and rate of emission of oppositely charged ions occurs. This suggests a selective force of the metallic surface.—Herbert W. **Rand** and Amy **Browne**: Inhibition of regeneration in planarians by grafting: technique of grafting. Two planarians are narcotised with chloretone. A piece of tissue is excised from one, the lateral nerve cord being severed. The animal is placed on an acid-free gelatin strip made by pouring the hot solution on to a glass slide and cooling. The head is then removed from the other individual, immediately inserted at the wound in the first animal and kept in position by strips of gelatin. After the graft had become established, the head of the stock was removed. Regeneration of the head or the stock would occur in a normal worm, but the presence of the graft sometimes inhibits it.—H. W. **Rand**, J. F. **Bovard** and D. E. **Minnich**: Localisation of formative agencies in Hydra. A double-headed animal is produced by grafting a new head on to the side of the stock and the stock head is then removed. Sometimes regeneration of the stock head occurs; otherwise the stump remaining is absorbed. A headless graft does not inhibit regeneration.—H. W. **Rand** and Mildred **Ellis**: Inhibition of regeneration in two-headed or two-tailed planarians Animals with duplicated head or tail were produced by splitting a portion of one worm longitudinally. Removing one head or one tail led in some experiments to regeneration of the lost member, but in other cases the 'dominance' of the remaining head or tail inhibited regeneration.

VIENNA.

Academy of Sciences, July 8.—K. **Fritsch**: Contributions to our knowledge of the Gesneriaceæ—(ii.) The American species of the genus Klugia.—V. **Cordier**: The action of bromine on urea and guanidine derivatives.—H. **Muller**: Attempts to find radioactive products of the atomic disintegration by α-rays.—M. **Blau** and E. **Rona**: Ionisation by H-rays.—R. L. **Hasche**: The method of counting scintillations.—E. **Lieben** and D. **Laszlo**: The relation of creatin to albumin and carbohydrate metabolism.—J. **Pollak** and E. **Gebauer-Fulnegg**: New *o*-azo compounds.—K. **Ohara**: The use of ash for the determination of woods.—J. **Koller**: A new synthesis of coniine. The synthesis of *p*-meth-oxy-ephedrine and of *m*-methoxy-*p*-oxyephedrine.—G. **Sachs** and M. **Ott**: Notes on the preparation and analysis of some products of methylation of thiosalicylic acid.

Official Publications Received.

British and Colonial.

Queensland Department of Mines: Queensland Geological Survey. Publication No. 277: Geological Reconnaissance between Roma, Springsure, Tambo and Taroom (The Carnarvon Ranges and Buckland Tablelands). By Dr. H. I. Jensen, assisted by J. R. T. Dunlop. Pp. v+215. (Brisbane, Qd.: Anthony James Cumming.)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 37, Part 3. Pp. 251-345+plates 10-16. (London: Edward Stanford, Ltd.) 5s.

Report on the Administration of the Meteorological Department of the Government of India in 1925-26, and a Note on the Long-Established Observatories of Madras and Bombay. Pp. 21+6 plates. (Simla: Government of India Press.)

Photographs of Eminent Chemists. (Published by the Chemical Society.) R. W. Bunsen, Emil Fischer, A. W. von Hofmann, D. I. Mendeléeff, L. Pasteur, Sir William Perkin, Sir William Ramsay, Sir Henry Roscoe. Size of photograph, 8 in.×6 in. (approx.); size of mount, 15 in.×11 in. (London: Gurney and Jackson.) 5s. each; 21s. the set.

Records of the Survey of India. Vol. 19: The Magnetic Survey of India, 1901-20. Prepared by Lt.-Col. R. H. Thomas and E. C. J. Bond. Pp. ix+67+121+6 plates+9 charts. (Dehra Dun: Survey of India.) 4 rupees; 6s. 9d.

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1925-26. Pp. 28. (London.)

Proceedings of the Royal Society of Edinburgh, Session 1925-1926. Vol. 46, Part 3, No. 25: On Bernoulli's Numerical Solution of Algebraic Solutions. By Dr. A. C. Aitken. Pp. 289-305. 1s. 6d. Vol. 46, Part 3, No. 26: On a Polarised Light Quantum. By J. M. Whittaker. Pp. 306-313. 9d. Vol. 46, Part 3, No. 27: Bothrodon pridii, an Extinct Serpent of Gigantic Dimensions. By J. Graham Kerr. Pp. 314-315. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted at the Meeting of the Administrative Council on October 20th 1926. Pp. 6. (London.)

University College of North Wales. Calendar for, Session 1926-27. Pp. 461. (Bangor.)

Proceedings of the Cambridge Philosophical Society. Vol. 23, Part 4, October. Pp. 337-491. (Cambridge: At the University Press.) 7s. 6d. net.

Foreign.

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin." Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 9, Livraison 1-3, Août. Pp. 292+5 Tafeln. (Buitenzorg.) 7.50 f.

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 534: Effect of Concentrated Loads on the Length of Measuring Tapes. By Lewis V. Judson. Pp. 383-396. (Washington, D.C.: Government Printing Office.) 10 cents.

University of Colorado Bulletin. Vol. 26, No. 6, General Series No. 231: Catalogue, 1925-26, with Announcements for 1926-1927. Pp. 421. (Boulder, Colo.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 68: Notes on the Aphididae of Egypt. By W. J. Hall. Pp. viii+62+8 plates. (Cairo: Government Publications Office.) 5 P.T.

Bulletin of the Peking Society of Natural History. Technical Series, No. 1: A Tentative List of Chinese Birds. Part 1: From Colymbiformes through Coraciiformes. Compiled by N. Gist Gee, Lacy I. Moffett and G. D. Wilder. Pp. viii+144. (Peking.)

University of Illinois Engineering Experiment Station. Bulletin No. 155: The Cause and Prevention of Embrittlement of Boiler Plate. By Prof. Samuel W. Parr and Frederick G. Straub. Pp. 62. (Urbana, Ill.) 35 cents.

University of California Publications in American Archaeology and Ethnology. Vol. 19, No. 2: Pomo Folkways. By Edwin M. Loeb. Pp. 149-409+3 plates. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.)

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 41: Statistics of City School Systems, 1923-24. Pp. 181. 25 cents. Bulletin, 1925, No. 44: Land-Grant Colleges, Year ended June 30, 1925. By Walter J. Greenleaf. Pp. vi+70. 10 cents. Bulletin, 1926, No. 10: Accredited Higher Institutions. Compiled by Ella B. Ratcliffe. Pp. vi+106. 15 cents. (Washington, D.C.: Government Printing Office.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 336: Tides and Currents in Delaware Bay and River. By Lt. L. M. Zeskind and E. A. Le Lacheur. (Special Publication No. 123.) Pp. iv+122. (Washington, D.C.: Government Printing Office). 25 cents.

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge. Vol. 65, No. 2. Pp. 67-140. (Philadelphia, Pa.)

Department of the Interior: U.S. Geological Survey. Bulletin 783-B: Mineral Investigations in Southeastern Alaska. By A. F. Buddington. (Mineral Resources of Alaska, 1924-B.) Pp. ii+41-62+3 plates. Bulletin 783-C: Geology and Oil Developments of the Cold Bay District, Alaska, by Walter R. Smith; A Ruby Silver Prospect in Alaska, by S. R. Capps and M. N. Short. (Mineral Resources of Alaska, 1924-C.) Pp. iii+63-95+plate 4. Bulletin 783-D: The Nixon Fork Country and Silver-Lead Prospects near Ruby. Papers by John S. Brown. (Mineral Resources of Alaska, 1924-D.) Pp. iv+97-150+plates 5-6. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Professional Paper 139: Geology and Ore Deposits of the Ducktown Mining District, Tennessee. By W. H. Emmons and F. B. Laney, with the active collaboration of Arthur Keith. Pp. vi+114+23 plates. (Washington, D.C.: Government Printing Office.) 35 cents.

State of Illinois Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 16, Art. 2: Recent Insecticide Experiments in Illinois with Lubricating Oil Emulsions. By S. C. Chandler, W. P. Flint and L. L. Huber. Pp. 99-126. (Urbana, Ill.)

Journal of the College of Science, Imperial University of Tokyo. Vol. 44, Art. 6: On some Remarkable Relations between the Yearly Variations of Terrestrial Phenomena and Solar Activities. By Torahiko Terada. Pp. 20. 0.50 yen. Vol. 44, Art. 7: On some Fossil Shells from the Island of Saishū in the Strait of Tsusima. By Prof. Matajiro Yokoyama. Pp. 9+1 plate. 0.75 yen. Vol. 44, Art. 8: Die Hydroidenfauna der japanischen Region. Von Prof. Dr. E. Stechow. Pp. 23. 0.75 yen. Vol. 45, Art. 1: Mollusca from the Coral-Bed of Awa. By Prof. Matajiro Yokoyama. Pp. 62+iii+5 plates. 2.20 yen. Vol. 45, Art. 2: Tertiary Mollusca from Dainichi in Tôtômi. By Prof. Matajiro Yokoyama. Pp. 18+2 plates. 1.25 yen. Vol. 45, Art. 3: Molluscan Remains from the Lowest Part of the Jô-Ban Coal-Field. By Prof. Matajiro Yokoyama. Pp. 22+5 plates. 1.35 yen. Vol. 45, Art. 4: On the Classification of Fusulinidae. By Yoshiaki Ozawa. Pp. 26+4 plates. 1.20 yen. Vol. 45, Art. 5: Molluscan Remains from the Uppermost Part of the Jô-Ban Coal-Field. By Prof. Matajiro Yokoyama. Pp. 34+6 plates. 1.75 yen. Vol. 45, Art. 6: Paleontological and Stratigraphical Studies on the Permo-Carboniferous Limestone of Nagato. Part 2. Paleontology. By Yoshiaki Ozawa. Pp. 90+14 plates. 3.60 yen. Vol. 45, Art. 7: Molluscan Remains from the Middle Part of the Jô-Ban Coal-Field. By Prof. Matajiro Yokoyama. Pp. 23+3 plates. 1.00 yen. Vol. 45, Art. 8: On the Stereochemical Configurations of Cobalt Complexes with Anomalous Co-ordination Numbers. By Kichimatsu Matsuno. Pp. 16. 0.60 yen. (Tokyo.)

Geologische Rundschau: Zeitschrift für allgemeine Geologie. Herausgegeben von der Geologischen Vereinigung. Sonderband. Festschrift zum 70 Geburtstag Gustav Steinmann, dargebracht von seinen Schülern. Pp. v+660+23 Tafeln. (Berlin: Gebrüder Borntraeger.)

Catalogue méthodique des livres de médecine. Août 1926. Pp. 186. (Paris: Masson et Cie.)

Diary of Societies.

SATURDAY, November 6.

Royal Society of Medicine (Otology Section), at 10.30 A.M.—Diseases of the Outer Ear:—Dr. D. McKenzie: Introductory Remarks.—Dr. A. M. H. Gray: Common Affections of the Skin of the Outer Ear.—F. C. Ormerod: Intractable Dermatitis of the Pinna and External Auditory Meatus Secondary to Chronic Suppuration of the Middle Ear.—F. J. Cleminson: Deafness Associated with Fragilitas Ossium.

Royal Institution of Great Britain, at 3.—Rev. H. M. Walker: The Study of History (1).

MONDAY, November 8.

Royal Society of Edinburgh, at 4.30.—Principal A. P. Laurie and J. Milne: The Evaporation of Water and Salt Solutions from Surfaces of Stone, Brick, and Mortar.—Prof. J. H. Ashworth and Miss Janet C. W. Bannerman: A Tetracotyle in the Brain of the Minnow.—Prof. D. Waterston: Development of the Hypophysis Cerebri in Man, with a Note upon its Structure in the Human Adult.—Dr. A. G. Cannon and Miss S. M. Manton: On the Feeding Mechanism of a Mysid Crustacean, *Hemimysis Lamornae*.—Dr. E. Ghosh: On the Anatomy of the Mastacembelidae of Bengal with Notes on their Habits.—Sir Thomas Muir: The Theory of Persymmetric Determinants from 1894 to 1919.—S. C. Chakrabarti: A Factorable Continuant.

Biochemical Society (in Chemical Department, St. Thomas's Hospital Medical School), at 5.—J. Needham: The Rhythm of Chemical Differentiation in Avian Embryos.—E. M. Goldblatt: Some Observations on Acidosis and Alkalosis.—W. J. Griffiths and Prof. H. MacLean: The Part played by Regurgitation in Gastric Digestion.—J. Lowndes: Estimation of Cystine in the Modified Van Slyke Method of Analysis of Proteins.—Prof. R. H. A. Plimmer: Changes in the Amino Acids in the Proteins of the Hen's Egg during Development.—J. L. Rosedale: The Amino Acids of Flesh.—H. W. Dudley, O. Rosenheim, and W. W. Starling: Spermidine, a Hitherto Undescribed Base occurring in Animal Tissues.—W. J. N. Burch: Hydrolysis of Phosphoric Esters.—Prof. R. H. A. Plimmer and W. J. Burch: The Action of Ethyl Metaphosphate on Alcohols, Ammonia, and some Amino Compounds.—J. G. Davis and W. K. Slater: Aerobic and Anaerobic Metabolism of the Cockroach.

Institute of Chemistry (Bristol Section) (at Bristol University), at 5.30.—R. Pilcher: Alchemists and Chemists in Art and Literature.

Institution of Automobile Engineers (Birmingham Centre) (at Chamber of Commerce, Birmingham), at 7.—J. H. Southcombe: Recent Research on Friction and Lubrication.

Institution of Electrical Engineers (Informal Meeting), at 7.—D. J. Bolton and others: Discussion on the Economics of Lamp Choice.

Institution of Electrical Engineers (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—L. C. Grant: High-Power Fusible Cut-outs.

Institution of Electrical Engineers (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—S. Mavor: The Applications of Machinery at the Coal Face.—L. Miller: The Design of Storage-Battery Locomotives for use in Coal Mines.—B. Nelson: Electricity in Mines—a Short Survey.

Ceramic Society (at Central School of Science and Technology, Stoke-on-Trent), at 7.30.—F. L. Bolt: Systems of Oil Firing and their Possible Applications to the Potteries.

Institute of Metals (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Discussion on Die-Casting.

Surveyors' Institution, at 8.—D. Watney: Inaugural Address.

Royal Geographical Society (at Æolian Hall), at 8.30.—Roy Chapman Andrews: The Work of the Central Asiatic Expedition in Mongolia (Second "Asia" Lecture).

Medical Society of London, at 8.30.—Dr. J. Parkinson and A. J. Walton: Discussion on Sternal Pain.

Cambridge Philosophical Society (in Botany School, Cambridge), at 8.45.

TUESDAY, NOVEMBER 9.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. Shadwell: Medicine in Ancient Assyria (FitzPatrick Lectures) (1).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. G. W. C. Kaye: The Acoustics of Public Buildings (Tyndall Lectures) (1).
INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. F. Mollwo Perkin: Oil Fuel and other Fuels from Carbonisation Processes.
INSTITUTE OF MARINE ENGINEERS, at 6.30.—W. J. Guthrie: Some Notes on Reduction Gear.
ROYAL PHOTOGRAPHIC SOCIETY, at 7.—T. H. B. Scott: Presidential Address.
INSTITUTE OF CHEMISTRY (Glasgow Section), jointly with Society of Chemical Industry (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7.—Dr. T. Gray: An Apparatus for the Supply of Gas at Constant Pressure.—Dr. W. B. Davidson: Gaseous Fuels.
INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at Broadgate Café, Coventry), at 7.30.—J. R. Southcombe: Recent Research on Friction and Lubrication.
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—W. L. Winning: Chairman's Address.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—A. C. Mitchell: Heavy Timber Construction in Harbour and Dock Works.
QUEKETT MICROSCOPICAL CLUB, at 7.30.—A. A. Pearson: Mushrooms and Toadstools.
PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.—Dr. J. H. Burn: Some Methods of Biological Assay.
ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Prof. G. M. Robertson: An Analysis of the Decrease in the Number of Deaths from General Paralysis in England and Wales.
INSTITUTION OF MECHANICAL ENGINEERS (South Wales Branch) (at Swansea).—Prof. F. Bacon: Chairman's Address.

WEDNESDAY, NOVEMBER 10.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—J. R. Beard and T. G. N. Haldane: The Design of City Distribution Systems, and the Problem of Standardisation.
ROYAL SOCIETY OF ARTS, at 8.—Sir Thomas H. Holland: International Interests in Raw Materials.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—H. Willshaw: Moulding and Vulcanisation of Rubber Articles.
EUGENICS SOCIETY (at Royal Society), at 8.30.—Prof. Spearman: The International Symposium on Shape Qualities.
INSTITUTION OF MECHANICAL ENGINEERS (at Sheffield).—Prof. E. G. Coker: Elasticity and Plasticity (Thomas Hawksley Lecture).

THURSDAY, NOVEMBER 11.

ROYAL SOCIETY (jointly with the Royal Astronomical Society), at 4.30.—Discussion on the Results of the Recent Eclipse Expedition.
LONDON MATHEMATICAL SOCIETY (Annual General Meeting) (at Royal Astronomical Society), at 5.—Prof. A. L. Dixon: Interpolation Forms in the Algebra of Invariants (Presidential Address).—Award of the De Morgan medal to Prof. A. E. H. Love.
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. Shadwell: Medicine in Ancient Assyria (FitzPatrick Lectures) (2).
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—E. W. Hey Groves: Reconstructive Surgery of the Hip Joint (Bradshaw Lecture).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir T. W. Edgeworth David: Antarctic Exploration Past and Future (2).
INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—Prof. S. P. Smith: An All-Electric House.
OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—C. Beck: An Accurate Method of Ascertaining the Focal Point of an Optical System.—J. W. T. Walsh and W. Barnett: The Effect of Slightly Selective Absorption in the Paint used for Photometric Integrators.
INSTITUTION OF THE RUBBER INDUSTRY (Manchester Section) (at Manchester).—W. N. Burbridge: Rubber Softeners.—H. A. Hariston: The Effect of Solid Compounding Ingredients as Softeners.
INSTITUTION OF MECHANICAL ENGINEERS (at Leeds).—Prof. E. G. Coker: Elasticity and Plasticity (Thomas Hawksley Lecture).

FRIDAY, NOVEMBER 12.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir James B. Brunyate: The Report of the Indian Currency Commission.
ROYAL ASTRONOMICAL SOCIETY, at 5.—S. R. Pike: On the Chromospheric Currents above a Sunspot.—Prof. E. A. Milne: The Reflection Effect in Eclipsing Binaries.—Prof. A. S. Eddington: Note on Dr. Pokrowsky's Proposal for Determining the Angular Diameter of a Star.—L. Berman: The Orbit of $\Sigma\ 78 = \beta\ 482$.—Royal Observatory, Greenwich: Stellar Parallaxes.
MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (at 11 Chandos Street, W.1), at 5.—Dr. A. I. Simey and others: Discussion on Suggestions as to the Modification of the Rules Usually Observed in the Management of Infectious Diseases in Boarding Schools.
PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—A. Dewhurst: A Rapid Bolometer.—Dr. E. Griffiths and J. H. Awbery: Hygrometry.—Dr. Smithells and Mr. Avery: The Effect of Working on Tungsten.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—Resumed Discussion on Sir Theodore Morison's Paper, How should an Engineer be trained?
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Lt. J. T. Wheatley: Estimating.

INSTITUTE OF METALS (Swansea Local Section), (at University College, Swansea), at 7.15.—J. H. Wells: Zinc Smelting and Recovery of its Bye-Products.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.
INSTITUTE OF METALS (Sheffield Local Section), (at Sheffield University), at 7.30.—H. Brearley: Ingots and Ingot Making.
RAILWAY CLUB (25 Tothill Street, S.W.1), at 7.30.—W. J. Thorrowgood: Light Signalling.
PHILOLOGICAL SOCIETY (at University College), at 8.—T. Lewis: Origin of Welsh Institutions.
INSTITUTION OF MECHANICAL ENGINEERS (at Glasgow).—Prof. E. G. Coker: Elasticity and Plasticity (Thomas Hawksley Lecture).
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section), (at Manchester).—W. H. Cantrill: The Application of a Coat of Paint; its Composition, Manipulation, and the Factors governing its Efficiency and Permanence.

SATURDAY, NOVEMBER 13.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. E. M. Walker: The Study of History (I.).
PHYSIOLOGICAL SOCIETY (at London School of Medicine for Women).

PUBLIC LECTURES.

SATURDAY, NOVEMBER 6.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—C. Daryll Forde: Weather Forecasts and the Weather.

SUNDAY, NOVEMBER 7.

GUILDHOUSE (Eccleston Square), at 3.30.—Dr. W. H. Eccles: The Influence of Wireless on Modern Life.

MONDAY, NOVEMBER 8.

UNIVERSITY OF LEEDS, at 5.15.—Prof. T. R. Merton: The Spectra of Mixed Gases.
UNIVERSITY COLLEGE, at 5.30.—Prof. G. E. Moore: Universals and Particulars. (Succeeding Lectures on November 15 and 22.)

TUESDAY, NOVEMBER 9.

MANCHESTER ROYAL INFIRMARY, at 4.15.—Dr. W. E. Gye: An Outline of the Knowledge gained by the Experimental Study of Cancer (Lloyd Roberts Lecture).
UNIVERSITY COLLEGE, at 5.30.—Dr. J. H. Jeans: Recent Developments in Cosmical Physics.

WEDNESDAY, NOVEMBER 10.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. Winifred Cullis: Industrial Psychology applied to the Home.

THURSDAY, NOVEMBER 11.

BIRKBECK COLLEGE, at 5.30.—Dr. F. W. Aston: Atoms and Isotopes. (Succeeding Lecture on November 18.)
COLLEGE OF NURSING (Henrietta Street, W.1), at 5.30.—Dr. W. M. Feldman: The Contribution of Physiology to Social Hygiene.
KING'S COLLEGE, at 5.30.—Dr. A. Scott: The Restoration and Preservation of Museum Objects.

SATURDAY, NOVEMBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: The Life of a Sea-Urchin.

SUNDAY, NOVEMBER 14.

GUILDHOUSE (Eccleston Square), at 3.30.—Dr. E. E. Fournier d'Albe: Eyes and Ears of the Future.

CONGRESSES.

NOVEMBER 15 TO 18.

INTERNATIONAL CONFERENCE ON BITUMINOUS COAL: New Developments in Utilisation (at Pittsburgh).—Dr. F. Bergius: The Transformation of Coal into Oil by Means of Hydrogenation.—Prof. F. Fischer: Liquid Fuel from Water Gas.—Dr. C. H. Lander: The Present Status of Low Temperature Distillation of Coal in England.—Dr. R. Lessing: Coal and its Mineral Matter.—G. M. Gill: English Developments in Carbonisation of Coal in Gas Works.—H. Nielsen: The L. and N. Process.—General G. Patart: The Production of Methyl Alcohol from Coal.—M. R. Campbell: Our Coal Supply, its Quantity, Quality, and Distribution.—A. C. Fieldner: The Practical Value of Fundamental Research on Coal.—J. M. Weiss: Coal Tar Disposal.—C. J. Ramsburg: A Continuous Water Gas Generator.—Prof. S. W. Parr: Fundamental Studies on Coal as Related to Carbonisation Problems.—C. V. McIntyre: Development in Low Temperature Distillation of Coal at Fairmont, W. Va.—W. E. Trent: Some New Uses for Pulverised Coal.—Dr. W. H. Fulweiler: Utilisation of Bituminous Coal in the Manufacture of Water Gas.—Dr. H. C. Porter: Economic Aspects of the Pre-treatment of Coal for Smokeless Fuel.—H. Kreisinger: Powdered Fuel for Power Purposes.—R. M. Crawford: The Recovery of Phenols from Fuel Tars.—H. A. Brassert: Utilisation of Heat in Modern Steel Plants.—Dr. L. C. Jones: Coal in Relation to the Production of Fixed Nitrogen.—O. P. Hood: Smokeless Fuel.—Dr. W. P. Bunge: The McEwen-Runge Process for the Low Temperature Distillation of Coal.—S. B. Church: The Utilisation of Coal Tar Products.—E. Piron: The Piron Coal Distillation Process.—O. Monnett: The Smoke Problem of Cities.—I. F. Laucks: The Greene-Laucks Process.

NOVEMBER 16.

NATIONAL CONFERENCE ON MILK IN RELATION TO PUBLIC HEALTH (at King George's Hall, Caroline Street, W.C.1).

SATURDAY, NOVEMBER 13, 1926.

CONTENTS.

PAGE
Scientific Achievement and Aptitude 685
Judging Intelligence. By R. J. Bartlett 687
Melanesian Mythology. By Sidney H. Ray . . . 688
Photographic Photometry. By T. S. P. . . . 689
Intermediates. By Prof. J. F. Thorpe, C.B.E., F.R.S. 689
Our Bookshelf 690
Letters to the Editor:
River Terraces of the Euphrates.—Prof. W. J. Sollas, F.R.S. 692
The Transmission of Cutaneous Leishmaniasis to Man from Artificially Infected *Phlebotomus papatasii.*—Dr. S. Adler and O. Theodor . 692
Science and Psychical Research.—A. A. Campbell Swinton, F.R.S.; W. W. L.; J. Reid Moir 692
Patent Law and Unemployment.—E. Wyndham Hulme; The Writer of the Article. . . 694
Explanation of the Spectra of Metals of the Second Group.—Prof. Meghnad Saha . . . 695
Absorption Bands in Nitrogen.—Dr. H. Sponer . 696
The Reaction to Flea Bites: Anaphylaxis and Louse Infestation.—Prof. A. D. Peacock . . . 696
The Antiquity of the Labiatae or Mint Family.—Prof. T. D. A. Cockerell 696
Early Egypt and the Fayum.—Sir Flinders Petrie, F.R.S. 696
Chlorine Gas Filters in Relation to Reaction Velocity.—Wilfrid Taylor 697
The Structure of the Continents.—Dr. John W. Evans, C.B.E., F.R.S. 697
Sterility in the Vegetable Marrow.—John Parkin . 697
Optics and Poetry.—Rev. H. C. Browne . . 697
'Red Rain' at Bordighera, Italy.—Prof. G. H. Bryan, F.R.S. 697
Cretaceous Mammal Skulls from Mongolia. By Dr. William K. Gregory and G. G. Simpson . 698
Properties of Thin Films. By Sir William B. Hardy, F.R.S. 700
Acclimatisation to High Altitudes. By Dr. J. S. Haldane, F.R.S. 702
Obituary:
Prof. Edouard Naville. By Dr. H. R. Hall . 703
Dr. Francis Warner 704
News and Views 705
Our Astronomical Column 709
Research Items 710
The Nutrition of Cattle 713
Marine Biology at Plymouth. By E. S. R. . . 714
University and Educational Intelligence . . . 715
Contemporary Birthdays 716
Societies and Academies 717
Official Publications Received 719
Diary of Societies and Public Lectures . . . 719

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Scientific Achievement and Aptitude.

SCIENTIFIC literature in the United States has of late contained many references to that country's paucity of leading investigators in pure science, as distinct from its applications; and as we have already mentioned (NATURE, May 22, 1926, p. 731), the National Academy of Sciences has appointed a special board of trustees to administer a national fund to be raised for supporting research work in that domain. In the June issue of *Nation's Business*, published by the U.S. Bureau of Commerce, Dr. E. E. Slosson discusses this subject in the latter part of an article entitled "Pure Science Pays its Way." Examining the nationality of the Nobel prize-winners in physics, chemistry, physiology or medicine, he finds that out of a total of 72 prize-winners since 1900, Germany can claim 21, British Isles 11, France 10, Holland 6, the United States and Sweden 4 each, Denmark and Switzerland 3 each, Austria, Canada, Italy and Russia 2 each, Belgium and Spain 1 each. A Nobel prize has not yet been awarded outside of Europe and the North American continent. Further, by dividing the number of prize-winners into the number of millions of population, he obtains for each country a number which, he states, may be called "the national index of scientific research": Denmark, Holland and Switzerland 1, Sweden 1·5, Germany and Austria 3, France and the British Isles 4, Belgium 7, Spain and Italy 20, United States 28, and Russia 66.

As a check on this method of gauging national achievement in scientific research, Dr. Slosson selects the more objective plan of analysing the nationality of the discoverers of new chemical elements. Starting with the year 1894, prior to which the United States was not sufficiently developed to compete, he finds that seventeen elements have been discovered, of which seven were found in Great Britain, four in France, two in Germany, and one in each of the countries Austria, Czechoslovakia, Denmark, and the United States. With reference to sciences other than those for which Nobel prizes are rewarded, Dr. Slosson quotes the opinion of the editor of *Science* to the effect that the United States leads the world in biology, geology and astronomy and stands about even with Great Britain and Germany in mathematics and medicine.

The precise significance of Dr. Slosson's figures is not easy to deduce. The nationality of Nobel prize-winners, although a source of elation or depression, according to one's own nationality or proclivity, does not appear to have more than a remote connexion with general national ability or achievement in research; the winners are, in the main, men of genius, who are notoriously very rare, whose occurrence is exceedingly fitful, and the conditions of whose production are very obscure. In obtaining his national index figures, we think that the author has unwittingly done his own country an injustice; we should omit the coloured population as well as much of the alien immigrant labour, just as we should omit the *moujik* population of Russia. In our opinion, a better index would be obtained by dividing the number of Nobel laureates in each country into the number of people who have enjoyed—or survived—a secondary school education.

The criterion afforded by success in discovery, whether of new elements or other things, appears to be too narrow; it ignores discovery of new methods and new generalisations, which are usually of much greater moment; and it neglects the factor of luck, which often plays an important part. As Galton observed: "When apples are ripe, a trifling event suffices to decide which of them shall first drop off its stick; so a small accident will often determine the scientific man who shall first make and publish a new discovery." It appears to us that a more accurate index would be obtained by analysing the literature-references in such impartial works as the "Progress Reports" published by the Chemical Society; and we commend this suggestion to Dr. Slosson, in case he wishes to pursue the subject. We are, however, not convinced of the general utility, or even of the desirability, of instituting international comparisons, particularly in regard to science, which should know no frontiers; but we recognise that Dr. Slosson, like all good "100 per cent." Americans, is anxious for his country's welfare, and that in diagnosing the ailment, he is also searching for its cause and cure.

The backwardness of the United States in producing leaders of research in pure science has doubtless a plurality of causes, among which *auri sacra fames* may well find a place, side by side with Dr. Slosson's reason that, in recent years, professors have been deprived of much valuable time to devote to research by the enormous influx of students into the universities. These causes, however, are not confined to the United States.

It may be, as E. Renan predicted, that the United States is expiating its original fault of creating a considerable popular instruction without any serious higher instruction; but it appears to be more profitable to think of the future than of the irretrievable past, and of our own shortcomings as well as those of a sister nation. Leaving genius aside, the really important issue is that every progressive nation must give thought to the conditions that favour the provision of efficient research workers. The number of such men is probably never great, but in the mass is not inconsiderable. They appear to come within the class of one in four thousand, which Galton selected as his second order of eminence (the first being men of genius, who represent about one in a million), and it is comforting to note that he was convinced that their ability is inheritable. The problem is how to produce more. Writing more than half a century ago, Huxley took a pessimistic view of the possibilities: "The great mass of mankind," he said, "have neither the liking, nor the aptitude, for either literary, or scientific, or artistic pursuits; nor, indeed, for excellence of any sort. Their ambition is to go through life with moderate exertion and a fair share of ease, doing common things in a common way."

This opinion is probably shared by most thinkers to-day; nevertheless, we believe that there is more latent interest for knowledge and attainments among the masses than is implied in Huxley's statement. Where Nature fails or stops, nurture may sometimes succeed. The great instrument of education could be used much more effectively than it has been as a winnowing process for sorting out the capables from the incapables; and, if we would be saved from the limbo of drab mediocrity, we must use it not only for developing latent aptitudes, but also for promoting that passion for excellence which is at the basis of all the best work in science, art, letters, and religion.

Judged by these criteria, our schools are sadly deficient; aptitude for learning, native curiosity and the pursuit of inquiries, are too often killed or suppressed by the pedantry of the pedagogue, if they have not already been throttled in the home; and the same educational diet is administered to all, irrespective of ability or inclination. As a result of this treatment, we find that very few adults have either the desire or the capacity for acquiring new knowledge; comparatively few have learned to take a pleasure in their work; and, what is far worse, few have acquired the habit of thought: of viewing things impartially, of comparing, evaluating, and of drawing correct inferences from trustworthy data.

The habit of sober, reflective, critical thought is one of the greatest needs of the time, and the lack of it is reflected almost daily in social and industrial misunderstandings. Whatever good compulsory education has done to the artisan classes, it has not been successful in making them think; and the same may be said of the majority in other classes: most men are as vulnerable as ever to the oratory of speakers of the persuasive, political type, and the authority of the printed word is still an almost universal article of belief.

The habit of independent thought and critical inquiry, the habit of work, and the desire to excel, appear to be the fundamental requirements of any country that aspires to remain in the vanguard. Given these, we have no doubt that a nation will find within its ranks all the ability that it may need for ensuring progress, including that important part of it which depends upon research work in science and its applications.

Judging Intelligence.

How we Judge Intelligence: an Investigation into the Value of an Interview as a Means of estimating General Intelligence. By Egbert H. Magson. (Thesis approved for the Degree of Doctor of Science in the University of London.) (*The British Journal of Psychology*, Monograph Supplements, 9.) Pp. ix+115. (Cambridge: At the University Press, 1926.) 8*s.* 6*d.* net.

EVALUATION of the character of his fellows plays an important part in the life of man. In harmony with this, the Consultative Committee of the Board of Education in its report on "Psychological Tests of Educable Capacity" expresses the opinion that "a careful and detailed study of the legitimate aims and inevitable limitations of viva-voce examinations" presents a promising line of advance in the attempt to discover reliable means of assessing ability. Dr. Magson's work, "published as a first contribution towards this complete and detailed study," is an excellent example of the painstaking industry with which psychologists, by the statistical treatment of adequate data obtained under carefully controlled experimental conditions, are unravelling the complexities of mental activity.

Following the method used by Webb in his work on character, several 'judges' were asked to distribute a number of individuals in seven grades of general ability so that the distribution in the grades was approximately 'normal.' The variability in such estimates emphasises the need of objective scales of reference; and in the search for such scales psychology has scored a first success in intelligence tests. These tests measure an inborn general mental ability concerned with analysing and co-ordinating the data of experience rather than with the reception or retention of the data. This general ability the judges were asked to estimate on the basis of five-minute interviews, and their ability to do so was judged by the correlation shown between their estimates and the results obtained from intelligence tests given to the 'subjects.'

Very few of the judges had any misgiving as to ability to perform the task, and most had a high degree of confidence in the trustworthiness of their own judgments. The judgments, however, revealed considerable differences of opinion. In one group of 25 subjects, 21 were placed in 3 or more grades, while the marks of one subject were scattered throughout the seven grades from +3 to −3. In stressing this disagreement the author appears to have overlooked the fact that, in 18 cases out of the 25, at least 3 of the 6 judges gave the same mark. In all probability, with an increased number of judges, the existence of a definite modal grade would have been clearly demonstrated.

The untrustworthiness of single judgments is a commonplace in psychology. A general tendency for a number of judgments to group about some mid value replaces the almost exact agreement in determinations of physical constants. That general tendency in this case is expressed by the fairly high mean consistency coefficient, 0·52 ± 0·04 for 87 pairs of sets of estimates. The judges have estimated some quality in their subjects with a fair degree of accuracy. This quality, however, is not the general ability measured by intelligence tests, for the average correlation of interview judgments and intelligence test scores has the insignificant value 0·12 ± 0·13. As estimates of the general ability that is measured by intelligence tests, the interview judgments are valueless.

What, then, is it that the judges have estimated? Introspective reports showed that, while the answers given by the subject were considered to be the chief determinant, his appearance, expression, and manner influenced the judgment considerably. Putting these results of introspection to the test of experiment, verbatim reports of the interviews were assessed, first by other judges and then, a year later, by the original interview judges. It was found very difficult to divide the subjects, on the basis of answers alone, into more than three groups, and the correlation between the judgments so secured and the original interview judgments was only 0·37 ± 0·05. On the other hand, when the subjects were graded for general appearance and manner, by judges who knew them well, this order was found to correlate so high as 0·78 ± 0·04 with the interview judgments. To a far greater extent than was recognised by the judges, their estimates are founded on hasty generalisation from first impressions of appearance, expression, and manner.

For comparison with the 'interview' judgments, 'mature' judgments of judges who had known the subjects intimately for at least a year were obtained. These judgments have a consistency of 0·83 and correlate with the intelligence test records 0·54 ± 0·04 and with the interview estimates 0·22 ± 0·05. Hence, while the bases of mature judgments differ very considerably from those of interview judgments, the mature judgment is a much better estimate of the general ability measured by intelligence tests.

Search for the reason why the agreement is not closer revealed the fact that, accepting the test score as reasonably correct, the badly underrated and overrated cases were almost always explained by strong personal likes and dislikes entertained by the judges for the particular subjects. This bias acts to a large extent unconsciously, and introduces a very serious source of error into our judgments of those we know well.

Inquiry as to the possible influence of Maxwell Garnett's factor, 'cleverness,' involved the separate estimation of sense of humour, tendency to cheerfulness, quickness of apprehension and profoundness of apprehension. The estimates of 'profoundness' were found to correlate with the mature judgments so high as 0·89 ± 0·01. 'Profoundness' therefore plays a large part in the mature judgment, although its relation to interview judgment and intelligence test score yields coefficients too small to be considered significant.

The record of his own work, coupled with the excellent short summaries and bibliography of relevant work by other psychologists, is a valuable contribution to our knowledge of what the author, taking his cue from the Consultative Committee of the Board of Education, has described as "the inevitable limitations and defects of interviews as ordinarily conducted." To be of real value, an interview should be carried out by skilled interviewers, fully alive to the sources of error and working under rigidly controlled conditions; while the final decision should result from mean values obtained by pooling the entirely independent judgments of a number of such judges. The confident decision reached by the common practice of discussion over the table is far more likely to be wrong than right.

R. J. BARTLETT.

Melanesian Mythology.

Mythen und Erzählungen eines Melanesierstammes aus Paparatava, Neupommern, Südsee: Gesammelt und versehen mit Einleitungen und Erklärungen. Von P. August Kleintitschen. (*Anthropos* Ethnologische Bibliothek: Internationale Sammlung Ethnologischer Monographien, Band 2, Heft 4.) Pp. 509. (Mödling bei Wien: Verlag der Administration des *Anthropos*, St. Gabriel, 1924.) 15 gold marks.

THE very scant record of Melanesian mythology has been considerably augmented by the publication of myths and stories collected by the Rev. A. Kleintitschen of the Sacred Heart Mission from the natives of Paparatava, inland from Herbertshöhe in the Gazelle Peninsula of New Britain. With the similar collection made by Father Meier from the coastal people, the stories illustrate the beliefs of an important section of the Melanesian people.

There are one hundred and eighty tales, some of which, however, are variant relations of the same events. The native text is given, so that the work illustrates both language and folklore. Six of the seven groups into which the tales are divided are prefaced by summary accounts of the subjects to which they relate.

The first section describes the activities of the two legendary brothers To Kabinana and To Purgo in establishing the habitat, religion, and sociology of the Paparatava people. To Kabinana and To Purgo lived in a world already formed by a being vaguely named the *kaia* or spirit, who is called '*I*' (*i.e.* 'he,' the pronoun) on the coast. They had a mother, and were instructed in many things by the *kaia*. The exploits of these heroes recall those of Qat, Tagaro, Marawa, and other beings of southern Melanesia. They separated day and night. To Kabinana made level ground, but To Purgo furrowed it with valleys. Human figures were made, and sex bestowed by the insertion of a flying-fox and a young coconut. Another account says that To Purgo found a woman in a coconut. The sea was made, and triton shells, coral and clams placed in it. A black ant bit through the surrounding earth and the sea escaped and flowed round the land. The origin of death is ascribed to the neglect of To Kabinana and To Purgo to provide a fire of living wood for their mother after she had changed her skin. In another account, To Purgo becomes a kangaroo and tramples out the fire.

The next three series of tales relate to the ghosts. Death in the native view is not the separation of soul and body, for they may be parted before death, and the empty body from force of habit go on feeding and speaking; but the speech is foolish chatter, and there is no understanding. When activity ceases, death occurs, and a new life is begun as a ghost. The soul or shadow can be seen and not handled, and is sometimes endowed with a repulsive body. In one story a *tabaran* ate a soul, and a man broke up a *tabaran* all bones and roasted him. There are no rewards or punishments in the other world, but the shell money a man has distributed follows him and may possibly improve his sad condition.

The *tabaran* form the lowest order of ghosts. They lead a miserable life, and when they meet the living constantly complain. They are generally invisible, especially when engaged in evil-doing, but are sometimes seen as blow-flies and crows. They are intensely malevolent and plague mankind with ill-luck, sickness, and death.

The *tutanavurakit* form the second ghostly order. They dwell in a land where there is no pain or sorrow, but new joys and delight. They are beneficent towards men, and in all ways the opposite of the *tabaran*. The name *tutanavurakit* means 'everliving men,' that is, real men as distinguished from the *tabaran* who have nothing in common with mankind. In contrast to the *tabaran*, who share dark holes with the rats and bats, the *tutunavurakit* dwell in sunny places, where the ground is covered with moss, and shady trees and coco palms are plentiful.

The *kaia* are described as the greatest and most powerful ghosts. The name is connected with the verb *kaian* = to wonder at, and in spite of their many good qualities and benevolent acts, they are fearsome demoniac beings who inspire the natives with anxiety and terror. They have human bodies, but may take other shapes and especially favour the form of a *valvalir*, a snake about three metres long. Sometimes they are seen as giant stones, of which there are many (due to the now extinct volcano Varzin) in the Paparatava district. The stories about the *kaia* are of the same character as those told of the *tabaran* and the *tutanavurakit*. The animal stories are few, and only the kangaroo, dog, parrot, and snakes appear in them.

Father Kleintitschen has provided a rich and valuable store of material for the comparison of Melanesian folklore. Though he finds in New Britain the remains of a lunar mythology which he connects on one side with Sumatra, and on the other with the Banks' Islands and New Hebrides, there is no indication of the genealogical evolution of the higher Polynesian mythology. We have here in New Britain, as in other parts of Melanesia, the simple wonder-tales of a primitive folk.

SIDNEY H. RAY.

Photographic Photometry.

Photographic Photometry: a Study of Methods of Measuring Radiation by Photographic Means. By Dr. G. M. B. Dobson, I. O. Griffith, and Dr. D. N. Harrison. Pp. 121. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 7*s*. 6*d*. net.

PHOTOGRAPHIC methods of measuring the intensity of light have increased very much in mportance in recent years: in some cases they are the only ones which can be used, and in others they are the most convenient. Investigators wishing to use the methods, among them being the authors of this book, have hitherto had to resort to the original iterature on the subject in order to find out what has been done, no general summary being available.

Profiting by their experience, which has been gained at the expense of much time and research, the authors have written this review of the whole subject, discussing the principal methods employed, the sources of errors, how these errors can be minimised, and, generally, the best method of working. In making such measurements, everything depends on a proper knowledge of the properties of the photographic plate, its treatment during development, the measurement of densities, etc. Of this the authors have been fully cognisant; ndeed, they embody the results of some of their own researches in the text. The outcome of the authors' experience is a book which should be of the greatest possible use to workers in the same field, indicating as it does the correct method of using the photographic plate in the measurement of radiation intensities. In the last chapter, examples of such measurements are given, together with a consideration of the accuracy obtainable.

There is very little to criticise, the treatment being generally clear and straightforward. Occasionally, however, what is clear to the authors may not be obvious at once to the reader. For example, in defining the characteristic curve (p. 21), it is stated correctly that the logarithm of the amount of light is plotted as abscissa, but in the curve given "log intensity" is plotted as abscissa, attention not being directed to the fact that the time factor is taken as constant, as would be the case in the experimental determination of such a curve. On p. 33 an obvious slip is made in stating that a sector wheel can be used to vary the intensity of the incident light. By their treatment of the subject the authors show that they are aware that this is not correct, but it is advisable to point out the slip, since the supposed variation of intensity by the use of sector wheels is a common error.

In the preface, Prof. Lindemann states that "if one atom in a grain [of the photographic emulsion] has absorbed a quantum and been ionised, the whole grain is rendered developable." It is unfortunate that Prof. Lindemann lends his authority to this statement. It is still a matter of dispute as to whether the Einstein law of photochemical equivalence has been proved to hold for the grain of a photographic emulsion; but even if it be assumed to hold, there is no experimental evidence to show that the presence of one atom of silver on a grain renders that grain developable. In all probability a large number of atoms is necessary to give a nucleus big enough to initiate development.

T. S. P.

Intermediates.

Intermediates for Dyestuffs. By A. Davidson. Pp. xiii + 256. (London: Ernest Benn, Ltd., 1926.) 36*s*. net.

THERE can be no question that the whole problem of a national dyestuffs industry depends on the production of 'intermediates.' The allied industries of fine chemicals, explosives, artificial perfumes, and medicinal products also rely on the same source for the life-blood of their existence; in fact, many of the materials they produce are the 'intermediates' themselves. It is essential, therefore, that any nation which realises the necessity for a self-contained and efficient industry in this most vital department must see to it that not only the sources of its intermediates is secure, but also that the scientific knowledge by which the crude materials can be transposed into those capable of being used in the various industries is ready to hand.

So far as Great Britain is concerned, the raw material, coal-tar, from which the intermediates are produced is abundant, so that in respect of the source there is no need to anticipate trouble. Nevertheless, it is well known that prior to the War we relied mainly on Germany for the chemical knowledge and skill necessary to convert our raw material into finished intermediates. The eight years that have elapsed since the Armistice have seen a wonderful change, and at the present time only a very small percentage of the intermediates required for British dyestuffs industries and fine chemical industry is obtained from abroad. All honour, then, to those who have effected this wonderful transformation. We must not, however, rest content with this achievement. The chemistry of the intermediates is continually changing. New and improved processes for preparing old and familiar substances are always being discovered, and even the difference of a few pence in the cost of production may mean the loss or gain of a market. Moreover, the discovery of new intermediates often means the production of some new dye having, it may be, only a slight advantage over the old one but still enough to cause its replacement, owing to the appeal of the new dyed material to the fashion of the moment. There is also the possibility of the formation of new intermediates and their commercial utilisation. All these problems have to be met, and they can only be met, by keeping British research chemists, and those who intend to become research chemists, abreast of the times by imparting to them a thorough knowledge of this special branch of organic chemistry so that they may know not only what has been done already, but may also be in a position to advance knowledge on their own part.

It is therefore a pleasing picture to see a text-book of some 250 pages devoted entirely to a treatment of the chemistry of the intermediates. Mr. Davidson is to be congratulated on having produced a readable book on what must necessarily be a dull subject. In it an adequately full treatment is afforded to all the chief intermediates from the parent substances upwards. Especially noteworthy is the frequent use of tables to illustrate the manner in which the various derivatives are obtained from the parent substances, a treatment which the reader will find of the greatest assistance.

There can be no question that the book will be welcomed by all those who deal with the intermediates, and will also be of assistance to teachers who lecture in this branch of higher organic chemistry. As in all Messrs. Benn's chemical productions, the formulæ are clearly printed and the type free from errors. The absence of a bibliography is a detriment which might be removed in a future edition. J. F. Thorpe.

Our Bookshelf.

Prof. Dr. phil. Dr. jur. h.c. Ludwig Darmstaedter. Ehrenmitglied des Staatsinstituts für experimentelle Therapie und des Georg Speyer Hauses in Frankfurt am Main zu seinem 80 Geburtstage am 9 August 1926. (Berlin: Albert Frisch, 1926.)

Under the title "Naturforscher und Erfinder. Biographische Miniaturen" Prof. Darmstaedter published recently a collection of fifty most fascinating, short biographical notices of pioneer workers in various branches of science. I received it privately from the author, as a token of friendship on the approach of his eightieth birthday. We were fellow students under Kolbe at Leipzig in 1868. He is the one German student friend with whom I have remained in communication. I always connect him with Butlerow, as I vividly remember his bringing the celebrated Russian chemist to visit us in the laboratory.

The volume now before me is a collection of short biographical sketches of his activities, presented to Prof. Darmstaedter on his eightieth birthday, by his friends and admirers, more particularly by the managers of the George Speyer Haus in Frankfurt, who have instituted a Ludwig Darmstaedter Prize, to be given triennially, together with a Paul Ehrlich medallion, for distinguished work in biology or chemical therapeutics. They have done this in recognition of the part he has played, together with his deceased sister-in-law, Frau Franziska Speyer, in the extablishment and management of the George Speyer Haus, in which Ehrlich's work was carried on from June 1902 onwards.

Trained as a chemist, Darmstaedter began his career as a member of the firm of Benno Jaffé and Darmstaedter, manufacturers of glycerin. In 1884, the firm acquired Oscar Liebreich's lanolin patent. He left this firm in 1906 to devote himself to his collections. He was long a noted collector of old china. He also built up a very valuable collection of autographs and letters of noted men from the Middle Ages upwards. These he presented to the Prussian State Library in 1907. The Dokumenten Sammlung Darmstaedter zur Geschichte der Wissenschaften und der Technik is now a distinct department of this library.

Darmstaedter's activity as an alpinist, as well as the part he has played in forwarding the creation of the first juvenile reformatory on the European continent, are both described, as well as his multiple other activities, in the monograph.

Darmstaedter has always been a man of remarkable vigour and an untiring worker throughout his life. A classical scholar and highly cultured, he is a typical, educated German. When the lanolin patent was in the Courts here, before Mr. Justice Romer, he made a remarkable impression by translating, in the witness-box, passages from the Greek bearing upon the use of wool-fat. The presence of such men in industry has had much to do with German success. He is probably best known to the world as author of his extraordinarily comprehensive "Handbuch zur Geschichte der Naturwissenschaften und der Technik," produced in co-operation with Prof. R. du Bois Reymond and Carl Schaefer.

H. E. Armstrong.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 184. Abt. 9: *Methoden zur Erforschung der Leistungen des tierischen Organismus,* Teil 2, 1 Hälfte, Heft 4. *Methoden der Süsswasserbiologie.* Pp. 653-852 + xxiii. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 10·20 gold marks.

THIS publication completes the first half of the volume n this handbook dealing with methods of research for the study of life in fresh water. It opens with a chapter, by August Thienemann, on life in inland waters, giving in broad outline the conditions to be considered in a study of this zone of life and the connexions between the animate and inanimate components of the environment. There follow articles by H. Thomasson on the study of the microphyta of the limnetic littoral and deep zones, and by H. Gams on the higher water-plants. Einar Naumann gives a long account of methods of demonstration for the purpose of teaching imnobiology, with special reference to the plankton and neuston. Finally, T. Freidenfelt contributes a chapter on the mathematics to be employed, especially by those working on plankton, for testing the accuracy of technique and finding the true significance of results obtained by sample methods.

For those taking up the study of fresh-water biology, the work should prove valuable as a guide to the methods that are now employed. At the same time, the papers, although not containing full bibliographies, give sufficient information and references to enable one, at once, to get on the track of the literature dealing with the results of research in any special branch of this huge subject in which interest may lie.

Electrical Technology: a Textbook for the following Examinations, National Certificate, City and Guilds, A.M.I.E.E., B.Sc. Engineering. By H. Cotton. In 8 weekly parts. Part 1. Pp. xv + 48. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 1*s.* net each part.

THE student will find this a very convenient form in which to acquire Mr. Cotton's book on "Electrical Technology." Besides the advantage of paying for the book by eight instalments, there is a decided benefit n not having a bulky volume to carry about.

Part 1, which has just been published, includes the necessary elementary work in the form of a short introduction. This work should, of course, have been done previously, but the student will find the introduction convenient for reference. The whole volume divided into two parts, the first being devoted to direct current and the second to alternating current. Chaps. 1, 2, 3, and the beginning of Chap. 4, appear in the part just published.

A clear exposition of the magnetic circuit forms the first chapter, and the second chapter gives an account of electromotive force. Then follows the direct current technology. In the direct current part is to be included chapter on illumination and one on electrolysis and cells. The alternating current part is to include chapters on furnaces and welding, electric oscillations, and measuring instruments. The descriptions are adequate and the diagrams good, so that the student should find it a useful work.

Le problème de chimie: recueil de problèmes inédits avec leurs solutions à l'usage de la Classe de mathématiques spéciales des candidats au S.P.C.N., au M.P.C., au Baccalauréat (M.E.), aux Grandes Écoles et à divers concours. Lois générales, métalloïdes, chimie organique. Par Jean Duval. Pp. 116. (Paris: Albert Blanchard, 1926.) 10 francs.

MANY years ago, the plan of teaching chemistry, or rather, of exercising the mind in chemical matters, by means of problems and answers, was very fashionable. Nowadays it seems to have fallen into disuse, except perhaps in schools, although the method was a good one which enabled the student to fix reactions and principles on his mind without making undue calls on his memory. Of course, much depends on the kind of problem selected and the manner in which it is treated, but if too much chemical arithmetic is avoided, and the problem chosen involves some theoretical principle which appeals to the mind, a great deal of useful knowledge can be imparted, often from an unusual viewpoint. M. Jean Duval has applied the method to a number of cases and has produced a book which should appeal to students generally. Both inorganic and organic problems are chosen, many of them being of surprising ingenuity. The French is so easy to understand and is so clearly expressed that many English students would do well to add this book to their library.

Il Naturalista viaggiatore. Per Gestro e Vinciguerra. (Manuali Hoepli.) Seconda edizione. Pp. xv + 204. (Milano: Ulrico Hoepli, 1926.) 14 lire.

THE first edition of this work, published in 1881, was a pioneer amongst collectors' handbooks, and its successor, extended, illustrated, and brought up-to-date, gives concise instructions for the collection and preservation of animals, vertebrate and invertebrate, so that they may be afterwards available for detailed scientific examination. Much study has been given to the fluids which best kill and retain in preservation the characteristics of the tissues and structures of different types of animals, and accordingly a chapter is devoted to each group, from mammals to protozoa, while additional chapters deal with general instructions for marine research, and the collection of plants and of mineralogical specimens. The work resembles in character the "Handbook of Instructions for Collectors," issued by the British Museum, but the paper binding is quite insufficient for a volume which is likely to see much and rough service in many climes.

Chambers's Encyclopædia: a Dictionary of Universal Knowledge. New edition. Edited by Dr. David Patrick and William Geddie. Vol. 8: *Penobscot to Saco.* Pp. iii + 871. (London and Edinburgh: W. and R. Chambers, Ltd.; Philadelphia: J. B. Lippincott Co., 1926.) 20*s.* net.

THE newest volume of this encyclopædia again bears evidence of careful revision and the addition of new articles. Events that have occurred within the last few months are mentioned. Many of the longer articles are admirable summaries and should prove invaluable for quick and easy reference. There are eight new coloured maps as well as many text illustrations and diagrams.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

River Terraces of the Euphrates.

IN NATURE (vol. 111, p. 332, 1923) attention was directed to the remarkable uniformity in height of the successive terraces bordering the rivers which open into the Mediterranean Sea and the Atlantic Ocean. We now learn from Dr. E. Passemard (*C.R.*, t. 183, p. 365, 1926) that this uniformity extends beyond these regions into the valley of the Euphrates, which opens through the Persian Gulf into the Indian Ocean.

Five well-marked terraces are well displayed one above the other on the right bank of the river along the great curve which it makes in passing from Rakka to Deir-el-Zor. Their heights above the river, as measured by M. Darrous, Topographer to the "Mission hydrographique Héraud," are given in metres in column 1 below:

	1.	2.
5th Terrace	77·13	93-95
4th ,,	56·14	55-57
3rd ,,	30·52	28-30
2nd ,,	15·36	15-16
1st ,,	3·60	...

A comparison of these with those of the terraces of the Isser, Algeria, measured by General Lamothe (col. 2), reveals a remarkable correspondence between the 2nd, 3rd, and 4th terraces of the two rivers: but this agreement does not extend to the 5th terrace. The 1st terrace was not observed on the Isser, but it exists at about the same height elsewhere in the Atlantic region.

The interest of these observations is increased by the discovery in the 3rd terrace of an implement which is assigned by Dr. Passemard to the upper Chellean industry.

W. J. SOLLAS.

University Museum,
Oxford.

The Transmission of Cutaneous Leishmaniasis to Man from Artificially Infected *Phlebotomus papatasii*.

THREE examples of the transmission of cutaneous Leishmaniasis to man from naturally infected sandflies, *P. papatasii* ♀♀, have been recorded by us (*Ann. Trop. Med. and Parasitol.*, vol. 20, No 2) It was also shown that the causative organism in each of the three lesions was biologically and morphologically identical with *Leishmania tropica*. There could therefore remain no doubt as to *P. papatasii* being a transmitter of *Leishmania tropica*.

Nevertheless, inoculation experiments performed in 1925 on seven volunteers, with flagellates from sandflies artificially infected by feeding on oriental sores, all proved negative. In these experiments flagellates were obtained from sandflies 2, 4, 5, 6, and 7 days after the infecting feed. Since *P. papatasii* is a proved carrier of *L. tropica*, it was possible to account for these negative results only on the theory that *L. tropica* undergoes a complete biological cycle of development in the sandfly, and until the cycle is completed all the flagellates (and Leishmania forms) in the sandfly are non-infective.

In order to determine at what stage *L. tropica* in the sandfly becomes infective, a further series of experiments was performed with flagellates from artificially infected, laboratory-bred sandflies 8, 9, 10, 11, 12, 13, 14, 15, and 21 days after the infecting feed. All the sandflies were kept at laboratory temperature, 19°-23° C. The infecting feeds were made on a lesion which was the result of an artificial infection with flagellates from a natural infected sandfly. Up to the present two experiments have given positive results.

(1) *P. papatasii* ♀ hatched in laboratory, Sept. 8, 1926; fed on experimental lesion same date; died on Sept. 16, and dissected soon after death. (No further feed was allowed after the infecting feed) Numerous flagellates were found in the pharynx, œsophagus, and mid-gut of the sandfly, but none in the hind-gut. Two inoculations were made into the left forearm of a volunteer shortly after the dissection.

Oct. 14, 1926. A papule noted on the site of one of the inoculated points was found to contain numerous Leishman-Donovan bodies.

(2) *P. papatasii* ♀ hatched in laboratory, Sept. 7, 1926; fed on experimental lesion, Sept. 9; died Sept. 17, and dissected shortly after death. (No further feed was allowed after the infecting feed.) Numerous flagellates were found in the whole alimentary tract from pharynx to rectum. Two inoculations were made into the left forearm of a volunteer shortly after the dissection.

Oct. 14, 1926. A papule on the site of one of the inoculated points was found to contain Leishman-Donovan bodies.

Thus a strain of *L. tropica* has been observed between June 26, 1925, and Oct. 14, 1926, through four successive generations of hosts.

(1) A sandfly (naturally infected).
(2) A human being experimentally infected from (1).
(3) Laboratory-bred sandflies infected from (2).
(4) Human beings infected from (3).

The proof that *Phlebotomus papatasii* is a transmitter of cutaneous Leishmaniasis is therefore complete.

S. ADLER.
O. THEODOR.

Microbiological Institute,
Hebrew University,
Jerusalem, October 15.

Science and Psychical Research.

IN reply to Dr. Tillyard's letter in NATURE of October 23, I cannot see that 'catalytic agent' is in any way a better simile for a medium than is the word 'instrument,' for catalysts, equally with instruments, are not possessed of any form of consciousness or of motives. Moreover, how can we be sure, as Dr Tillyard states, that a medium is not actively a participant in the experiment? Trances can be simulated, and anyway, what is to prevent the subconscious mind being affected by motives, just as may be the case in the fully conscious mind?

The occasional failure of experiments in chemistry classes, as also, let me add, in the case of physics demonstrations, have no analogy to the uncertainty that seems to exist in all psychic affairs. As Dr. Tillyard must well know, no new fact in chemical or physical science is ever finally accepted until the experiments that establish it have been repeated by numerous observers, and further, until observers are satisfied that the experiments can be repeated with certainty at will, and give identical results under the same conditions every time.

Where do we get such exactness in psychical re search ? Mr. W. H Massey, the well-known engineer, tells me that he once offered a reward of 1000*l*., which he advertised in the papers, to any one who could give a single conclusive demonstration of telepathy. In reply he did not get one single offer, and was told by an eminent authority on the subject that it was absurd to expect that telepathy could be done to order, and that it only occurred apparently spontaneously and on rare occasions. What sane scientific man would believe in any physical phenomenon which, once experimentally obtained, could not be reproduced at will and with certainty; and why should we treat psychical phenomena upon any different basis ?

Dr. Tillyard objects to my strictures on the word 'national' as applied to a psychical research laboratory, which is so new that it has not yet even got into the London Directory. No doubt there are hundreds of concerns calling themselves 'national' Some are really national institutions, and others assume this position. Most are merely commercial concerns, in many cases insignificant ones, wishing to advertise their commodities and give themselves a name by which they hope to magnify their small importance. Thus, I find that 'national' is even adopted by a firm of funeral undertakers. It is the same spirit that leads caravanserais that by no means deserve the appellation to call themselves 'Grand' or even 'Majestic.' When we come, however, to a new scientific institution the object of which is, I assume, the serious elucidation of truth, then I cannot think that it was a happy idea to begin this comparatively minor institution's career by calling it by a pretentious name to which it has no real claim, and may easily be confused by the ignorant with another really national laboratory of vast importance.

I have, however, no wish to labour this point, in regard to which Dr. Tillyard has attacked me. It was only a minor issue in my letter in NATURE of September 25, where the principal reason I gave for declining Dr. Tillyard's kind invitation was that, in my opinion, thermographic phenomena in connexion with mediums are more a matter for a physiologist than for a physicist.

Dr. Tillyard, however, broadly accuses me of "an unscientific attitude to the subject of psychical research." This he bases on his belief that I have never been to a spiritualistic—or shall we say psychical—séance, and never intend to go to one. I must defend myself against this charge; but here I must first differentiate between what, on one hand, I would call spiritualistic séances, where professional mediums are employed, and where spirits, either directly visible or through mediumistic agency are vocal or mechanically active, are supposed to be conjured up, and secondly, séances or meetings at which such things as telepathy are experimented with, where no mediums are requisite. Let me say at once that I have taken part in numerous serious meetings of the latter kind, where telepathy without contact was attempted, but have never met with even the slightest evidence of what could be called success This, I may add, has been always to my exceeding disappointment, as was also the case when I tried most strenuously to repeat Blondlot's *N*-ray experiments. In both cases at first I fully expected to succeed, just as I did succeed when I repeated Röntgen's X-ray experiments when these were first announced, and before they had been confirmed by any one else in England.

As regards the other type of spiritualistic séances, I think I can honestly say that if I have in the past never attended such, this is for the reason that I have never been invited to attend one, as I am sure, in the days when I delighted in Maskeleyne and Cook's Egyptian Hall of Mysteries, and also enjoyed wonderful thought-reading exhibitions by Stuart Cumberland and others, I should have jumped at such an invitation As regards the present and the future, however, perhaps increasing age and experience have given me a greater sense of responsibility, and my present attitude is that I do not think it right to give any countenance to proceedings where I should fully expect to be misled, and afterwards told that, anyway, I could not explain the phenomena I had been shown, and that therefore there must be something supernormal in them.

My firm conviction is that, as in the past, so at present, there is overwhelming evidence that at all spiritualistic séances where there are ghostly apparitions, spirit voices, and any kind of communication with what is supposed to be another world, the phenomena are invariably due to fraud—not necessarily conscious, perhaps in some cases subconscious, but absolute fraud all the same. I have already been taken to task for the use of this ugly word 'fraud' in this particular connexion, but I get it from no less a master in science than Lord Kelvin, who used frequently to say that all the phenomena of what he called that 'wretched superstition of spiritualism,' when not to be explained by 'defective observation,' were due to 'fraud.' If it is considered an unscientific attitude to refuse to have any dealings with fraud, then I prefer to be thought unscientific, for I agree with the book of Ecclesiasticus that "He that toucheth pitch shall be defiled therewith."

In conclusion, let it not be supposed that I impute anything worse than undue credulity to our very few really eminent scientific spiritualistic believers, past and present, who I am sure were or are quite honest in what they thought or think to be their pursuit of truth. Of these I would only repeat the words of my countryman, David Hume, who, speaking of miracles more than one hundred years ago, asked the simple question as to whether it was more probable that these very extraordinary and unprecedented things did actually happen, or whether the observers or narrators of them were mistaken.

A. A. CAMPBELL SWINTON.

40 Chester Square, S.W.1,
October 27.

ONE wonders who are the onlookers who would be so 'unwise' as to elevate any of the three 'hypotheses' mentioned by Sir Oliver Lodge (NATURE, October 30, p. 622) to the "high status required of a scientific theory." Few would dignify even by the term hypothesis what are simply observations. Granted genuine phenomena, how much further are we scientifically ? Granted 'ectoplasm,' can science justify repetitions of the human vivisection necessary to produce it when there is no purpose, except curiosity, in view ? Granted an 'intelligence' behind the phenomena, can science say to which order amongst the myriad intelligences of Nature such belongs ? Granted a 'spirit' hypothesis, can science describe or define spirit ?

If the function of science be to discover the *rationale* of all facts of human experience, it follows that it can serve and protect mankind only in so far as it discharges this function. None of the many eminent men of science in European countries and the U.S.A. who, during the last seventy-five years, have attested the reality of psychic phenomena, have advanced a scientific theory of the cause. If present-day investigators would make themselves acquainted with what has been done by their predecessors (who were equally competent and disinterested), they would find that there are no grounds for believing that we know any more about the phenomena than men of science did fifty years ago; and truth to say, the 'hypotheses' advanced then were much more philosophically phrased and discussed. I should also like to ask on what authority Sir William Crookes is labelled a 'spiritist.' He, with the majority of men of science who have been interested, dropped the investigations when convinced of the facts, because it was found that the phenomena were mainly repetitions of what had been already widely recorded in a large body of literature in various ages and countries, and that no new scientific facts could be deduced from recurrent sporadic phenomena, unconnected with existing scientific knowledge, and beyond the control of men of science.

More recently another type of 'researcher' has persisted in certain investigations without either the justification of a 'spiritist' belief or the sanction of scientific prevision. What is the motive? What can be the motive when, after fifty years of psychical research, the problem is exactly where it was in the Dark Ages, during which the Church, at least, discouraged human vivisection and also necromancy? These are strong words; but are investigators unaware of the fate of the majority of mediums, many of whom in the beginning are simple, honest, but sensitive human types? Do they not know how frequently degeneracy gradually ensues from the use of the mediumistic faculty? In the lives of mediums are many strange and terrible tales of immorality, sensuality, obsession, insanity, and crime. Those who have studied the history of this subject know, too, how often investigators have completely lost and never recovered their own reason once they have resigned their self-control to follow the dictates of an unknown 'guide.' Zöllner was not the first or the last to suffer this penalty.

It would be dangerous, therefore, to accept blindly Sir Oliver Lodge's counsel to "follow our leaders." He is a great man of science. We accept his authority in matters of physics, as we accept facts of astronomy, etc., from other men of science, and are glad to do so, as we know they have undergone the necessary training and discipline to become specialists in their subjects. They speak with the authority of knowledge and do not ask us to follow other unknown leaders of whose *bona fides* they or we know nothing.

On what authority, however, can any of the modern 'scientific investigators' of psychic phenomena ask us to accept their fancies about a *spiritual* world? Have they attained knowledge by self-discipline, self-sacrifice, and the experience of trials overcome? Have they shown any signs of the power reputed to be possessed by religious teachers and Wise Men, 'mediators,' of old, who could themselves control the energies of the lower 'psychic' world, cast out 'evil spirits' from the insane and obsessed unfortunates, and deliver clear and inspiring teaching from a serene, spiritual level so far above the commonplace 'communications' that issue via mediums as science is (or ought to be) above vanity?

The younger 'psychical researchers' would be better engaged in compiling a history of the lives of mediums and collecting statistics of the periodic epidemics of psychism, which latter should be plotted with waves of crime. An inquiry might be made also as to why the mediumistic practices encouraged amongst us to-day were forbidden by the Hindus and all Eastern religions before their decline. Neither the religion nor the science of our times understands what was evidently part of the knowledge of ancient scientific religion Hence the danger.

W. W. L.

THERE cannot be much doubt that Sir Oliver Lodge (NATURE, October 30, 1926, p 623) wishes to compare the attitude of an hypothetical race of "secluded, but intelligent aborigines," towards rumours of X-rays, telephones, radio telegraphy, and the existence of a hitherto unsuspected race of white men—with that of present-day opponents of what is called 'spiritualism.' This comparison, in my opinion, is unsound In the first place, it would be possible for any one of the aborigines mentioned to insist that the believers in X-rays, and other things of a like nature, conduct him to the part of the world where these phenomena were alleged to be produced, in order that he might examine them. Further, upon arrival, he would be met by actual individuals of the race of white men, as to whose existence he had harboured doubt, and these people, of flesh and blood like himself, would proceed to show him the phenomena in actual operation, and, I take it, explain to him, in a perfectly rational and detailed manner, how they were brought about. Such a demonstration, which could be repeated, under ideal conditions for seeing and understanding, as many times as the aborigine wished, would, without question, convince him that the rumours he had heard in his own country were based upon fact, as it would any other reasonable person.

In the case of the disbeliever of the claims of modern spiritualists, no such rational and clear demonstration is vouchsafed. He is unable to converse in a normal manner with the 'intelligences' who, it is asserted, are responsible for the production of the 'occult' phenomena, and no spiritualist is able to give him the slightest real inkling as to how these phenomena are produced. In fact, to use Sir Oliver Lodge's words, he finds himself in the hands of "gropers in a tangled region off the obvious track," and cannot be blamed if his disbelief is merely increased by such an unsatisfactory experience.

Not only is the comparison under discussion unsound: it is also unfortunate. Aborigines, like certain people of the present day, though intelligent in some things, are nevertheless found to be willing believers in even the most preposterous of 'ghosts,' and would thus be most unlikely to doubt the statements (regarding X-rays and other similar phenomena) of those of their companions whose observations they had been in the habit of treating with respect.

J. REID MOIR.

Patent Law and Unemployment.

IN a leading article in NATURE of September 18, it is argued that the increase in the percentage of patents kept alive to the end of the fourteenth year since 1905 is due to official examination for novelty introduced in that year. I submit that this reasoning does not hold good. The rise preceded the year 1905, as the following figures will show

Year.	Sealed	Paid 14th year's Tax.	Percentage.
1897	14,465	442	3·0
1901	13,995	594	4·2
1902	15,242	596	3·9
1903	15,105	653	4·3
1904	16,124	804	4·9

Prior to the Act of 1883 the percentage was much higher—nearly 10 per cent. for 1876. Probably many factors unite in determining the variation of the percentage. The market value of patents depends upon their industrial value in a given period, and this value will depend upon their property of being used for the promotion or obstruction of home industries. Hitherto no attempt has been made to analyse the result of the British patent system with the view of determining how far it tends to the introduction of new industries. I agree with the writer that this should be done, and that the system should be subjected to a searching investigation by economists with the view of ascertaining the influence of the Law of Novelty upon industrial progress. E. WYNDHAM HULME.

Old House, East Street,
Littlehampton, October 4.

WITH regard to Mr. Hulme's first point, the accompanying graph, Fig. 1, which shows the number of patents surviving fourteen years from each of a large number of years, indicates that his selection of figures is not representative. The effect of the Acts of 1883 and 1902 is very clearly seen. It is true, however, that the figures for 1903, 1904 show the effect of the Act of 1902 (the figure for 1903 is differently given in different reports), while the slight increase for 1901, 1902 may or may not be a normal fluctuation. The rise in 1903, 1904 may be attributed to two causes: (*a*) The Act of 1902 probably owes its effect not so much to its direct action as to the enhanced prestige which it conferred on patents generally. It is not unnatural, although it is not strictly logical, that patents which escaped the official examination (first made in 1905) should nevertheless benefit by this general rise in the prestige of patents. (*b*) A number of specifications which would normally have been filed in 1905 or 1906 was rushed into the Patent Office in 1903 and 1904 in order to escape the examination: this is clearly indicated by the number of patents granted to foreigners, which were as follows:

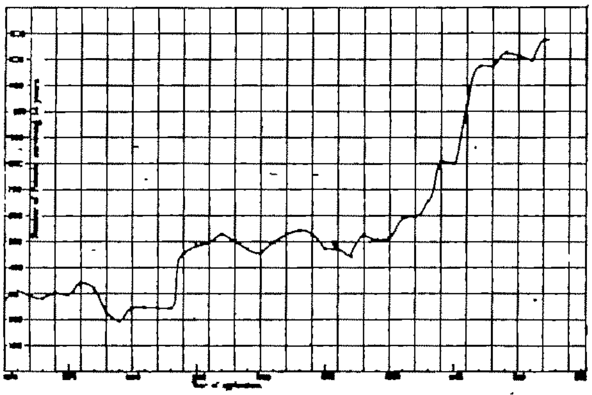


FIG. 1.

1900	6424	1905	6255
1901	6573	1906	6503
1902	6509	1907	7373
1903	7455	1908	7522
1904	7019	1909	6485

These rushed-in patents would, on the whole, belong to the more serious class, for the academic type of patent is filed promptly, without waiting for experimental development, and cannot, therefore, be "rushed." Inventions coming from abroad are certainly selected inventions.

As regards Mr. Hulme's second point: the *percentage* figure for 1876 is not significant for the present issue, for the absolute figure for that year was only 341, as compared with 1200 or more in recent times. The fact is that the peculiar incidence of application and renewal fees in the early days favoured a high percentage of survival.

THE WRITER OF THE ARTICLE.

Explanation of the Spectra of Metals of the Second Group.

THE explanation of the complicated spectra of elements is now making rapid strides, thanks to the more complete and accurate knowledge of the structure of the atom which we owe to Stoner, and the development of the quantum principles of combination which we owe to Russell, Pauli, Heisenberg, and Hund. The latter authors have so far confined their attention to the explanation of the fundamental terms of the spectra. But the principles can be extended for finding out the higher members as well. The following is a brief sketch:

If we write out the different sub-levels according to Stoner (K_{11}, L_{11}, L_{21}, L_{22}, etc. . .), and begin with the alkalies, the fundamental orbit is some X_{11}-orbit. But if we allow the electron to run through the successive sub-levels we get $2p_{12}$, $3d_{23}$ . . . $2s$ . . . terms. In the case of alkaline earths we keep one electron in any X_{11}-orbit, and allow the second to run through the successive sub-levels. The resultant orbit is calculated by applying the rules of quantum-addition for r (multiplicity-quantum number), and k (azimuthal-quantum number), but discarding Pauli's rule for the inner quantum number. This is quite justified, because Pauli's rule ought to hold only when the electrons close a sub-level. Thus, taking calcium, if both electrons are taken in the N_{11}-level the sub-group is closed, Pauli's rule holds, we get $^1S_0$ only and not $^3S_1$. But when one electron is in N_{11}-level, the second or vibrating one is in the O_{11}-level, Pauli's rule should not hold, we get the second Rydberg member of 2^1S_0, and 2^3S_1. Combination of the N_{11}-electron with the orbits just following or just preceding gives large prime terms; thus N_{11}, N_{21}, or N_{22} gives us the large $^3P_{012}$, $^1P_1$ terms; N_{11}, M_{21}, or M_{22} give us the large $^3D_{123}$, $^1D_2$, which are observed in calcium as well as in strontium and barium, but not in magnesium, because in magnesium there is no vacant D-level preceding the fundamental M_{11}-level. The theory thus explains the details of the normal spectrum of magnesium, calcium, barium, strontium, zinc, cadmium, mercury in a very simple and convincing way.

The success, however, applies not only to the regular terms, but also to the dashed terms which, according to Russell and Saunders, arise from the metastable ^2D-levels of Ca^+, Sr^+, or Ba^+. Taking calcium, we put the first electron in the M_3-levels, and then add the second electron either to these levels, or to any one of the higher levels in the Stoner-sequence. In this way we get not only $\bar{S}_0$, $\bar{P}$, $\bar{D}$, $\bar{F}$-levels of both singlets and triplets and their higher Rydberg sequences fixed up by Russell, but also the $^3P'$, $^3D'$, $^3F'$ terms. The latter terms are regular terms, and ought to be designated as b^3P, b^3D, b^3F. Thus Russell and Saunders' contention that these terms arise from the metastable D-level is completely justified. In short, the procedure accounts in a most convincing way for all the details in the spectra of elements of the second group, including the probable values of these terms.

A detailed paper will be published in the *Philosophical Magazine*.

The ideas in this communication are contained implicitly in the writings of Hund and others, but they have not been worked out in detail, nor has it been shown that they are capable of explaining in such details the structure of the spectrum.

MEGHNAD SAHA.

Physical Laboratory,
Allahabad, India,
September 6.

Absorption Bands in Nitrogen.

SOME time ago the critical potentials in nitrogen were determined by the present writer (*Zeit. f. Phys.*, 34, 622, 1925) by measuring the excitation potentials of the 0-0 band of the second positive group and of the negative bands. The results were 13·0 and 19·6 volts respectively. Having the absolute value of 13·0 volts, and using the term scheme of N_2 given by R. T. Birge (*Phys. Rev.*, 23, 294, 1924), the excitation potentials of the first and fourth positive groups of nitrogen could be calculated, and a value of 8 volts was obtained for the resonance potential, as was predicted by R. T. Birge (NATURE, 114, 642, 1924). The band system belonging to the transition between the first excited and the normal state was, however, not known. In order to settle the question about the normal state of the nitrogen molecule, absorption plates have been taken. It is extremely difficult to get the right conditions for this experiment. The final pictures were taken with the vacuum spectrograph of Prof. J. J. Hopfield, which he kindly offered to me for that purpose.

We filled the whole spectrograph with carefully prepared nitrogen to about 20 cm. pressure and used Lyman's capillary method (*Astrophys. J.*, 60, 1, 1924, and NATURE, 118, 156, 1926) for the continuous light source. The plates show a band system with frequency differences which have the same values as those of the final state of the first positive group, proving definitely that the first positive group is going out from the first excited state of the molecule. The 0-0 band of the new system corresponds to an excitation potential of 8 volts, confirming the prediction of R. T. Birge and my critical potential measurements. In the detailed paper which will be given soon, these and other bands appearing on the plate will be discussed.

H. SPONER.

Department of Physics,
University of California, September 13.

The Reaction to Flea Bites: Anaphylaxis and Louse Infestation.

I WAS much interested in Prof. Boycott's letter (NATURE, October 23, p. 591) dealing with anaphylaxis consequent upon the bites of fleas, as I have in mind an interesting case illustrating the same phenomenon after infestation by lice. The case came under my notice in 1918 whilst I was serving as entomologist with the American Red Cross Trench Fever Commission in France under Prof. (then Major) Richard P. Strong, of Harvard University, U.S.A. During the experimentation a number of volunteer subjects were injected intravenously with filtered extract of louse excrement from insects which had fed upon trench fever cases. One such volunteer was inoculated at 3.25 P.M., and, to quote, "Z. showed very marked anaphylactic phenomena at 3.40 P.M., severe œdema of the face, and very marked general urticaria and much discomfort. The symptoms slowly subsided. Z. had previously been used for the feeding of normal lice from May 31 to June 10. During this period over one hundred lice were fed upon him twice daily. His case illustrates a very unusual form of anaphylaxis" ("Trench Fever," Oxford University Press, 1918, p. 278).

Again, from the case report (p. 430, *ibid.*), Z. showed "marked generalised œdema, beginning half an hour afterwards and temperature of 99·8° F., gradually decreasing, and lasting two days, except around previous bites of normal lice, where it lasted five days." It remains to mention that the man had been used as a 'foster nurse' for uninfected lice used in other experiments, and that the injection work and clinical observations were carried on by Prof. Strong and Prof. (then Major) Homer F. Swift.

A. D. PEACOCK.

Zoological Department,
University College, Dundee,
October 26.

The Antiquity of the Labiatæ or Mint Family.

IN Knowlton's recent catalogue of the Mesozoic and Cenozoic plants of North America, there is not a single species of Labiatæ. Schenk, in Zittel, refers only to interglacial *Lycopus europæus* and *Stachys palustris*. More recently Reid has recorded preglacial Labiatæ, such as Lycopus, Stachys (two species), and Mentha from England. The fruits and calyces are distinctive, and should be easily recognisable; but owing to the specialised character of the family, and the prevalent opinion concerning the late evolution of herbaceous plants, it has seemed unreasonable to expect very ancient fossils of this type.

Nevertheless, among some fossils collected in the Green River Eocene of Colorado in 1923 is a characteristic labiate calyx. The specimen was obtained in the Roan Mountains by Prof. Junius Henderson and Mr. John Byram, high up on the plateau. The calyx is dark, the tube 3·3 mm long and 1·3 mm. broad, with five slender, spreading teeth which are about 2 mm. long. There are twice as many striæ as teeth; these are quite distinct. The general aspect is nearly that of Mentha, but the spreading of the teeth rather suggests *Leonurus cardiaca*, in which, however, the teeth are much broader at the base. Two of the teeth seem to be united a trifle higher up than the others, but there is scarcely any departure from strict radial symmetry. As it is impossible to refer this with any assurance to a particular modern genus, it may be placed under a new generic term Menthites, as *Menthites eocenicus*.

Evidently we must look in the Mesozoic for the origin of the Labiatæ. T. D. A. COCKERELL.

University of Colorado,
October 14.

Early Egypt and the Fayum.

THE statements about the Fayum question in NATURE of October 30, pp. 624-5, were already familiar to me, but they do not appear to invalidate the six reasons which are as I have stated (p. 514) for the received view of the Nile-fed lake. For example, the sandy island flagged over with stones for a quay is exactly what fishermen need for drying fish away from the jackals. A discussion of details would much exceed a journal correspondence. But the appeal to "hard geological facts" involves, to begin with, a solution of the problem of interpretation. There must first be some common understanding about the traces of a Nile-fed lake level, which would appear from (1) a lake rising and falling 8 or 10 feet every year, with margins varying over about a furlong of sands; (2) with a general rise of level 4 or 5 feet every 1000 years; and (3) the ground being later dried up and subjected to 2000 years of high-wind denudation without any vegetation covering it, and some hundreds of rain storms. At least it is certain that the traces of it would be quite different from those of the old permanent estuarine lake of pre-human date, both physically and biologically. When we know what to expect, we may then know how to interpret the present appearances. FLINDERS PETRIE.

Chlorine Gas Filters in Relation to Reaction Velocity.

DURING the course of some work which I have been carrying out recently on the photo-synthesis of hydrogen chloride from its elements, rather curious results have been obtained. The light used to activate the chlorine-hydrogen mixture was filtered through varying quantities of chlorine gas with the object of studying the corresponding variations in the reaction velocity. It was found that a very small pressure of chlorine in the filter was able to reduce the actinic power of the light very greatly, but increases of the chlorine pressure produced less and less effect The curve obtained by plotting actinic power against density of filtering medium was not, however, an exponential function, but more the shape of a rectangular hyperbola which for high densities tended to a definite 'residual' value for the actinic power. A tube of 45 cm. of chlorine at atmospheric pressure reduced the reaction velocity to 10 per cent. of its initial value.

In conjunction with Mr. A. Elliott, further experiments were carried out using a tube one metre and a half in length, and the curve extended in the direction of still greater concentrations. The residual velocity was then reduced to 5 per cent., and a very similar curve was obtained when a solution of chlorine in carbon tetrachloride was used as the filtering medium instead of chlorine in the gaseous state.

WILFRID TAYLOR.
(Earl Grey Fellow.)

University of Durham, Armstrong College,
Newcastle-upon-Tyne, September 24.

The Structure of the Continents.

IN the investigation of the structure of the continental masses there are two important considerations which must not be overlooked.

The first is the inadequate data available for the calculation of the velocity of transmission of vibrations in the earth's crust Dr. Jeffreys has made excellent use of what little there is, but, as I pointed out at the meeting of the British Association at Bournemouth in 1919, and as he himself has contended, there is urgent need of systematic *experimental* work on the times of transmission of such vibrations.

In the second place, experiments on the elasticity and physical characters of hand specimens of rocks is of little value for the determination of those of deep-seated magmas of similar composition, not only on account of the enormous pressure that prevails even at moderate depths, but also because of the presence of volatile constituents, consisting largely of the elements of water and (especially in basic rocks) of sulphur compounds, far in excess of those contained in hand specimens of even glassy rocks such as tachylyte.

JOHN W. EVANS.

Imperial College of Science,
South Kensington, S.W. 7,
October 25.

Sterility in the Vegetable Marrow.

SEEING that a letter on the above subject has recently appeared in NATURE (October 23, p. 592), it may be of interest to place on record my experience this summer regarding pumpkins. Besides growing vegetable marrows, which, as it happens, have behaved quite normally this season, bearing an abundant crop, we usually put out a single pumpkin plant and manage, as a rule, to obtain from it one large fruit. For the first time, two plants were put out this year—a piece of good fortune, for one of these declined to produce a single female flower. I had it under strict observation the whole season. The other behaved normally, forming plenty of female flowers and ripening one fruit. The two plants grew side by side under identical conditions of soil and light. Pumpkins have been grown by me for the last six or seven years, and this is the first time a plant has been seen to behave in this way. I have never yet come across a completely male marrow plant.

I fear I can offer no adequate explanation as to the reason for the lack of female flowers in the marrow plants mentioned by Miss Armitage. If the past summer had been cold and sunless, low temperature might have been suggested as the cause; but, as she writes, the season has been favourable for half-hardy plants, and the abundance of marrows formed and matured here point to this. It looks as if the maleness had been innate in the seeds and not induced by external conditions.

JOHN PARKIN.

Blaithwaite,
Wigton, Cumberland,
October 25.

Optics and Poetry.

"Iam clarum mane fenestras
Intrat, et angustas extendit lumine rimas."
PERSIUS (A.D. 34-62), *Sat* iii. 1-2.

"Here is full morning coming through the window shutters, and making the narrow crevices look larger with the light"—(Conington's translation).

THAT a narrow slit seems to grow wider as the intensity of the light coming through it increases is of itself a dry and not very important matter of common observation; but the very charming use of this fact by the Latin poet, as an indication to the sluggard within that he has long overslept the proper hour of rising, gives it a new attraction and interest, and is worth noting. "We go on snoring, enough to carry off the fumes of the unmanageable Falernian, while the shadow is crossing the fifth line of the dial," that is, at eleven o'clock.

This apparent widening of a narrow slit is perhaps due to a kind of dazzle or halation affecting the surface of the retina, comparable to the irradiation or spreading of the light on a photographic plate. After a night in bed the eyes would naturally be more alert to effects of this kind. M. Gustave Le Bon found by experiment that it requires at least fifteen minutes spent in darkness to bring the eyes to their maximum sensitiveness to faint illumination. No doubt the poet had often observed the phenomenon himself as he lay, 'twixt sleep and waking, watching the slits in the shutters, first in the grey dawn and then lit by the sun.

H. C. BROWNE.

Dublin, October 21.

'Red Rain' at Bordighera, Italy.

'RED rain' fell at Bordighera on the morning of October 31, coating the pavements and vegetation with a dense red-brown deposit which turned to salmon colour when dry. The shower, which terminated about noon (English summer time), was accompanied by a current of hot moist air from the east. The previous day was wet and overcast, and the evening after the shower there was a thunderstorm with long flashes of lightning from east to west at an estimated altitude never touching below 2500 feet. Samples of the deposit (doubtless sand from the Sahara) are being preserved for microscopical examination.

G. H. BRYAN.

Le Lucciole, Bordighera,
Italy, November 1.

Cretaceous Mammal Skulls from Mongolia.

By Dr. WILLIAM K. GREGORY and G. G. SIMPSON.

THE discovery of Cretaceous mammal skulls in Mongolia by the Central Asiatic Expedition of the American Museum of Natural History is an event of exceptional importance in vertebrate palæontology. The Cretaceous forerunners of the varied placental mammals of the Palæocene and Eocene have hitherto been known only by inference. The studies of Cope, Osborn, Wortman, Matthew, and others upon the dentition and skeleton of Eocene mammals led to the view that the earliest insectivores and creodonts, taken collectively, were descendants of the most primitive group of placentals, for which the name Therictoidea was proposed by Gregory in 1910.[1] It was further inferred that the stem placentals of the Cretaceous would be more or less intermediate in character between the Jurassic "Amphitherium" and such early Eocene forms as Palæoryctes, Didelphodus, and the Oxyclænidæ.[2]

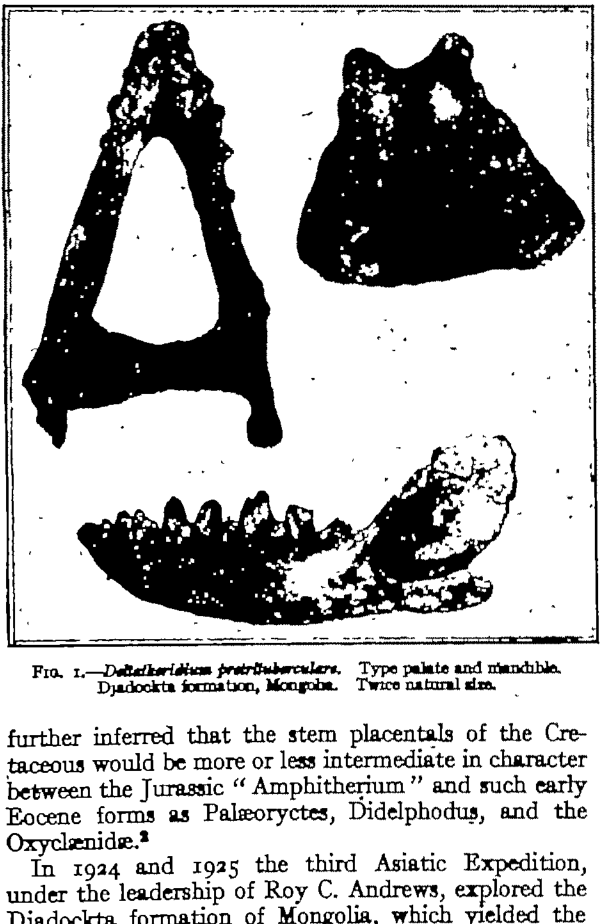


FIG. 1.—*Deltatheridium pretrituberculare.* Type palate and mandible. Djadockta formation, Mongolia. Twice natural size.

In 1924 and 1925 the third Asiatic Expedition, under the leadership of Roy C. Andrews, explored the Djadockta formation of Mongolia, which yielded the famous dinosaur eggs and the superb series of Protoceratops skulls and skeletons. Here Mr. Walter Granger and his associates, after prolonged search, finally discovered no fewer than seven skulls or parts of skulls, some with associated lower jaws, of Cretaceous mammals. Of these the first specimen discovered in 1924 proved to be an allotherian or multituberculate, and has been described as the type of a new genus and family of allotherians in the *American Museum Novitates*.[3]

The remaining specimens discovered in 1925 have been very skilfully extricated from the matrix by Mr. Albert Thomson and generously entrusted to us for description by Prof. Osborn and Dr. Matthew. Upon examination the new specimens appear to be quite distinct from all of the hitherto described jaws and teeth of Cretaceous mammals, including those in the Marsh collection of the Peabody Museum, Yale University, in the American Museum of Natural History, in the United States National Museum, and elsewhere.

All the known American Cretaceous mammals, except the allotherians, are marsupials, related rather closely to the existing opossums, so that as the evidence now stands the placental mammals did not invade north-western America until the Palæocene. All the Mongolian Cretaceous mammals, on the contrary, again excepting the allotherians, so far appear to be placental.

So far back as Morrison (basal Cretaceous) times the pantotherian or trituberculate mammals were differentiated into several families. We are therefore not surprised to find that the Mongolian Cretaceous placentals show considerable diversity among themselves, so that even in the half-dozen specimens now available there are representatives of not less than four genera and two families, all apparently new to science.

The largest of these animals was somewhat bigger than a large house rat. Its skull and dentition were distinctly carnivorous in type, with enlarged laniary canines and sharp-bladed, narrow, triangular molars, approaching in these features the most primitive Eocene creodonts. Three genera are referred to this family, which is named by us the Deltatheridiidæ.[4] The upper molar teeth are in what may be called a pre-tritubercular stage of evolution, since the para- and meta-cones are connate or not separated from each other and are median in position, in line with the primitive tips of the premolars, while the so-called 'protocones' are internal spurs from the base of the crown. The lower molars are tritubercular, with shearing paraconid-protoconid blades and narrow heels.

In the second family, called Zalambdalestidæ, the very elongate snout suggests that of Solenodon, except that the lateral, not the median, incisors are enlarged. The cheek teeth, much worn in the type, strongly suggest those of zalambdadont insectivores, but a referred specimen indicates that the para- and metacones were partly separated and more buccal in position than in modern zalambdodonts, thus supporting Matthew's view[5] that the peculiar zalambdodont molars have been derived from a more normal tritubercular type. The lower molars are tuberculo-sectorial, with fairly broad heels. One pair of the anterior teeth, probably the median incisors, were much enlarged and procumbent, working between the enlarged upper incisors. The canines were small or absent, and there were long spaces behind the enlarged front teeth. The skull avoids the specialisations of modern zalambdodonts, the nasals being separate, the zygomatic arches complete and the glenoids not displaced medially; orbital region less reduced, with prominent lacrymal rims; brain-case moderately expanded, not tubular. In these and other important details the Zalambdalestidæ agreed with the Deltatheridiidæ, and the characters of one of the new genera named Hyotheridium indicate that at that time the two families were still closely related, however much their presumed descendants, the placental carnivores and insectivores, diverged in later times.

---

[1] The Orders of Mammals, *Bull. A M.N H.*, 27, p. 464; see also pp. 304–307, 467, 468.

[2] "The Origin and Evolution of the Human Dentition." Baltimore, 1922, pp. 99-107, 512.

[3] Simpson, G G., 1925. A Mesozoic Mammal Skull from Mongolia. *American Museum Novitates*, No 210, Nov. 24, 1925.

[4] *American Museum Novitates*, October 1926. Cretaceous Mammal Skulls from Mongolia, by William K Gregory and G G Simpson.

[5] Matthew, W. D., 1913. A Zalambdodont Insectivore from the Basal Eocene, *Bull. A.M N.H.*, 32, Art 27, pp. 307-314.

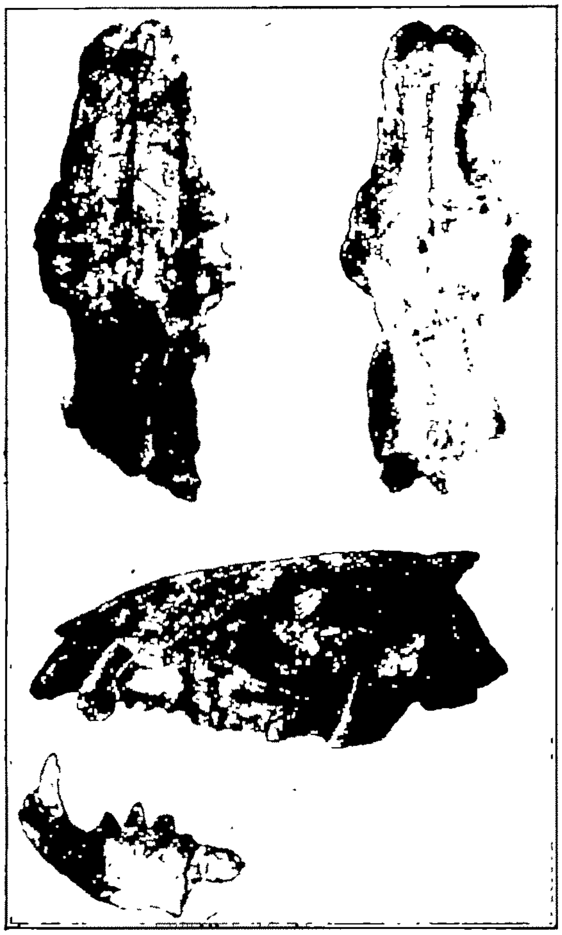


FIG. 2.—*Deltatheridium pretrituberculare.* Referred specimen. Twice natural size.

Accordingly these specimens afford additional support for the following conclusions, based on much other evidence.

(1) The Palæocene and Eocene insectivores and oxyclænid creodonts, taken collectively, represent survivors of an earlier insectivore-creodont stock, examples of which have now been discovered in Mongolia.

(2) The discovery of these earliest of definite placentals in Mongolia furnishes some support to the hypothesis that Central Asia was the homeland of the placental radiation.

(3) The Mongolian Cretaceous mammals stand between the Jurassic pantotherians and the Palæocene placentals, both in time and in dental structure, but are somewhat nearer to the latter.

(4) The Mongolian Cretaceous mammals favour the view of Wortman and others that the para- and metacones collectively of the mammalian tritubercular molar are in line with, and homologous with, the 'reptilian' tip of the premolar crowns, and that the so-called protocones represent internal basal spurs, correlated functionally with the differentiation of a heel or talonid, on the lower molars.

The following is a list of the mammalian fauna now known from the Djadockta formation:

MULTITUBERCULATA.
  Philodontidæ.
    Djadochtatherium matthewi Simpson.
INSECTIVORA.
  Deltatheridiidæ.
    Deltatheridium pretrituberculare G. and S.
    Deltatheroides cretacicus G. and S.
    Hyotheridium dobsoni G. and S.
  Zalambdalestidæ.
    Zalambdalestes lechei G. and S.

Of these all are known from at least part of the skull, including the palate, and all but Deltatheroides also from associated lower jaws. Zalambdalestes is incomparably the best known of all Mesozoic mammals, every main part of the skull and jaws being known, although some features are still rather obscure

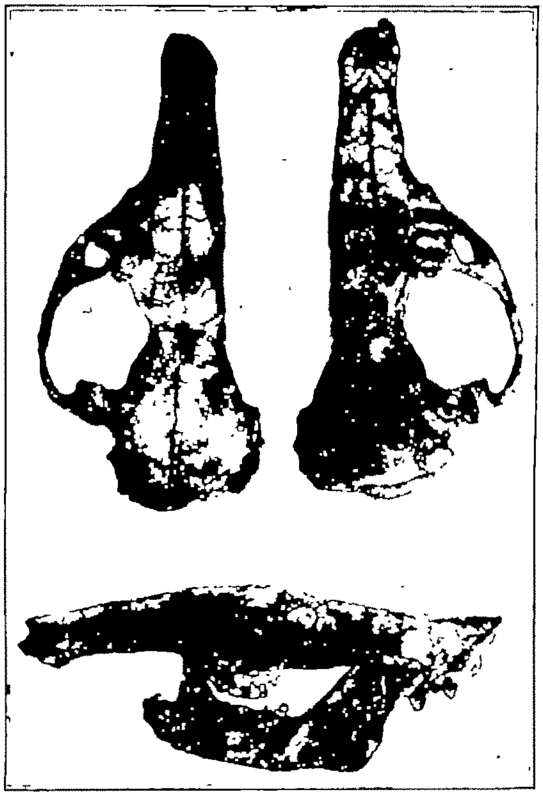


FIG. 3.—*Zalambdalestes lechei.* Type. Twice natural size.

Properties of Thin Films.[1]

By Sir WILLIAM B. HARDY, F.R.S.

EVERY one knows of the three states in which matter can exist—solid, fluid, and gas or vapour. Thin films of matter, familiar to all in the form of soap bubbles or lubricating films of oil, are no less than a fourth state, because, choose what physical constant we may, it will have a different value for any particular kind of matter in this state from what it has in any of those other states which are more easily apprehended by the senses.

Life itself depends upon this fourth state of matter. There is a film spread over the surface of each living cell which seems to control the passage of substances into or out of the cell. This film is actively maintained by the expenditure of energy on the part of the cell. The new technique of microdissection, by which living cells so small as to be almost or quite invisible can be dissected, has increased our knowledge of this surface film. If it be punctured at one place the living matter in the neighbourhood of the puncture becomes curdled in appearance and dies, but the membrane grows in at the back of this dead substance, cutting it off from the rest of the cell. This is the fundamental surgery of living matter.

I cannot hope to do more now than deal in haphazard fashion with this vast subject. I propose to begin with an experiment which, in spite of its simplicity, shows how ubiquitous films are, and how our most elementary impressions of the external world depend upon them.

Take, for example, smoothness. It is not a property of solid matter in mass, but of this fourth state of matter. A tea-cup has the delicate velvety feel of a polished surface; but neither porcelain nor ware is really smooth in that sense. Their surface, like that of all other naturally occurring surfaces, is covered by a film of greasy matter, which may come from the atmosphere or from the 'clean' cloth with which the object has been dried. If that film be removed the surface feels harsh and rough because, to use the engineer's phrase, one's finger-tips, if they are freshly washed, seize to it.

It is not possible quickly to remove the film. The necessary procedure would take too long, and in any case the film would quickly re-form in the atmosphere of a room. I can, however, destroy its effectiveness by taking advantage of a curious property of water. That substance is not only not a lubricant for vitreous surfaces, but it is also an anti-lubricant in that it destroys the effect of the natural lubricating film. All I have to do, therefore, is thoroughly to wet the surfaces of the tea-cup and saucer, and the tea-cup ceases to slide in the saucer.

A tea-cup suggests a storm, and that suggests the curious power which oil has of smoothing the sea. The oil spreads over the surface of the water until the layer is only about the five-millionth of a millimetre in thickness. A figure of that kind is apt to mean little; I will therefore try to give an impression of the minute quantity of oil needed in another way. In 1919 an oil ship was wrecked inside the Lizard. The oil-tanks were burst open and the oil rapidly escaped. There has been no sensible quantity of oil in the wreck for the last six years, yet sufficient still escapes to the surface of the sea to produce an obvious 'smooth' for a mile or more to leeward. The effect of a film of oil of quite invisible thickness upon the sea is very real. A vessel labouring in a sea-way or running before a gale can, and does, find some measure of safety by streaming bags filled with oil to windward, and Pliny records how the oyster-fishers used oil to calm the surface of the sea so that they were more easily able to work.

It is obvious that the presence of this oil film cannot seriously modify the energy of great seas, say, a quarter of a mile from crest to crest; but when seas enter a 'smooth' they change their character with dramatic suddenness. They lose their viciousness, and the moment they are in the 'smooth' take the character of those relatively harmless undulations which do not break on to a vessel, but merely make her roll and pitch. The question how the oil film, so tenuous as to be of invisible thickness, curbs the sea is an interesting one, and the attempt to answer it will inevitably introduce us to the chief properties of films on water.

In the late 'nineties a most ingenious method of demonstrating the existence of films on water, and of controlling them for experimental purposes, was devised by a German lady, Fräulein Pockels. I think I may say without exaggeration that the immense advances in the knowledge of the structure and properties of this fourth state of matter which have been made during this century are based upon the simple experimental principle introduced by Miss Pockels. Take an oblong trough of metal filled with water. On the surface of the water, quite invisible because it is even thinner than the invisible dead black portion of a soap film, there is a layer of greasy contamination. If I lay upon the trough a strip of glass or metal so that it touches and is wetted by the water, and move it along, I can compress the superficial film in front and expand it behind. Both processes are easily rendered visible by scattering lycopodium dust on the surface.

The capacity which these films have of expansion is easily shown by sweeping the natural film to one end, thus leaving a tolerably clean surface of water behind. Some lycopodium dust is now placed at one end and the surface touched with a platinum wire, the extreme tip of which has just been dipped into an oil. The dust particles are swept away swiftly in front of the advancing film of oil, although the film itself is absolutely invisible.

The film tends to spread, but the surface of the water in virtue of its surface tension tends to contract. It is this same surface tension which rounds up drops of fluid to spheres, or as near an approach to the spherical shape as other forces which may be operating, such as gravity, permit. There are therefore opposing influences: the tendency of the water to contract, opposed by the tendency of the film to expand, with the result that composite surfaces of oil and water have a surface tension less than that of pure water. Composite fluid surfaces have also an enhanced mechanical stability. When a ring of wire a few centimetres in diameter is withdrawn from clean water no film is formed across it, but when the surface of the water is coated with oil it acquires the property of forming free films, which may have an endurance comparable even with that of a soap bubble. In Fig. 1 the curve E F G H gives the surface tension plotted against the quantity of oleic acid per unit area of surface, and the curve A B C D gives the duration of bubbles which have been formed on the surface by allowing air to escape slowly and regularly from an orifice within the trough. It will be noticed that the bubbles are most stable when the film of contamination is just dense enough to begin to alter the surface tension, and that the bubbles have no stability when contamination is either vanishingly small or very great.

---

[1] Discourse entitled "Films," delivered at the Royal Institution on January 29

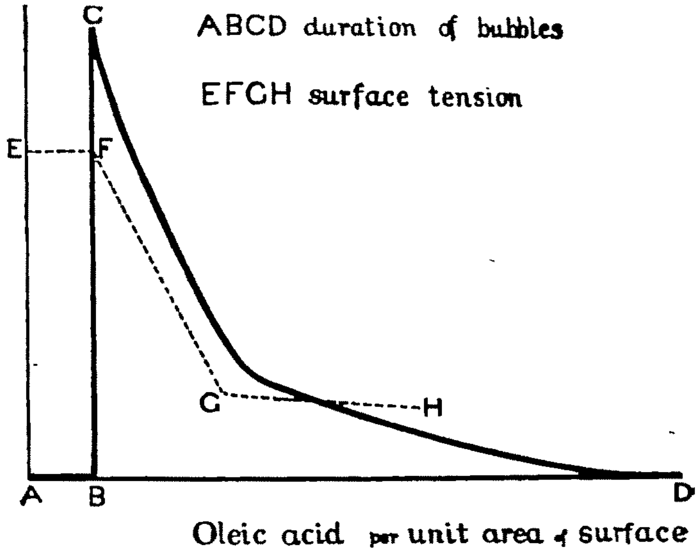


FIG. 1.

Do these properties of composite surfaces, namely, the lowered surface tension and the increased mechanical stability, explain the calming of the sea? In my opinion the answer is 'No,' but current doctrine would perhaps say 'Yes.' It has been pointed out that the special capacity of composite surfaces to resist extension and their mechanical stability, which is only another special aspect of the same thing, tends to prevent the inevitable expansion of the surface which occurs when a wave is formed. This has been held to be a sufficient explanation. I do not think it is, and for two reasons. The first is that the surface of the sea is always contaminated by something which lowers its surface tension and gives to it a remarkable measure of mechanical stability. One of the most striking aspects of a heavy gale is the 'windrows,' which are due to the foam formed when a sea breaks being blown by the wind in long lines over the surface. Foam after all is no more than a collection of bubbles; obviously therefore these naturally formed bubbles have great stability.

The nature of the film which covers the surface of the sea must remain uncertain. Sometimes it is composed of substances like saponin, of vegetable origin, derived from the masses of seaweed flung upon the coast. Foam of this kind is remarkably stable. I have seen it on the day following an on-shore gale knee-deep in the hollows above Flamborough Head. The bruising and shattering of seaweed is, however, a coastal happening and 'windrows' are deep-sea phenomena.

The true explanation of the 'smooth' produced by a film of oil was, I think, furnished by Benjamin Franklin in 1773. His discussion is worth reading. It has the spacious dignity and charm which the hurry and specialisation of to-day have of necessity banished from scientific papers. He tells how he was at sea in 1757 with a convoy of ninety-six sail, the wind being very fresh, and how he noticed a 'smooth' in the wake of two of the vessels. He inquired the cause of one of the officers and was told with some degree of contempt, it being a thing which every fool should know, that the 'smooth' was due to the fact that the cook had just thrown greasy water over the side. In those days tallow was used to coat the bottoms of vessels to keep them clear of growth, and Franklin also notes the 'smoothness' in the wake of vessels which had been freshly tallowed.

Franklin's explanation is based entirely upon friction. The oil makes the sea so very smooth that the wind cannot 'catch upon it.' I confess Franklin's explanation did not appeal to me at first, but I believe he is right. The comparative safety of a 'smooth' is due, not to the fact that the seas in it are sensibly smaller than those outside of it, but to the fact that they have been deprived of their viciousness. Now the viciousness of a sea, the degree of danger it carries to the mariner, is measured by its instability. It is when the head of the sea topples over and becomes a mass of water moving with a high velocity that it is dangerous. Within the limits of a 'smooth' produced by oil the seas cease to break, or to 'crack,' as Cornish fishermen say. The wind not only drives a sea forward by its horizontal pressure, but also draws the crest upwards by friction against the surface of the wave.

If the friction between the air and the water be greatly reduced, the wind fails to lift the crest of a wave to the point at which it is blown bodily over by the horizontal pressure. The wave then sinks down to a relatively harmless 'swell.'

The 'catch' of the wind upon the waves is not, however, confined simply to a direct frictional pull, and here it is that the surface tension perhaps comes in. It is easy to convince oneself that an oil film prevents the formation of ripples—that is, of the very smallest kind of wave. When there is no oil film, a great wave carries countless ripples and wavelets each of which gives the wind a direct thrust on the surface. It is to the suppression of ripples and wavelets that the characteristic smooth appearance is due, and when they cease to be formed, the chief 'catch' of the wind upon the sea is lost.

Acclimatisation to High Altitudes.[1]

By Dr. J. S. HALDANE, F.R.S.

THERE is now general agreement among physiologists that, as was originally concluded by Paul Bert, the formidable group of symptoms known as 'mountain sickness' is due essentially to the lowered partial pressure of oxygen owing to the diminished barometric pressure of high altitudes; also that the symptoms depend upon the lowered oxygen pressure being insufficient to saturate with oxygen to a normal extent the hæmoglobin of the arterial blood, so that a normal pressure of oxygen is not maintained in the central nervous system. The defective saturation of the arterial blood shows itself by blueness, often extreme, of the lips and face. Persons who ascend by gradual stages to high altitudes are commonly found to be immune to mountain sickness; and this fact has been brought into extraordinary prominence by the experiences of the last Mount Everest expedition. Members of the expedition were completely immune to mountain sickness at a height of 27,000 feet, though persons going without acclimatisation to a similar barometric pressure in balloons or steel chambers lose consciousness rapidly, and would shortly be dead if they remained in the rarefied atmosphere.

Two expeditions have been made to high altitudes with the special object of investigating the nature of the acclimatisation. The first was to Pike's Peak in the Rocky Mountains in 1911 by Douglas, Yandell Henderson, Schneider, and myself, with supplementary investigations by Miss FitzGerald at mining villages, etc. The second was to Cerro de Pasco, Peru, in 1922 by Prof. Barcroft and associates. There have also been various observations in steel chambers under reduced barometric pressure, and in air-tight chambers in the air of which the oxygen percentage was allowed to fall without accumulation of carbon dioxide. These observations have shown that (1) for a given consumption of oxygen or production of carbon dioxide in acclimatised persons the volume of air breathed is increased in proportion to the fall in barometric pressure; (2) the percentage of hæmoglobin in the blood is similarly increased. Both of these changes will evidently act in the direction of diminishing the fall in oxygen pressure in the central nervous system. If the breathing were increased without compensatory changes in the body, the latter would be very abnormally alkaline, owing to excessive washing out of carbon dioxide. This extra alkalinity is, however, almost entirely compensated owing to the fact that as soon as the breathing begins to be increased owing to the stimulus of want of oxygen, the kidneys begin to excrete an increased amount of alkali, as was shown by Kellas, Kennaway, and myself. Hence in an acclimatised person the alkalinity of the body is scarcely increased at all.

So far, there appears to be agreement on the subject of acclimatisation; but on further points there is marked difference in opinion. The very careful, and apparently conclusive, experiments of Fredericq and of A. and M. Krogh had shown that, as measured with the aerotonometer, the oxygen pressure of the arterial blood is, under normal resting conditions, always lower than that of the alveolar air in the lungs. On the other hand, the experiments of Douglas and myself by the carbon monoxide method had shown that the mean oxygen pressure of the blood leaving the lung alveoli is, under normal resting conditions, exactly the same as that of the alveolar air, so that diffusion equilibrium for oxygen between alveolar air and blood is complete. At the time we attributed the difference in results to there being a loss, during the conveyance of the arterial blood from the lungs, of a slight amount of oxygen owing to the presence in the blood of reducing substances which had not had time to be oxidised completely in the lungs. A later investigation by Meakins, Priestley, and myself in 1918 furnished, however, a much simpler and more satisfactory explanation, which at the same time cleared up a number of other clinical and physiological observations which had hitherto been unintelligible.

The alveolar air, as obtained by one form or another of the method introduced by Priestley and myself in 1905, is evidently a mixture of the samples of air from innumerable alveoli. In some alveoli the oxygen percentage will be lower, and in some higher, according as the blood supply is greater or less in relation to the air supply. The mixed arterial blood will reflect these conditions. Now the dissociation curve in the living body of the bicarbonate, in which form carbon dioxide is transported in the blood, is practically a straight line over the differences in carbon dioxide pressure which come into account in the lungs. This was shown by Christiansen, Douglas, and myself in 1914. Hence the effect on the mixed arterial blood of varying carbon dioxide pressure in the lung alveoli will be just the same as if the carbon dioxide pressures in all the lung alveoli were equal. On the other hand, the dissociation curve of oxyhæmoglobin is nothing like a straight line, and has the characteristic doubly inflected form discovered by Christian Bohr. The effect of the varying oxygen pressure in different alveoli will therefore be that the mixed arterial blood will have a lower oxygen pressure than that of the mixed alveolar air. This effect will, moreover, be exaggerated if the oxygen pressure of the alveolar air is abnormally low, as at high altitudes.

We have thus a complete explanation of the difference between the results by the aerotonometer and carbon monoxide methods, since the latter method gives the average of the oxygen pressures of the various streams of blood leaving different alveoli, and not the oxygen pressure of the mixed arterial blood. We have also the explanation of why, in unacclimatised persons, a quite moderate lowering of barometric pressure—for example to the pressure at 11,000 feet—may produce extreme symptoms of mountain sickness, with great blueness of the lips.

In the Pike's Peak expedition we used the carbon monoxide method, and found, in every subject investigated, that after acclimatisation, the average oxygen pressure of the blood leaving the alveoli was much higher than that of the alveolar air. But this was not the case in an unacclimatised control, who was still blue when examined, and shortly afterwards became mountain-sick, though after he was acclimatised, and his lips were again normal in colour, he reacted just like the other acclimatised subjects. We therefore concluded that active secretion of oxygen is an essential part of acclimatisation. Later experiments by Kellas, Kennaway, and myself in 1918 on acclimatisation in a steel chamber gave strong confirmation to this conclusion.

---

[1] From a lecture delivered to Section I (Physiology) of the British Association at Oxford, on August 10.

In the Peru expedition no experiments were made by the carbon monoxide method, but Prof. Barcroft and his associates made determinations of the percentage oxygen saturation of the arterial hæmoglobin. From the results of these analyses they drew the conclusion that the oxygen pressure of the arterial blood is never higher than that of the alveolar air. This conclusion, however, depended on a further conclusion that in all the subjects investigated the dissociation curve of the oxyhæmoglobin in the blood was greatly altered in such a way that the blood passing through the lungs would take up more oxygen than at sea-level. This result is in direct contradiction of careful experiments made previously by Barcroft himself on the Peak of Teneriffe and on Monte Rosa, and of particularly careful confirmatory experiments made by Douglas and myself on Pike's Peak, at practically the same height as in the Peru expedition. No explanation is given of the contradiction, and it seems quite incredible that a real difference could have existed. Until, at least, confirmatory evidence is forthcoming, I can only conclude that there was some error of experiment in the Peru determinations. The analyses of the arterial blood gave just such results as we should have expected from the Pike's Peak experiments; and if, as I must still believe, the dissociation curves were practically the same as at sea-level, these blood-gas analyses prove, by themselves, our conclusion that oxygen secretion is an essential element in acclimatisation.

Prof. Barcroft unfortunately failed to understand the nature of our conclusions as to oxygen secretion, or the significance of previous work as to the relation between the mean alveolar oxygen pressure and the oxygen pressure of the mixed arterial blood. He has thus been unwittingly led, particularly in his recently published book on "The Respiratory Functions of the Blood," into a complete misrepresentation of my own views on the subject. On reviewing the whole of the existing evidence, including the very important data from the Everest expeditions, I can see no way of interpreting the phenomena of acclimatisation without the assumption of oxygen secretion in addition to the other known factors.

(The lecture contained a review of the evidence bearing on oxygen secretion by the lungs, since the time when its occurrence was first suggested by Ludwig; and at the end there was a discussion of the reason, now evident enough, why so little benefit was obtained in the last Everest expedition from the use of oxygen.)

Obituary.

PROF. EDOUARD NAVILLE.

THE late Prof. Edouard Naville, who died recently at Geneva in his eighty-third year, was a typical representative of the older generation of Egyptologists. The son of a distinguished Genevese family, of strong Evangelical tenets, he came to England when young to study at King's College, London, and here imbibed the liking for England and all things English that was characteristic of him through life. He went on to Bonn, and later studied Egyptology under Lepsius. He and Maspero both began their scientific work at the same time, round about the year 1870. In spite of great differences of temperament and style, their work shows resemblances characteristic of their time, especially in purely archæological matters; neither was able quite to enter into the spirit of the newer science of archæology or to understand its insistence on the importance of small things equally with great. The men of that generation thought only of great, beautiful, and fine things, and could see nothing of importance in a bead or a scarab. They were scholars and connoisseurs, not anthropologists.

Naville began to excavate in the early 'eighties for the Egypt Exploration Fund, shortly after its foundation (as also did Prof. Sir Flinders Petrie), and his work at Bubastis and at Deir el-bahri for the Fund will always be notable; that at Deir el-bahri being indeed among the most important excavations carried on by the Society. His work on the supposed site of Pithom and on the route of the Exodus was the most important, and in its time certainly interested a large body of subscribers. But his views on this subject are not now so generally accepted as they were then. The placing of the Exodus in the reign of Meneptah is no longer regarded as a *chose jugée*, and Naville's views on the actual route of the Exodus have undergone some modification at the hands of younger scholars. For their time, however, his theories were very advanced, and of great importance. At Deir el-bahri he uncovered the great temple of Hatshepsut, and in later years (1903–7) that of Mentuhotep IV., this time assisted by the present writer, Mr. E. R. Ayrton, Mr. C. T. Currelly, and others. His earlier work had been done almost entirely alone, except that for one season at the Hatshepsut temple he had had the assistance of Mr. D. G. Hogarth. His plans and architectural descriptions were made for him chiefly by the late Mr. Somers Clarke, though in the Mentuhotep temple Mr. C. R. Peers and one of Naville's relations, M. Edmond Fatio, also helped.

Later on, Naville began the excavation of the Osireion, the great subterranean building behind the temple of Abydos, thought by him to be of the time of the Old Kingdom, but proved by his successor in the work, Mr. H. Frankfort, to be the funerary temple and cenotaph of Seti I. (XIXth Dynasty), thus confirming a surmise of Borchardt's published in *Klio* several years ago. This building was discovered by Sir Flinders Petrie and Miss M. A. Murray so long ago as 1902, but on account of the enormous labour and expense required for its excavation had been abandoned until Naville and the Exploration Fund took it up. Naville's work, in which he was assisted by Mr. T. E. (now Prof.) Peet and Mr. G. A. Wainwright, resulted in the clearance of practically the whole of this extraordinary building. Then the War came and closed down operations. Naville, after it, was too old to resume the work, which could not in any case be begun until last year, when Mr. Frankfort carried it to its conclusion.

Naville's other scientific work related chiefly to the "Book of the Dead," of which he published the first critical edition. He was always specially interested in the religious side of Egyptian culture, and published a short work on "Egyptian Religion."

Naville was always proud of his knowledge of England, in the fortunes of which he took steady interest. In fact he was politically almost an Englishman, and showed his partiality by his impassioned defence of our action in the Boer War, when he published many pamphlets in all tongues in our favour, gaining rather an unenviable notoriety thereby on the Continent. He was a man of the courage of his opinions, and a keen polemist, as his attacks on "the Higher Criticism" of the Old Testament and his long disputes with the German Egyptologists on the question of the Semitic origin of the Egyptian language or the succession of the Thutmosids show; and in polemic he by no means always came off second-best.

Naville possessed many British and foreign degrees, was an Hon. F.S.A. and foreign associate of the Institute of France. During the War he was a prominent member of the Central Red Cross Committee at Geneva, over which he presided. No notice of him would be complete without a word regarding his devoted wife. Mme. Naville (*née* de Pourtalès) assisted him enormously in his work by copying descriptions, piecing together fragments of monuments, and so forth; her knowledge of Egyptology was considerable, and he always emphasised the value of her assistance to him in his scientific work.

H. R. HALL.

DR. FRANCIS WARNER.

THE passing of Francis Warner has removed one of the last of the group of physicians and physiologists who studied movements and gaits, attitudes and postures in the 'seventies of the last century. Much of the study was conducted by means of pneumatic tubes connected with Marey's recording tambours. This phase of Warner's work was set out in his well-known work, "Physical Expression," and in his Hunterian lectures to the Royal College of Surgeons. Modern electrical methods and kinematography have modified and extended the conclusions then reached. Warner's clinical observations on the postures and movements of nervous and defective children made at the East London Hospital for Children, and later supplemented at the London Hospital, still remain standards for all observers.

In the early days of compulsory elementary education, it was soon found that many children were unable to profit by the facilities offered; in some instances, such as those who were blind or deaf, the need for special schools was obvious and was soon supplied in gradually increasing measure, but in the case of others with mental or physical defects, public opinion was more slowly influenced. It is largely to Dr. Warner's efforts in investigating the conditions of some 10,000 children in the London elementary schools and to his labours on a series of commissions that the present provision in London, unequalled anywhere in the world, came into being. Warner made a great point of observing the child at rest and while performing certain very simple movements, such as looking at an object or holding the hands straight in front of the body with the palms down. He directed attention to slack or convulsive postures of the hand which indicated nervous instability, to the knitting of the eyebrows, which might indicate nervous strain or hypermetropia, to muscular overaction of various kinds.

For some years Warner's tests formed a large part of the examination of children suspected of needing special education, and though they have been supplemented and in part replaced by tests of the Binet-Simon pattern, and other tests of power of performance and of adapting thought and movement to new requirements, they are still an essential item of a complete examination. Above all things, Warner stressed the point that an examination should be dynamic rather than static, that evidences of defect as shown by stigmata, then popular as supposed indices of mental status, were as nothing compared to that derived from actual movements and performances.

Dr. Warner was one of the first of a series of school hygienists and child students, who did much himself and, by his example and ready help and advice, laid the foundations of the present system of care for the health of scholars and the comfort and sanitation in the broadest sense of our schools.

PROF. CARLOS SPEGAZZINI died on July 1 of this year. He was born on April 20, 1858, at Bairo, Italy, and was a pupil of the late P. A. Saccardo at Padua. In 1878 he contributed his first paper on mycology, a study of coprophilous fungi, to the short-lived periodical *Michelia*, which Saccardo edited. He published a series of notes on the diseases of the vine and began to issue fascicles of dried specimens ("Decades mycologicæ Italicæ"). In 1880 he went to the Argentine as professor of natural history at Buenos Aires. The number of fungi recorded for the Argentine was then thirty-nine. Spegazzini worked this virgin soil to the full, and until his death made continuous contributions to the mycological flora, extending his investigations to most countries of South America. His work was that of a general systematist, and in the thousand or so new species he described, practically all groups are represented. His work appears to be much more carefully done than is usual in such mass production, and is illustrated by clear and attractive drawings. Spegazzini not only accomplished an enormous amount of mycological work but also published numerous papers on Phanerogams, specialising during the last few years more particularly on Leguminosæ. Odd papers on all sorts of subjects testify to his great interest in general natural history and science.

WE regret to announce the following deaths:

Sir Edward Busk, sometime Vice-Chancellor and Chairman of Convocation of the University of London, and a member of the governing bodies of the Imperial College of Science and Technology and of several well-known schools, on October 29, aged eighty-two years.

Mr. R. N. Lennox, formerly assistant to the late Sir James Dewar at the Royal Institution, on November 1.

News and Views.

The King has approved of the following awards this year by the president and council of the Royal Society: A Royal medal to Sir William Hardy for his pioneer work on colloidal chemistry and the theory of lubrication. A Royal medal to Prof. A. V. Hill for his distinguished work on the physical and chemical aspects of muscular contraction. The following awards have also been made by the president and council: The Copley medal to Sir Frederick Hopkins for his distinguished and fruitful work in biochemistry. The Rumford medal to Sir Arthur Schuster for his services to physical science, especially in the subjects of optics and terrestrial magnetism. The Davy medal to Sir James Walker for his work on the theory of ionisation and ionic equilibria in solution. The Darwin medal to Dr. D. H. Scott for his contributions to palæophytology, particularly in relation to the period of coal. The Hughes medal to Admiral Sir Henry Jackson for his pioneer work in the scientific investigation of radio-telegraphy, and its application to navigation.

The following is a list of those recommended by the president and council of the Royal Society for election to the council at the anniversary meeting on November 30:—*President*—Sir Ernest Rutherford; *Treasurer*—Sir David Prain; *Secretaries*—Mr. J. H. Jeans and Dr. H. H. Dale; *Foreign Secretary*—Sir Richard Glazebrook *Other Members of Council*—Sir Hugh Anderson, Dr. F. W. Aston, Prof. L. Bairstow, Prof. F. O. Bower, Sir Archibald Garrod, Prof. E. J. Garwood, Sir Thomas Heath, Prof. J. P. Hill, Dr. P. C. Mitchell, Prof. R Muir, Sir John Parsons, Sir Robert Robertson, Mr. A. A. C. Swinton, Sir Gilbert Walker, Sir James Walker, Mr. W. C. D. Whetham.

The announcement that Sir Alfred Yarrow has made a donation of 10,000*l*. to the funds of the British Association is of particular significance, as showing the appreciation of scientific study and research by a great leader of industry. A few years ago another pioneer of engineering science—Sir Charles Parsons—made a like gift to the Association; and it may be hoped that the generous lead thus given will be followed by other representatives of progressive industry which benefit directly or indirectly by the advancement of scientific knowledge. Sir Alfred Yarrow, feeling that the present urgent needs of the British Association, in its work for science, should receive precedence over provision for the distant future, has made it a condition that his gift should be expended, as to both capital and interest, within a period of twenty years. Sir Charles Parsons has expressed himself similarly with regard to his gift. Through these gifts, and by the provision for their use in a single generation, the Association will be able to strengthen its powers of obtaining general attention for the objects of science, and of affording more steady assistance to scientific research in directions indicated as desirable during the deliberations of its various sections at the annual meetings.

We learn with great pleasure that no less an artist than Sir William Orpen has consented to paint the portrait of Prof. J. A. Fleming, whose many friends and admirers, as we have already announced, are raising a fund for this purpose. The portrait is to hang in University College, London, with which Prof. Fleming has been so long and honourably connected, and no doubt Sir William Orpen's willingness to paint the picture is in part due to the fact that Sir William Orpen himself received his early artistic training at the Slade School, which is part of University College. A replica of the portrait is also to be presented to the Institution of Electrical Engineers, as representing the great scientific profession and industry for the advancement of which Prof. Fleming has done so much. In the popular view no doubt Prof. Fleming is chiefly known as the inventor of the famous 'valve', which, adapted as it has been in many forms to radio telegraphy and telephony, has made broadcasting possible. His other great activities as a teacher, and especially as a writer, must not, however, be forgotten. His many works, on alternating electric currents, on electric lamps, on electrical testing, and on electric wave telegraphy, are standard volumes, while his reminiscent account, "Fifty Years of Electricity," makes the most delightful and inspiring reading. It is an open secret that many years ago Prof. Fleming would, but for his unfortunate deafness, have been elected president of the Institution of Electrical Engineers, and to add to his many other qualifications for honour, he is well known as one of the most skilled and popular experimental lecturers on electrical subjects in the world. The subscription list for the portrait is still open, and intending contributors are asked to send their donations as early as possible to the honorary secretary of the Fund, Prof. W. C. Clinton, University College, Gower Street, London, W.C.1.

The new science laboratories of the University College of North Wales, Bangor, were declared open on Tuesday, November 2, by Sir Joseph Thomson. A tour of inspection of the laboratories was made in the morning, and in the afternoon Sir Joseph addressed a gathering of about eighteen hundred people in the Pritchard-Jones Hall of the College The science laboratories form part of the North Wales Heroes' Memorial, and consist of five separate buildings, which house the six Departments of Physics, Chemistry, Botany, Zoology, Agriculture, and Forestry. When completed, the whole memorial, which includes a memorial arch and a bursary fund in addition to the laboratories, will have cost a sum approaching 150,000*l*. Of this amount about 120,000*l*. has already been subscribed. The afternoon meeting was presided over by Lord Kenyon, president of the College. He read and presented to Sir Joseph Thomson an address in album form, and the laboratories were then thrown open to the public. The buildings are of one storey, with the exception of the agricultural block, which has two storeys. Each block covers a floor space of about

10,000 square feet. All the heating, gas, water hydrant, and electric mains which serve the different rooms are run in brick trenches under and between the buildings. By this means all the pipes and cables are readily accessible. Special mains have been laid by the Corporation The physics block is furnished with a liquid air plant, and accommodation is provided for about 100 students and a dozen research men. Each research room is furnished with electric power supplies of 400 volts D.C.: 200 volts D.C., 150 volts from a battery (any voltage from 2 to 150 volts in steps of 2 volts can be obtained), and alternating current at about 220 volts and 50 cycles. The main laboratories, of which there are three, and the lecture rooms are provided with the same electric power supplies. The floors are of concrete, which is covered with cork lino for insulation purposes. The cable carrying the electric power and the battery leads run along shallow ducts in the floor. The department is furnished with a well-equipped workshop. A small hut has been erected a few yards away from the main physics building in which measurements in radio-activity will be conducted. The general lay-out and equipment of the other blocks are similar to those of the Physics Department.

THERE has recently appeared in the *Daily Express* a series of articles by leading men of science under the general title of "The Mystery of the Universe." The contributors are the Astronomer Royal (Sir Frank Dyson), Profs. Plummer, Eddington, and Andrade, Sir Oliver Lodge, and the Bishop of Birmingham (Dr. Barnes). The first four writers confine themselves in the main to an exposition of the leading facts and generalisations of modern physics and astronomy; Sir Oliver Lodge attempts "to weave together the four preceding articles and draw scientific conclusions"; and the Bishop of Birmingham considers the same material in relation to the much-discussed question of the connexion between religion and science. It is a matter for satisfaction that one of the principal London newspapers should publish such articles as these, and we hope the example will be followed by other daily papers from time to time. The influence of science on the life of the community is far greater than is commonly realised, and it is in every way desirable that at least the general outline of current research should be given as wide a publicity as possible. Nor can it be too strongly emphasised that this should be done by experts, and not by the ordinary reporter who, however well instructed he may be, has in practice often failed lamentably to give even an intelligible, much less an accurate, account of scientific matters We offer our congratulations to the *Daily Express* on the excellent lead it has given in this direction.

A NOTEWORTHY feature of the series is that it deals exclusively with the physical sciences. Of the six contributors (considering only their scientific qualifications), three are astronomers, two physicists, and one a mathematician. This would perhaps seem fitting if the utilitarian aspects of science were in question, but they are scarcely mentioned; the emphasis, as the title indicates, is laid on the unknown and the unapplied, and the fundamental relationships between science, religion, and philosophy form the background, concealed or expressed, of the whole. The exclusion of biology is to be regretted, for a symposium on the mystery of the universe which includes no discussion of life from the scientific view-point, must necessarily be unbalanced. The expressed conclusion that physical discovery brings us no nearer to a solution of the problem of the nature of life and mind makes the omission even more striking. If, however, we may take the subjects dealt with, and the manner of their treatment, as indicative of the trend of public thought in these matters, the change from the bitter squabbles of the last century between would-be advocates of religion and science is as welcome as it is complete. There is no longer a *conflict* between religion and science; there is a *relationship*, perhaps not yet discovered completely, which we seem to be able to approach with greater chance of success along the road of cosmic physics than along that of biology. This is, perhaps, the greatest advance which scientific philosophy has yet made.

THE authorities of the Science Museum at South Kensington have instituted a series of exhibitions of apparatus used in, and results obtained by, recent research, and the first of the series is now open to the public free. It deals with work which has been carried out at the National Physical Laboratory in the Departments of Physics, Metallurgy, and Engineering. The new hygrometers for cold stores, new thermal insulators, protectors against X-rays, new high vacuum pumps, apparatus for predetermination of the acoustical properties of halls, the composition of steels and other alloys, and the detection of defects in their interior by X-rays, furnaces for metallurgical investigations, and methods of testing the lubricating properties of oils under pressure are all shown, and later in the month it is proposed to show some of the results which have been obtained by the Adhesives Research Committee of the Department of Scientific and Industrial Research. These exhibitions will enable the general public to understand readily the advances which are now being made by research workers in science and how they may be applied in industry.

FOR some time past many students and others interested in Africa have felt that a special organisation, framed on an international basis, is urgently needed for the study of African linguistics and culture. Such an institution was desirable not only to continue work such as that carried on by the Hamburg Colonial Institute before the War, but also to collate, supplement, and extend the work of existing organisations such as, in England, the African and Geographical Societies and the Royal Anthropological Institute. The aim of the projected organisation was practical as well as scientific: it was intended not merely to promote African studies in the widest possible sense, it was proposed that it should, as the result of such studies, lay down lines for, and participate in, educating and training the African native, by stages suited to his mentality and culture, for the inevitable clash of cultures when he has to meet conditions arising out of the European occupation and exploitation of his country. As a result of invitations issued after a conference held in London in September 1925, a considerable body of influential support has been obtained. The International Institute of African Languages and Cultures, as the new organisation has been named, will include among its members accredited representatives of the African Society, the Advisory Committee on African Education of the Colonial Office, of which the Secretary, Major Hans Vischer, has accepted the vice-directorship of the Institute, the Royal Anthropological Institute, the School of Oriental Studies, the Advisory Committee on Bantu Studies in South Africa, the National Research Council of the United States, the principal universities and learned societies interested in African studies of France, Belgium, Italy, Germany, Austria, and Sweden, and the missionary societies, both Roman Catholic and Protestant. Sir Frederick Lugard will act as chairman of the executive council. M. Delafosse, the well-known authority on Africa, and Dr. D. Westermann, equally well known as an authority on African linguistics, will be joint directors. An extensive programme of work, to a great extent but not entirely, linguistic, has already been mapped out. Further particulars of the Institute and terms of membership may be obtained from the temporary offices, Lever House, Blackfriars, London, E.C. 4.

THE *Rand Daily Mail* for September 20 contains a notice of a conference to be held at Potchefstroom which will endeavour to prove scientifically "that no reconciliation is possible between Scripture and evolutionary science, and that evolution is a false dogma of pagan origin and anti-Christian character." Among the points to be proved are the following: That the Bible alone explains the origin, essence, and final purpose of things. That there is a generally accepted theory of evolution, but there are no experimental proofs. That the facts of palæontology do not point to the gradual development of forms, but are explicable on the hypothesis of catastrophic change. That the fabulous age of the earth ascribed to it by geologists is an uncalled-for speculation. That the intimate connexion between man and the apes has not yet been proved. With regard to man and the apes, that descent is not the relationship between them has already been pointed out to the Fundamentalists of America by Prof. Osborn; but as for the other points raised, it is not our business to refute, but to direct attention to them. If they were raised seriously in the interests of scientific truth, there would be no cause for uneasiness; but as this is evidently a definite effort on the part of a theological faction to influence and organise ill-informed public opinion, we must regard it in a very serious light. Those who suppose that the cause of religion is helped by this sort of thing are deceiving themselves; there is nothing that can possibly damage it more than this ill-advised propaganda. It is especially dangerous in countries where democratic institutions are combined with a not very high standard of general education. Sinister possibilities lurk behind this agitation, obscure as it may seem to those in England. Democracy, when it takes to persecution, can rival Torquemada, for from its verdict and sentence there is no appeal.

IN the *Nineteenth Century* for October Sir Frank Beaman has an article on "Psychology and Crime." He seems to be annoyed at the suggestion that psychology can have anything to offer towards the understanding of the criminal. With the actual administration of the law as it stands the psychologists would be quite in agreement with the writer. If the facts prove incontestably that A killed B, and if it is the law that any person who kills another is to be hanged, there is no more to be said. In law, though, as in other branches of knowledge, difficulties soon arise as to the exact connotation of the words and the exact sphere of application. It should be noted, too, that insanity is always "legal insanity"; insanity has a purely legal significance and has no place in medicine. Nearly half the article is by way of introduction, and we are given Sir Frank Beaman's views, expressed with dogmatic fervour, on the human factor in various sciences, political economy, the statistical method (which is very fallacious), the ignorance of medical practitioners (they do not know why some otherwise quite normal people are literally poisoned by eggs or by gooseberries), the variety of the human body, Mendelism (greatly over-vaunted), evolution (a question-begging term), psychology (the least trustworthy of the sciences), psycho-analysis (morbid and sensational), spiritualism (pretentious), the morbid taste of the general public, etc. The actual problem seems a little lost against this background. The general method is not unlike the Bellman's "What I tell you three times is true." There is something to be said for the more usual form of the statistical method.

THE Greenland expedition of the University of Michigan returned to America in September under the leadership of Prof. W. H. Hobbs, who gives, in *Science* of October 8, a short account of the work done during the summer. The base of the expedition was on Maligiak Fjord, fifty miles east of Holsteinsborg, where a meteorological station was set up. Pilot balloons were sent up to test the direction of the upper air currents. Some ninety balloons were traced to an average height of 7000 metres, several to 10,000 and one to 14,000 metres. Three meteorographs, with records intact, were recovered from *ballons-sondes* which had reached considerable elevations, in one case more than 1500 metres. An exploring party under Prof. Hobbs ascended the ice-sheet 100 miles east of Holsteinborg. Pilot balloons were traced to a maximum height of 5500 metres and wind observations were made at three-hour intervals at the surface. Self-registering meteorological instruments have been left at Holsteinborg to be used throughout the winter. Tidal observations were also undertaken. Prof. Hobbs plans to return to Greenland next summer with a larger expedition and to continue his studies of Greenland winds both on the margin and in the interior of the ice-sheet.

AN interesting correspondence in recent issues of the *Times* shows that the sound of the 'concentration shoot' at Portland on Saturday afternoon, October 30, was heard at great distances in the midland counties. There are records from Long Wittenham, near Abingdon (98 miles from Portland), Shipton-under-Wychwood and Shotover in Oxfordshire (103 miles), Bourton-on-the-Water in Gloucestershire (104 miles), Eton and Chertsey (108 miles), Bosbury in Herefordshire (112 miles), and Dunchurch near Rugby (141 miles). The wind at three of these places was roughly in the direction opposite to that of Portland. Moreover, the sounds were very distinct. At Eton and Bosbury the observers were working in their gardens. At Shotover, according to the president of Trinity College, Oxford, "the noise was so loud that we thought that it might proceed from some explosion at the Morris Motor Works, which lie to the south of the hill." The remarkable point about these observations is not so much the great distances of the places, but the unusual loudness of the sounds, which suggests that the places mentioned lie in an outer sound-area separated from the source by a silent zone.

THE paper read by Messrs. J. Beard and T. Haldane to the Institution of Electrical Engineers on November 4 was a very timely one, as they discuss the possibility of standardisation in the design of the systems used for distributing electric light. It seems certain that in ten years' time the supply of electricity to consumers in Great Britain will be at least doubled. It is very advisable, therefore, that piecemeal extensions of the various supply networks such as have sufficed in the past should no longer be made. The present time is most suitable for getting all the benefits of standardisation. The suggestions made are very helpful. Engineers have just adopted 230 volts as the standard pressure. One of the reasons for adopting this somewhat odd number is that when a three-phase system is used and 230 volts is used for lighting, 400 volts is available for power. As one of the pressures is equal to the other multiplied by the square root of three, it is impossible to make them both decimal. In the system of distribution proposed by the authors, the distributing pressure from the substation would be at 11,000 volts. It would then be transformed down to 400 volts and 230 volts by a four-wire three-phase distributing system. Continuity of supply is secured by having a duplicate high voltage supply. The low voltage cables are very convenient, having four equal cores inside a lead covering. The costs, however, which are independent of the load, are very large, the main item being the high cost of excavation for the distributor cables. This accounts for the rapid rate at which the total costs per unit delivered decrease with the load. If the load is doubled they are reduced by about one quarter. In our opinion, the adoption of a standard system such as that suggested by the authors would be in the interest both of the industry and of the country.

A PROPOSAL for a meteorological cruise in the Atlantic in 1927 is suggested in the *Meteorological Magazine* for September. The cruise is to honour the memory of Colonel Chaves, the founder of the Meteorological Service of the Azores. The meteorological observations from the Azores were transmitted free by the Portuguese Government and have in the past added much to the possibility of successful forecasting of the weather in the British Isles. There is an eclipse of the sun on June 29 next year, of which the line of totality crosses the Irish Sea, and this is suggested as a starting-point. It is proposed that the cruise should occupy about 25 days, beginning with June 28. Readers of the *Meteorological Magazine* and others disposed to join in such a cruise are asked to communicate with Mr. C. J. P. Cave, vice-president of the Royal Meteorological Society, or with Sir Napier Shaw, lately Director of the Meteorological Office.

To the four series of picture postcards devoted to precious stones, and the two series representing decorative stones, the British Museum (Natural History) has now added two further series (D9 and D10) of cards illustrating crystals (London: British Museum (Natural History). 1*s*. each set). As before, each set consists of six attractively printed cards, accompanied by an explanatory leaflet. The leaflet includes a masterly little essay on crystallography, ranging in its scope from Steno's fundamental law of angles, announced in 1669, to the work of Laue and the Braggs on X-ray analysis. The first set of cards gives examples of cubic, tetragonal, hexagonal, and rhombohedral crystals; and the second of the remaining systems and of twin-crystals. Both in accuracy and attractiveness of reproduction, and in educational value, these new series fully maintain the high standard achieved by previous issues.

SENATORE G. MARCONI has been elected an honorary member of the Institution of Electrical Engineers.

DR. W. H. STEAVENSON, who contributed the article on Mars to our issue of November 6, has been elected president of the British Astronomical Association in succession to the Rev. C. D. Percy Davies.

IT is gratifying to note that Mr. Mackay, who for several seasons past has been engaged in excavation at Kish in Mesopotamia, has been engaged by the Archæological Survey of India to work on the sites in the Indus Valley on which remains of the earliest culture yet known in India, including the famous pictographs of Sumerian type, were discovered. Mr. Mackay's knowledge of Mesopotamia will be invaluable in these excavations should further material bearing any resemblance to Sumerian antiquities be brought to light.

THE Trustees of the Beit Fellowships for Scientific Research announce that Sir Otto Beit has promised to hand over to them a further sum of 15,000*l*. This will enable the Trustees to make all their appointments to fellowships for two years, instead of one year as has happened in the past. The fellowships are tenable at the Imperial College of Science and Technology, South Kensington, and since the foundation of the fund in 1913 there have been eighteen appointments. The extension of tenure will add considerably to the value of the fellowships from the point of view of the promotion of fundamental research.

SIR FLINDERS and Lady Petrie and other members of the British School of Archæology will leave in the course of a few days for Palestine, where the winter will be spent on excavating Egyptian remains in the southern area of that country. As announced since last season, the School, for the present at any rate, will discontinue work in Egypt itself owing to the difficult conditions in which archæological research has now to be carried on. While it is not possible at this moment to mention any specific object in view, there are many problems requiring investigation. The work of the expedition will depend upon circumstances; but no doubt Sir Flinders Petrie hopes to secure further evidence bearing upon the Badarian culture, which, on his view, reached Egypt through Palestine.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A professor of physiology in Presidency College, Calcutta—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (November 20). A Principal of the Municipal Technical College, Dewsbury—The Secretary for Education, Town Hall, Dewsbury (November 20). A Warden of the Farm Institute and Experimental Station at Askham Bryan, near York—The Joint Clerks, Yorkshire Council for Agricultural Education, County Hall, Beverley (November 30). An assistant horticultural instructor under the Kent Education Committee—The Director of Education, Springfield, Maidstone (November 24). An assistant lecturer in chemistry at University College, Swansea—The Registrar, Singleton Park, Swansea (November 27). A Vice-Warden for Ashburne Hall of Residence for Women Students of Manchester University—The Honorary Secretary, Ashburne Hall, Fallowfield, Manchester (November 29). An assistant lecturer in agricultural chemistry in the University of Leeds—The Registrar (November 30). A radiologist in the medical department of the Federated Malay States—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (December 4). An assistant in the department of zoology of the National Museum of Wales—The Director, National Museum of Wales, Cardiff (December 4) A professor of physical chemistry in the University of Bristol—The Registrar (December 10). A teacher of geography and mathematics at the Borough Polytechnic Institute—The Principal, Borough Road, S.E 1.

Our Astronomical Column.

COMETS—Neujmin's periodic comet, 1916 II., has been detected by its original discoverer, Mr. Neujmin (presumably at the Simeis Observatory, Crimea), on Nov. 5 at $1^{\rm h}\ 37{\cdot}9^{\rm m}$ U.T. in R.A $10^{\rm h}\ 10^{\rm m}\ 56^{\rm s}$, N. Decl. 18° 29′, magnitude 14·5. The date of perihelion deduced from the R A. is Jan. 15·93, 1927, from the Decl Jan. 15·80, 1927. The evidence is, on the whole, against the identity of the doubtful object photographed in 1920 with the comet, but is not yet decisive. The comet is approaching both sun and earth, so should become considerably brighter The following corrected ephemeris is for $0^{\rm h}$ U.T.:

	R A.	N. Decl.	log r.	log Δ.
Nov. 16	$10^{\rm h}\ 43{\cdot}1^{\rm m}$	14° 36′	0·1689	0·1411
20	10 54·9	13 1		
24	11 6·7	11 22		
28	11 18·5	9 38		
Dec. 2	11 30·2	7 50	0·1546	0·0922

A doubtful object (comet or minor planet) of the twelfth magnitude was discovered by Prof. J. Comas Sola, of Barcelona, Nov. $5^{\rm d}\ 0^{\rm h}$, R A. $2^{\rm h}\ 56^{\rm m}\ 36^{\rm s}$, N. Decl 6° 31′, daily motion—$1^{\rm m}$, south 3′. Later: Mr. B. M. Peek and Mr. G. Merton confirm the cometary character of the observations on the morning of November 10.

GIACOBINI'S COMET AND THE METEORIC DISPLAY OF OCTOBER 9.—Mr. W. F. Denning writes: "It appears certain that on October 9 the earth intersected a point in the orbit of Giacobini's comet, but that this point was about two months in front of the comet. The latter is due at perihelion on about December 10 next, so that taking the rate of velocity of the meteors at 14½ miles per second, as computed by the Rev. M. Davidson, the comet's place on October 9 was about 77 millions of miles distant along the orbit from the point of intersection with the earth on the above date. In 1900 the nearest approach of the two orbits was about 5½ millions of miles, but perturbations since that date have sufficiently disturbed the orbit of the comet to make it intersect that of the earth at this return. Had the comet arrived at perihelion two months earlier this year, the conditions would then have favoured a meteoric display of exceptional grandeur. Dr. A. C D Crommelin's position for the cometary radiant is 265° + 54°, Mr. Prentice's radiant for the meteor shower was 263° + 54°, and the radiant of the fireball of October 9, as deduced by Mr. King and myself from a number of observations, is 262° + 55°, so the agreement is very good and near β Draconis."

MARS.—*Popular Astronomy*, Nos 7 and 8 contain Report No. 37 of Prof W. H. Pickering on the 1924 apparition of Mars. He commences with a discussion of the rotation period, and concludes that when allowance is made for Marth's change in the adopted position of Mars' axis in 1896, the period now generally employed, $24^{\rm h}\ 37^{\rm m}\ 22^{\rm s}{\cdot}65$, represents the observations of the last fifty years. The research is complicated by the considerable changes of size and shape to which some of the dusky markings are liable

In discussing various drawings of 1924, Prof. Pickering notes that there is considerable agreement among observers as to the position of the canals, but there is much personality as to the width assigned to them. An objection frequently brought by M. Antoniadi against the objective reality of the canals, based on their being drawn straight when far from the centre of the disc, is answered by a careful observation of the canal Amenthes-Thoth on October 19 and 20, 1924; it was respectively 16° east and 16° west of the centre of the disc. The curvature was clearly reversed in the two drawings, which corroborates the objective reality of the marking, and its close adherence to a great circle.

Proceeding to the question of the nature of the canals, Prof Pickering notes his own opinion that the supposition of their being artificial explains more facts than any other, and that the regular patterns, such as pentagons and stars which were seen in 1892, 1907, and 1924, point in the same direction He does not claim it as more than an hypothesis, but he considers that it is rendered more probable by his own observations of Martian clouds in 1922, and Dr. Wright's photographs in infra-red light in 1924, which indicated a considerable amount of atmosphere.

Research Items.

An Early Eskimo Culture in Alaska.—In a communication issued by the Victoria Memorial Museum, Ottawa, Mr. Diamond Jenness, Chief of the Division of Anthropology, reports on the results of four months' field-work in Alaska, where he excavated ancient ruins and studied local dialects with the object of determining the origin and antiquity of an Eskimo civilisation which has left traces in Canada extending from the Mackenzie River Delta to Hudson Bay. At Wales, the point of Alaska nearest to Asia, ruins were discovered belonging to four distinct periods, all preceding the discovery of Alaska by Europeans The remains of the second period resembled very closely those of the oldest known ruins of Arctic Canada. Excavations on the Diomede Islands confirmed those at Wales, and revealed a still earlier culture, of which there is no trace in Canada. The most characteristic feature of this culture was a style of curvilinear engraving unlike anything known of Eskimo art elsewhere, ancient or modern. Its source must be sought either among neighbouring Indian tribes or in north-east Asia. In regard to the former suggestion, it is to be noted that local Eskimo folklore and traditions show strong Indian influence, to be seen also in the masked dances, the use of body armour of bone or ivory, and certain sounds in the language. An antiquity of some 1000 to 1500 years is tentatively assigned to the earliest culture.

Didinga Witchcraft.—In *Sudan Notes and Records*, vol 8, Mr. J. H. Driberg, in the course of notes on Didinga customary law, refers to the penalties imposed on witches and wizards, and gives some indications of the character of the belief among these people. The practice is very prevalent and is usually associated with the use of poison. The influence of the evil eye is greatly feared, but does not belong to witchcraft proper, to which, however, the habit of bestiality, presumably a sexual abnormality, is attributed as a practice intended to injure live-stock. The wizard attains his object by dances. To secure the death of a man, a dance is performed at night at his door; to injure his crops, the dance takes place in the crops, but not necessarily at night. The dead are disinterred by wizards, who are fond of dancing by new graves. A wizard caught performing his dances invariably begs for compassionate treatment and proffers a spear, an axe, or a bracelet, which, if accepted, is carefully hidden away. Notwithstanding promises of amendment, the wizard continues his dances, the evidence in the form of the objects accepted as ransom accumulating until the wizard is seized and arraigned before a council, by which he is sentenced to death and hanged A goat is sacrificed at his funeral. The wizard's powers are transmitted to another, with or without his knowledge, by a certain drug served in a pot of beer. Involuntary witchcraft so induced is an adequate plea at trial provided the principal wizard who was responsible is denounced. The wizards are all highly strung and hysterical, and are capable of self-delusion to such an extent that they believe themselves invisible when dancing on cultivated ground.

Fish Passes—In a very interesting paper (*Fisheries, Scotland, Salmon Fish.*, 1926, II. Edinburgh and London: H.M. Stationery Office, 4*s.* 6*d.* net), Mr. W. L Calderwood gives accounts of different salmon passes that have been constructed from time to time. These descriptions, together with photographic illustrations, show the gradual evolution of the modern type of pool pass from the original ladder pass, through such forms as the Bracket pass and many others fitted with baffle arrangements. There are many factors to be borne in mind in building a pass, and it is largely from the comparative failure of previous types that the most modern forms have been evolved. Of special importance in the British Isles is the fact that spring-running salmon are not jumpers, and will not face a strong rush of white superaerated water when that water is cold (below 40° F.). For such fish, then, the gradient of the pass must be easy, with no falls necessitating jumps; the velocity also must be sufficiently slow and regular to allow plenty of black water. Of paramount importance is the position of the outflow of the pass; this should be near to the obstruction to be avoided and close to the usual lie of running fish; it should also discharge a sufficient flow of water to be attractive The protection of the inflow from flood water and the carrying of stones and gravel into the pass is necessary. The most modern pass consists of a series of pools with only slight drops between, a protected entrance for the water and an arrangement of movable sills, worked by floats, ensuring the passage of the same flow of water through the pass at all levels of the river, whether in flood or drought. Plans of two new passes designed by Mr. Rook for the river Tummel are given.

Fungal Symbiosis.—In a communication to the Reale Accademia delle Scienze dell'Istituto di Bologna (*Rendiconti*, Vol. 29), Prof. Fausto Morini describes three examples of the parasitic existence of one fungus on another. In the case of a spermogonial form of *Phyllosticta parassitica* growing on the perithecia of *Uncinula salicis*, the injurious effect of the parasitic organism on the development of the host is apparent from the diminished number and size of the ascospores. In the second case, the host consists of a species of mucor resembling, in the ramification of the sporangiophore hyphæ, a reduced and modified form of *M. racemosus*, although it appears to be allied also to *M. corymbosus*. The parasite, a species of Piptocephalis, differing slightly from *P. Fresenıana*, especially in the characters of the haustorial hyphæ, penetrates the mycelial hyphæ of the mucor and branches freely therein. The third example is that of *Piptocephalis microcephala* on *Pilobolus crystallinus*. A scheme of classification of the principal fungal symbioses is appended to the paper.

Abnormal Fern Prothalli.—Miss E. Schindler has found that the spores of *Asplenium septentrionale*, *A. trichomanes*, *Dryopteris filix mas*, and *Polypodium vulgare* will germinate when submerged beneath a liquid nutrient medium. Under these conditions they give rise to long filamentous structures, the cells dividing generally only by walls in one plane. These filamentous prothalli branch fairly freely. Neither the normal meristematic growth of the prothallus nor the formation of archegonia, follows in these prothalli unless they succeed in raising themselves out of the liquid medium into the damp air above it; antheridia occur sometimes on the submerged prothalli when growing in nitrogen-free culture media. This work was carried out by Miss Schindler at Cracow, under the guidance of Prof. Rouppert, and is published in the *Bulletin International de l'Académie polonaise des Sciences et des Lettres*, No. 5-6 B, June 1925.

Potato Mosaic and Temperature—The so-called 'virus' diseases are occupying considerable attention at present, and although 'leaf-roll' of potato is the form to which is attributed the greatest potency in inducing degeneration in English potato crops, those forms of mottled or puckered foliage connected with 'mosaic' are not infrequently reported. Considerable interest therefore attaches to the American experience recorded by C M. Tompkins (*Phytopathology* 16, 581-610, September 1926) as the result of his work at the Department of Plant Pathology, University of Wisconsin. Tompkins reports that air temperatures of 23° to 24° C, even though only occasionally prevailing, are sufficient to mask completely the existence of mosaic in diseased stock when judged by the ordinary diagnostic symptoms. If the plants are afterwards kept at lower temperatures, characteristic mosaic symptoms are again developed. On the other hand, under histological examination the leaves of the diseased plants in which the disease is masked are said to show marked deviation in structure from healthy leaves, both palisade and spongy parenchyma of the mesophyll being very regularly arranged so that air spaces are almost completely eliminated.

FOSSIL LEAF-BEDS IN VICTORIA.—In Miocene times in Victoria, the country adjacent to the shoreline, then 40 to 70 miles inland from the present coast, was in places marked by a lacustrine phase. It was then that large lake deposits were formed consisting of ferruginous mud or slime, fine pipe-clay or silty material. Into these lakes were swept large quantities of leaves of the Miocene forest and brush. The leaves are well preserved and are now found in the ironstones and pipe-clay deposits in seven localities in Victoria These fossil leaf-beds have been found at Pitfield, Bacchus Marsh, Berwick, Bogong, Cobungra and Dargo. Through some recent studies of the Tertiary flora of the sandstone and quartzite of Narracan in Gippsland (*Proc. Roy. Soc. Vict.* Vol 38, 1926, pp. 183-191), Frederick Chapman has added several new forms to the known list of fossil plants from the earlier localities mentioned. The Narracan flora comprises a eucalyptus of a modern coastal type, the myrtle beech (Nothofagus), the flame tree (Sterculia), the kanooka (Tristania), the cinnamon, and other Australian genera. Although of Miocene age, these deposits contain several types of leaves still existing in Victoria, mingled with others now belonging to areas situated in lower latitudes, as New South Wales and Queensland. Another point clearly established in this paper is the relatively older age of the Narracan leaf-beds as compared with the leaf-beds in the brown coal of Morwell and Yallourn.

MESOZOIC GEOLOGY OF ALASKA —*Bulletin* 776 of the U S Geological Survey, by G. C. Martin, 1926, contains a valuable record of the advances made in Alaskan geology during the present century. Mesozoic history provides by far the most important clues to the present structure of the Peninsula, and has a direct bearing on the mineral resources. At the end of the Palæozoic there was a widespread emergence of the land accompanied by intense and long-continued vulcanism Profound marine submergence followed in Upper Triassic times, but the sea withdrew from the entire area during the late Triassic and early Jurassic, and the rocks already deposited were folded. Marine transgression began afresh in the Lower Jurassic, and widespread vulcanism again broke out, culminating in great granitic intrusions with accompanying formation of ore deposits. The Jurassic was brought to an end with vigorous uplift and erosion. The sea again swept over Alaska in Lower Cretaceous times, receded at the beginning of the Upper Cretaceous, and then advanced again Finally, the submergence of the Upper Cretaceous slackened, marshes were formed and coal-beds deposited. The end of the Mesozoic and the beginning of the Eocene were marked by the complete withdrawal of the sea, a renewal of folding movements and intense vulcanism, intrusion, and mineralisation. A geological map of Alaska is now in preparation and will shortly be available.

ECONOMIC GEOLOGY OF CANADA —The Geological Survey of Canada has published on this subject an extremely valuable and well-illustrated memoir by G. A Young (No. 1 of the *Economic Geology Series*). Having regard to its physical features and geological structure, Canada is naturally divisible into six major regions. The Arctic archipelago and the Hudson Bay lowland contain extensive deposits of coal. The Canadian Shield is a U-shaped area bordering Hudson Bay, made up of ancient rocks, in which have been developed the Sudbury nickel-copper mines which are the world's chief source of nickel, the spectacular gold mines of Porcupine and Kirkland Lake, and the rich silver deposits of the Cobalt district In the Appalachian and Acadian region are the asbestos deposits of south-eastern Quebec and the coal-fields of Nova Scotia. In the St. Lawrence region to the south occur the salt beds and petroleum fields of Ontario The Interior Plains lie between the Canadian shield and the mountains to the west, and are underlain by vast reserves of coal. The Cordilleran region borders the Pacific, and in addition to extensive coal-fields it is noteworthy for the wealth of its placer gold-fields, copper-gold ores, and silver-lead-zinc ores. It is noteworthy on the negative side that Canada does not rank as a producer of aluminium, tin ores, or of precious stones. An excellent geological map accompanies the memoir, and a mineral map in which every important occurrence is numbered; an annotated list gives details of each.

TWILIGHT PHENOMENA.—In the *Denkschriften der Schweizerischen Naturforschenden Gesellschaft*, 62, 1926, there are two memoirs only, of which the first, of 190 pages, is by P. Gruner. It is the second of a series by this author, under the general title of "Contributions to the knowledge of twilight phenomena and of the Alpine glow"; the former paper (of 154 pages) gave a historical-chronological review of Swiss observations and publications on twilight colours and the Alpine glow. The present paper is a similar review of non-Swiss observations and publications on twilights, atmospheric-optical disturbances, and related phenomena As the extent of the memoir indicates, the author has cast his net widely and summarises an immense mass of literature, which he also indexes under the names of authors, with references, forming a bibliography. The subject is so large when the term "related phenomena" is interpreted generously, as in this case, that completeness is neither attained nor to be expected. But the memoir should be of real value to investigators whose work bears on these fields.

THE LAW OF SPEED RECORDS.—In 1906, Prof A. E. Kennelly published a paper on "An Approximate Law of Fatigue in the Speeds of Racing Animals," noticed at length in NATURE, vol. 75, p 463. In this he showed that if L is the length of the race in metres, T the time occupied by the winner in seconds, and V the mean speed in metres per second, we have approximately

$$T = \frac{1}{c}L^{9/8} = \frac{c^8}{V^9},$$

whatever the type of race. If $\log L$ is plotted against $\log T$, for example, different types of race give parallel straight lines. Prof. Kennelly has now published a second paper, "Changes during the Last Twenty Years in the World's Speed Records of Racing Animals"

(*Proc. Amer. Acad. Arts. Sci.* vol 61, No. 11, 1926), in which the records created since the first paper was written have been included. Only two classes of events show an appreciable general increase in speed: men swimming by about 10 per cent, and horses running by about 2 per cent. In all other cases the new records fit reasonably well to the lines previously given. The records for horses, running or pacing, show as before far the best fit to the straight-line law, and bicycling records still form an apparent exception to the rule. The conclusion deduced that speed should be maintained at a uniform level throughout the race is in accord with the work of A. V. Hill.

Diamagnetic Gases.—Recently, E. Zehrer (*Zeit. fur Phys.* vol. 37, p. 155, 1926), using an independent method, failed to confirm the experimental results obtained by Glaser, namely, that the specific susceptibilities of the diamagnetic gases hydrogen, nitrogen, and carbon dioxide were dependent on the pressure. It is therefore interesting to note that G. W Hammar (*Proc. Nat Acad. Sci.*, Oct. 1926), who employed the same method as Glaser, has found these susceptibilities to be independent of the pressure over a range from zero to one atmosphere. In searching for a possible source of error which might explain Glaser's results, Hammar found that a slight trace of moisture produced the effects described by Glaser, and he suggests that the difference between the two sets of results may be due to an adsorbed layer of water vapour on the surface of the test body. Hammar also directs attention to the need of greater reliability in the determination of the susceptibility of gases, since two of the latest and most careful determinations of the susceptibility of oxygen differ by 4·5 per cent., although each observer claims an accuracy of 0·1 per cent.

Heat Treatment of Gas Cylinders.—The second Report of the Gas Cylinders Research Committee, which has recently been issued, is concerned with the periodical annealing of cylinders. It was a recommendation of the Home Office Committee of 1895 that all cylinders of wrought iron or mild steel should be annealed every four years. On the other hand, the present Committee, in its first Report of 1921, considered that cylinders of 0·45 per cent. carbon steel should not require re-annealing during their life of fifteen to twenty years. The later experiments show that annealing, which is usually conducted at 650° C., and may be continued for many hours, is harmful. If the steel be overstrained and then annealed, the structure is altered, the ferrite and lamellar pearlite being replaced by ferrite with globular cementite, the size of the particles increasing with the time of annealing. This change is accompanied by a fall in the tensile strength and by an increase in brittleness, as shown by the Izod test. On the other hand, normalising, or heating to a temperature 50° above the critical point and then cooling in air without exposing to draughts, has no evil effects, and the injury done by overstraining followed by annealing may be almost completely corrected by such a treatment. The proper temperature is 900° for a 0·25 per cent. carbon steel and 850° when the carbon is 0·45 per cent. With properly made cylinders, a single normalising treatment after manufacture is all that is necessary. As it has been supposed that rough handling, involving jarring, may induce brittleness, experiments on the effect of repeated hammering have been made, with the result that the steel is not found to be rendered brittle by such treatment.

The Supposed Regeneration of Enzyme Activity.—During the past few years, various investigators have published experimental results which appear to indicate that certain enzyme solutions are able, after being boiled for some minutes, to recover partially their lost enzymic activity. Experiments made by Prof. Ivo Novi, and described in the *Rendiconti della R. Accademia delle Scienze dell' Istituto di Bologna* (Vol 29), help to prove, as was shown by Pasteur more than sixty years ago, that such phenomena are not observed when care is taken to prevent access of air-borne micro-organisms to the solutions.

Heats of Crystallisation.—The heats of crystallisation, Q, of seven more members of the homologous series of normal monobasic fatty acids, obtained by W. E. Garner, F. C. Madden, and J E. Rushbrooke, are to be found in the September issue of the *Journal of the Chemical Society*. With the exception of stearic acid, the data for all the even acids up to C_{20}, and all the odd acids except three, are now available As the series of acids is ascended, marked alternation in the values of Q is shown, and this is ascribed to an alternation in the arrangement of the terminal groups in passing from one acid to the next. An alternation in the melting-points of both odd and even members exists, and the two melting-point curves converge and approach a maximum at 115°. No evidence of alternation was obtained for the specific heats of the acids in the liquid state.

Radiation Theory of Chemical Action.—In a memoir published in the *Rendiconto dell' Accademia delle Scienze Fisiche e Mathematiche della Società Reale di Napoli*, Fascicoli 4-8, April-August 1926, Prof. Francesco Giordani proposes a modification of the formula connecting reaction velocity, k, with radiation density, u_ν, proposed by Lewis:

$$k = \frac{\pi c^2}{3mh\nu} u_\nu N.$$

He supposes that it is necessary to take into account the number of vibrations in the molecule r, which he puts equal to the number of ordinary chemical valencies concerned in the reaction, and instead of u_ν he uses $u_\nu{}^{1/r}$. When the modified Planck expression for u_ν is substituted in the equation, raised to the power $1/r$, it is shown that the results are in fair agreement with experiments on the decomposition by heat of phosphine, nitrogen pentoxide, and ozone (bimolecular). The great deviations between calculation and experiment which have previously appeared are then avoided.

The Determination of γ by the Method of Clement and Desormes.—The determination of the ratio of the specific heats of a gas by Clement and Desormes' method may be made to depend on measurements of temperature and pressure differences resulting from an adiabatic expansion or contraction (Lummer and Pringsheim, Partington, etc) The adiabatic change is obtained by momentarily connecting the gas, contained in a vessel under a slightly different pressure, with the atmosphere It has been known to all previous workers that equilibrium is not established instantaneously, but in a time which depends on the shape and size of the orifice, the volume of the vessel and the pressure difference In the *Proceedings of the Indian Association for the Cultivation of Science*, for August 15, 1926, G. Subrahmaniam and G. Gunnayia show how to calculate approximately the time necessary for the pressures to equalise, in terms of quantities found in the experiments. Their results indicate that the size of the aperture does not have any great effect when the temperature measurements are employed to calculate γ, but when the pressures are measured, overshooting takes place if the opening is too large. In fixing the lower limit for the size of the aperture the effect of radiation has to be considered.

The Nutrition of Cattle.

IN a previous article in our columns (NATURE, 1925, vol. 116, p 175) an account was given of some aspects of the feeding of cattle, including the method of indirect calorimetry, by means of which the value of different foodstuffs for maintenance and production can be determined, opportunity being taken at the same time to consider the relationship between the protein of the diet and the milk. The values assigned to different foodstuffs in nutrition depend not only on the accuracy of the experimental data from which they are estimated, but also on the correctness of the principles of the method of calculation used; that finality has not been reached in either case appears from a number of papers which have recently been published dealing with the various methods and their difficulties, both of technique and of interpretation. Probably the most important general figure for a foodstuff is its net energy value, that is, the amount of energy contained in it which is available for maintenance and production after deducting the non-utilisable energy and that necessarily expended in the actual processes of utilisation of the remainder

The net energy value can be determined *directly* by means of the animal calorimeter. The heat given off by the animal is deducted from the energy value of the food as determined in the bomb calorimeter, the difference giving that available for the maintenance or increase of body weight, and for the production of milk. The method requires the use of complicated apparatus and a great attention to detail: to ensure accuracy, a number of corrections must be applied to the experimental results (M. Kriss, *Jour. Agric. Res.*, 1925, vol. 30, p. 404), but with proper precautions the heat production can be satisfactorily estimated to within 1 per cent.

On the other hand, this estimation can be made *indirectly*, either by the use of the animal calorimeter again, but determining the oxygen consumption and the carbon dioxide production (instead of the heat emission) and calculating the latter from the amounts of protein, fat, and carbohydrate oxidised in the body, as determined from the respiratory exchange and the respiratory quotient, or, more simply, by deducting from the energy of the food the energy of the excreta plus that of the body tissue gained as determined from the nitrogen and carbon balances. This latter method is the one more generally used and gives results which compare well with the direct method (M. Kriss, *loc. cit.*, p. 393): its most serious source of error appears to be the loss of material, from the urine and fæces, presumably through fermentation, during drying, preliminary to the determination of the energy value of the excreta in the bomb calorimeter: this loss can be minimised by drying at a low temperature.

In using the second of the two indirect methods described above, the 'balance' method, a source of error may be introduced by irregularity of excretion; thus the fæces of a given period may not correspond accurately to that period, and this is especially the case when the diet is varied. R. W. Swift (*Journ. Dairy Science*, 1925, vol. 8, p. 270) has made a study of the weights of fæces in metabolism experiments of varying length with cows and bullocks, and has found that the chances are 31 to 1 that, with an eight-day collection period, the errors of the averages will not exceed 7 per cent. and 5 per cent. respectively: it is probably better to ignore the first few days on a new ration: hence the entire period should last about a week.

If an animal neither loses nor gains weight over an experimental period, the heat production will equal the available energy of the food: but only rarely does this occur; usually the calculated energy of the flesh and fat formed or lost from the body must be subtracted from or added to the energy of the ration, to give the maintenance requirement. It is possible to avoid the calculation of the energy of the body tissue gained or lost by feeding the animal on two differing sub-maintenance rations, and calculating from the lessened loss of energy from the body on the higher ration, the increased amount of energy which must still be added to the latter to prevent any loss from the body; at the same time an estimation can be made for the heat production of the body when no food whatever is given By increasing the diet above a maintenance value it is possible to obtain a figure for the amount of food which must be added for each pound of body fat laid on, an extremely important calculation for the fattening of animals.

Two assumptions are made in these calculations, which have been used chiefly by Armsby and Kellner respectively, as is pointed out by J. Wilson (*Scient. Proc. Roy. Dublin Soc.*, 1925, vol. 18, pp 77 and 117): first, that the maintenance requirement is the same whether food is being taken or not, or whether the ration is large or small, and secondly, that the maintenance requirement found with one type of food applies equally if the nature of the ration be changed, provided it has an equal calorific value. Wilson has made a critical examination of some of Kellner's and Armsby's results, from which he concludes that straw, for example, is less efficient than hay, as a ration, and that the food required by the bullock, whether idle or fattening, rises with the amount and kind of long fodder in the ration and also with the rate at which fat is being put on. Thus the maintenance requirement rises with an increase in the ration; in part this is due to the ensuing stimulation of metabolism which always occurs after food, so that the body lives less economically and a proportion of the energy of the food is wasted as useless heat. The increased heat production after a meal, especially one containing protein, is a well-known phenomenon. It is thus difficult to apply results obtained with one kind of food to an experiment in which another ration is given, or to assume that the energy value of a food will be the same at whatever level it is fed. Accurate results will be obtained only when the ration given is just sufficient for maintenance.

The force of these criticisms, however, is somewhat reduced by improvements in the methods of calculating results, including the adjustment of the daily heat production to a figure representing a standard day of twelve hours lying and twelve hours standing, as well as by improvements in technique. The latest method of calculation of the net energy values of feeding stuffs and some of the results obtained are given in a series of papers from the Institute of Animal Nutrition, Pennsylvania State College (M. Kriss, *Jour. Agric. Res.*, 1925, vol. 31, p. 469; E B. Forbes and M Kriss, *ibid.*, p. 1083; E B. Forbes, J. A. Fries, and W. W. Braman, *ibid.*, p. 987; D. C. Cochrane, J. A. Fries, and W. W. Braman, *ibid.*, p. 1055; E. B. Forbes, *Proc. Am. Soc. Animal Production*, 1924, p. 23, and *Science*, 1926, vol. 63, p. 311; and E. B. Forbes, J A. Fries, and M. Kriss, *Jour. Dairy Science*, 1926, vol. 9, p. 15). The animal is given different rations during a series of experimental periods: by subtracting the heat production of a period on a lower diet from that of one on a higher ration, the increased heat production due to the increase in the food is obtained. The net energy required for maintenance is the total heat production in the period minus the total increase in this value due to the food, calculated from the average of the figures previously obtained. The total net energy of the ration is the *average* net energy for maintenance as found in the different experimental periods in which the particular food under consideration was used, plus the energy gained by the animal, which is determined by subtracting the total heat production from the metabolisable energy of the food.

By this method it is found that the results obtained in the different experimental periods usually agree fairly well, and it is easy to see and discard any abnormal set of figures The authors are inclined to consider differences in maintenance requirements in different periods as due to experimental errors rather than to differences in the rations or in the plane of nutrition of the animal. On the other hand, from experiments on fasting animals it appears that energy is more efficiently utilised in sub-maintenance periods, so that consistent figures for net energy values of rations are more likely to be obtained when the plane of nutrition in the different periods does not vary too greatly, and thus that the results should be considered as applying accurately in other cases only when the animals are kept at a somewhat similar level of nutrition A further point to which attention may be directed is the applicability of results obtained with a particular breed to animals of another breed or in a different country where the rations are almost certain to be different. F. J. Warth, L. Singh, and S M. Husain (*Memoirs Dep. Agric. India*, 1926, vol. 8, p. 153) have established certain differences between their animals and those used in America in considering the requirements for milk production with Indian foodstuffs. These differences affect primarily the digestibility of the rations, due in part to their actual nature, but at the same time individual animals have their own characteristics.

In conclusion, it may be stated with confidence that there appears to be sufficient accurate knowledge of the efficiency of different rations for maintenance and production to enable the practical farmer to select from those available to him the most economical in meeting his requirements.

Marine Biology at Plymouth.

THE latest number of the *Journal of the Marine Biological Association* (N.S., vol. 14, No. 2, August 1926, 10*s*. net) is full of good things. Dr. Orton resumes the interrupted publication of his studies on the rate of growth of marine organisms with a paper on the cockle. The investigations were carried out mainly in an experimental box laid down in the estuary of the river Yealm, in which the growing cockles were exposed to practically natural conditions, and the results have been checked by observations on near-by cockle beds. Apart from the definite determination of growth-rate—a matter of some economic importance, though it may be expected that the growth-rate will vary in different localities—the main interest of the paper lies in the study of the growth rings on the shell. It appears that, in the main, the deeply marked rings do indicate the winter checks in growth, and may be used—with caution—to determine the age of the cockle. Dr. Orton has, however, made the interesting observation that the mere removal of the cockles from the box for an hour or so for the purpose of examination suffices to cause the appearance of a " disturbance ring " on the shell Specially well-defined rings are induced by the technique adopted of marking the shells for identification purposes with a file. Such disturbance rings can also be induced in the mussel. Further, in mild winters the winter-ring may become extended and spread out into several rings, so that accurate determination of the age by means of winter-rings is a matter of some difficulty, especially in the larger individuals. The paper would have been improved by the addition of a summary.

A second paper by Dr Orton deals with the comparative effect of dilute but lethal solutions of T.N.T. on native and Portuguese oysters (*Ostrea edulis* and *Gryphea angulata*), and was carried out at the request of the Fisheries Department to clear up a point left undetermined in the course of Dr. Orton's elaborate study of the abnormal mortality among native oysters in 1920–21. It is said that the mortality did not affect the Portuguese oysters. Dr. Orton shows, however, that both species are about equally susceptible to T.N.T.

The next paper—a valuable study, by Dr. C. M. Yonge, of feeding and digestion in the oyster—also arises out of Dr. Orton's oyster-mortality investigations, and its genesis illustrates in a striking way how important it is that ' fundamental ' or purely scientific studies should accompany, or better still precede, any investigations directed towards a practical or economic end. It became apparent from Dr. Orton's own work on the mortality of oysters that not nearly enough was known about the normal physiology of the oyster for any one to say what conditions were normal and what were indicative of disease or pathological disturbance. Dr. Orton wisely pointed the moral by recommending a special research into the anatomy and physiology of the oyster, and of this Dr. Yonge's paper gives us the first fruits.

The paper seems to us wholly admirable. Dr. Yonge is of the modern school in combining anatomy with physiology, in studying form and function together Considerable space is given to a clear and well-illustrated account of the anatomy and histology of the digestive apparatus both in the adult and in the larval oyster, and to a description of the amazingly complex system of ciliary currents by which the oyster collects and sifts out the tiny planktonic organisms on which it feeds, rejecting all such as are too large for it to deal with, and leading the rest over the palps into the mouth, down into the stomach and the digestive diverticula (commonly known as the ' liver ') Other sections treat of assimilation, the digestive enzymes, the function of the crystalline style, and the storing of reserve products. Dr. Yonge finds that digestion is mainly intracellular—soluble matter and fine particles being ingested by the cells of the digestive diverticula, larger particles by the phagocytes present in all parts. This is demonstrated by ingenious feeding experiments with iron saccharate, with blood corpuscles of the dog-fish, with olive oil, and with the diatom Nitzschia. He rejects the theory of the Danish workers that the oyster is primarily a detritus feeder, and emphasises the importance of the smaller diatoms, peridinians, algal spores, and other microscopic vegetable matter.

It comes out clearly from Dr. Yonge's work, especially that on the enzymes present, that the oyster, like other lamellibranchs, is specially adapted for the digestion, assimilation and storage of carbohydrates. The rationale of fattening the oyster for market is, then, to supply it with plenty of microscopic vegetable food, as already indicated by Savage in a recent paper, and as realised empirically in some fattening ponds, particularly in France. It has been known for some time that the oyster stores its surplus nourishment mainly in the form of glycogen, which is no doubt chiefly derived from the carbohydrates richly present in the diatoms and peridinians of its food. Dr. Yonge's elaborate paper represents a distinct advance in our knowledge of lamellibranch physiology, and cannot fail to be of great service both theoretically and practically.

The three papers so far considered take up about half the present number of the *Journal*, and the remaining papers can be only lightly touched upon. Mr. F. S. Russell continues his interesting studies on the vertical distribution of the macro-plankton, with papers on the diurnal changes in distribution of pelagic young fish and on the importance of light as a factor in determining the vertical distribution of plankton forms. From Dr. Atkins comes a third contribution to our knowledge of the phosphate content of sea-water in relation to the growth of algal plankton. Samples obtained from the English Channel, North Sea, the open Atlantic and Pacific confirm the author's views on the importance of phosphate as a limiting condition for production in the sea. Mr. C. F. Hickling gives some further details regarding the remarkable kind of luminescence discovered by him in the fish *Malacocephalus laevis*. Among two or three faunistic papers one may perhaps specially note one by Dr. Lebour giving a general survey of larval euphausiids, with a scheme for their identification. Such work is of very great service to plankton investigators, and it is to be hoped that Dr. Lebour will continue the good work and deal with other groups in the same way.

In conclusion, mention must be made of the ingenious 'vacuum grab' invented by Mr. O. D. Hunt, with the assistance of Dr. Bidder, and here described in detail. By means of this instrument samples of the bottom can be taken which retain the finest particles together with the micro-fauna and micro-flora therein contained. E. S. R.

University and Educational Intelligence.

BIRMINGHAM.—At the meeting of the Council of the University held on November 3 the following appointments were made: Dr. T. L. Hardy, assistant physician to the General Hospital, to be assistant to the chair of medicine, Dr. C. C. W. Maguire, physician for out-patients at Queen's Hospital, to be honorary demonstrator in the Department of Anatomy.

It was decided that the Court be asked to confer the title of emeritus professor upon Prof. O. J. Kauffmann, joint professor of medicine in the University from 1913 to 1926.

CAMBRIDGE.—Mr. T. W. Wormell, St. John's College, has been appointed observer in meteorological physics at the Solar Physics Observatory. Mr. J. T. MacCurdy, University lecturer in psycho-pathology, and Mr. H. C. B. Mynors, have been elected to fellowships at Corpus Christi College. The Adam Smith Prize has been awarded to G. T. Jones, Emmanuel College The Engineering Department has been presented with portraits of Sir Alfred Ewing, the late Prof. Bertram Hopkinson and Prof. Inglis. The Henry Sidgwick Memorial lecture will be given at Newnham College on Nov. 13 at 5 P.M., by Sir William Bragg, who will take as his subject "The New Crystallography."

LONDON.—The following doctorates have been conferred: *D.Sc.* (*Economics*) on Mr. S. G. Panandikar (London School of Economics) for a thesis entitled "The Wealth and Welfare of the Bengal Delta", *D.Sc.* (*Chemistry*) on Mr. G. W. Ellis for a thesis entitled "A Contribution to the Chemistry of Drying Oils, Parts i-iii. (containing a Study of the Autoxidation of Linseed Oil and a Theory on the Nature of the Autoxidation of Unsaturated Compounds)"; *D.Sc.* (*Veterinary Science*) on Mr. J. T. Edwards for a thesis entitled "The Chemotherapy of Surra (*Trypanosoma evansi* infections) of Horses and Cattle in India."

ST. ANDREWS.—On November 3 Dr. Fridtjof Nansen was installed as Rector of the University, after having been admitted to the honorary degree of Doctor of Laws. He delivered an inspiring address on the spirit of adventure, in the course of which he referred to his own experiences as an explorer and as a supporter of the League of Nations. The honorary degree of LL.D. was then conferred upon His Excellency Mons. P. B. Vogt, Norwegian Minister, Prof Vilhelm F. K. Bjerknes, of the University of Oslo; Prof. Bjorn Helland-Hansen, of Bergen, Capt. Otto Neumann Sverdrup (Captain of the *Fram*); Prof. J. Norman Collie; Brig.-General the Hon. Charles Granville Bruce; Sir T. W. Edgeworth David, and (*in absentia*) the Right Hon Viscount Cecil of Chelwood.

IT is stated in the *Chemiker Zeitung* that Dr. G. von Hevesy, professor of physical chemistry at the University of Freiburg in Baden, has been invited to succeed Prof. Bodenstein in the chair of physical chemistry at the Technische Hochschule at Hannover.

THE British Institute of Adult Education issued in September the first number of a half-yearly review entitled the *Journal of Adult Education*, published by Messrs. Constable and Co., Ltd., at 2*s*. 6*d*. The editors, Prof. J. Dover Wilson and Prof. A. E. Heath, are assisted by an advisory panel of thirty-one, whose names, well known in educational circles, appear on the cover. This first number is remarkable for the prominence given to the questions of what are and what should be the purposes of adult education The questions are raised both explicitly in the more important articles, and indirectly by incompatibility of the ideals of some of the writers. They are dealt with most comprehensively by Prof. Robert Peers, the director of the important department of extra-mural education of University College, Nottingham, who classifies the various views concerning the aims of adult education under the three heads—development of the individual person, social service, and social change. A certain ambiguity is observable in the arguments owing to confusion between the aims of the students, the aims of the teachers, and the aims of those who organise and administer and finance the work. Education that aims primarily—not at the student's emancipation from the shackles of ignorance, but at the emancipation of 'workers' from the restraints incidental to a social system under which 'the means of life' are subjects of private ownership, the education on a Marxian basis, as given in the 'Labour' colleges, is described in one of the articles as 'independent' working-class education. This article, beginning with this curious use of the word 'independent' and ending with an appeal to class hatred by describing resistance to the subsidising of the mining industry as "the whole power of capitalism turned to defeating one particular section [of 'the workers'] by the use of the starvation weapon against women and children," shows that a wide circulation of the Journal is anticipated.

A PROJECT for founding a British Institute in Paris was launched at a meeting at the Mansion House, London, on November 1. The scheme has been warmly commended by the Prince of Wales, by whom a Canadian hostel was opened in Paris but two days before, in the Cité Universitaire near the Parc de Montsouris. The erection of a similar residential college is not, however, a central feature of the British Institute project, which aims primarily at providing a centre for serious study and exchange of ideas for French students of English and for British students in France. It is proposed to work in co-operation with, if not to absorb, the existing Collége de la Guilde, founded thirty years ago by Miss Edith Williams and now carried on as a tutorial agency with the full approbation of the University of Paris authorities. At the Mansion House meeting Lord Crewe, the French Ambassador (M de Fleurian), Lord Burnham, M Desclos (on behalf of the Rector of the University of Paris), Sir Theodore Morison (representing the Standing Committee of the Vice-Chancellors of the Universities of the United Kingdom), Sir William Beveridge, Lord Meath, and Lord Derby all strongly supported the scheme, and an influential committee was appointed as a provisional council of the Institute. In the *University of London Gazette* of November 3 appears a notice of a Resolution of the Senate warmly approving the project and of the appointment of a committee to report how the University can co-operate. The minimum amount required for financing it is 100,000*l*., towards which Sir Daniel Stevenson and others have promised some 15,000*l* Sir William Beveridge stressed the need of an institution capable of representing British Universities in Paris as the American University Union represents the Universities of the United States in London and Paris. This need, which has long been felt, has become acute since the establishment of the International Institute for Intellectual Co-operation in Paris.

THE universities' duty of self-adjustment to contemporary social changes is discussed in a suggestive article by Hubert Phillips in the October number of the *University Bulletin*, the organ of the Association of University Teachers. In an age in which in the secular conflict of Man *versus* the State the honours seem to be with the latter, whilst the spiritual ascendancy of the syndicated press, the B.B.C., and the 'movies' seems to be assured, how, it is asked, are the will to criticise, and the will to determine, and the will to progress to be nourished and kept alive? It is suggested that it is 'up to' the universities to find ways and means. The newer universities are commended for not being ashamed to call themselves provincial and are exhorted to go further and "*be* provincial—to fight for people and places against syndicates and machinery." Lastly, reference is made to the fact that, unlike the churches (or certain of them), the universities have not made their voice heard as mediators in the disastrous struggle in the coal industry, notwithstanding that they are the custodians of accumulated wisdom in regard alike to mining technology, economics, social ethics, and industrial organisation and finance. We are reverting, in the view of the writer, to a society in which all significant institutions must exercise—somehow—political functions, or must perish: the professional politician is ceasing to matter. In these circumstances, it behoves the universities not to be obsessed by the fear of "interfering in politics," always provided they can keep their interference clear of any party complexion. The article is entitled "Some Academic Horizons": it is interesting as an addendum to Dr. Earle's paper, read at the Universities' Congress last July, on "An Imperial Policy in Education."

Contemporary Birthdays.

November 6, 1861. Principal Arthur P. Laurie.
November 8, 1872. Dr. Martin Onslow Forster, F.R.S
November 8, 1864. Prof. Benjamin L Robinson.
November 10, 1861. Mr. Robert T. A. Innes.
November 10, 1851. Prof. Waldemar C. Brøgger, For Mem. R.S.
November 10, 1847. Earl of Iveagh, K.T., G.C.V.O., F.R.S.
November 12, 1863. Prof. Alfred W. Porter, F.R.S.
November 14, 1891. Prof. Frederick G Banting.
November 14, 1869. Prof Harry Yandell Benedict.
November 17, 1847. Prof Archibald Liversidge, F.R.S.
November 18, 1869. Hon. Sir Arthur Stanley, G B.E.
November 18, 1855. Prof. Archibald Barr, F.R.S.

Dr. LAURIE was educated at Edinburgh Academy. He graduated at the Universities of Edinburgh and Cambridge. Sometime lecturer in physics and chemistry at St. Mary's Hospital Medical School, London, he has been professor of chemistry, Royal Academy of Arts, since 1912; in 1914 he became a member of the Chemical Products Supply Committee, Board of Trade. He has written many illuminating memoirs on artists' pigments and mediums. Dr. Laurie is principal of the Heriot-Watt College, Edinburgh.

Dr. M. O. FORSTER studied at Finsbury Technical College, and the Central Technical College, South Kensington. From 1902 until 1913 assistant professor of chemistry at the Royal College of Science, he became the first director of the Salters' Institute of Industrial Chemistry (1918–22), retiring to take up the directorship of the Indian Institute of Science, Bangalore. Dr. Forster was president of Section B (Chemistry) at the Edinburgh meeting of the British Association in 1921, delivering an address on "The Laboratory of the Living Organism." *Inter alia* he asked, "What is breakfast to the average man?" He answered the question by saying that it was a "hurried compromise between hunger and the newspaper." In 1915 Dr. Forster was awarded the Longstaff medal of the Chemical Society.

Prof. B. L. ROBINSON, botanist, was born at Bloomington, Illinois, U.S.A. He was educated at the Universities of Harvard and Strasbourg. Since 1899 he has been Asa Gray professor of systematic botany in Harvard University, whilst being from an even earlier date curator of the celebrated Gray Herbarium. Prof Robinson is a foreign member of the Linnean Society. He is the author of numerous papers on the classification of the higher plants of the United States, Mexico, and tropical America.

Mr. ROBERT INNES, astronomer, was born at Edinburgh. From 1903 until 1911 he was director of the meteorological department, Transvaal, South Africa, becoming then chief of the Union Observatory, Johannesburg. He is the author of many astronomical memoirs.

Prof. BRØGGER, the distinguished geologist, rector of the University of Christiania (Oslo) and one of its alumni, is a foreign member of the Royal Society and of the Geological Society. Sometime an assistant on the Norwegian geological survey, he became professor of geology in the University of Stockholm. Since 1890 he has held the chair of geology and mineralogy at Christiania (Oslo). He is Hon. LL.D., Glasgow, Hon. Sc.D., Cambridge, and Hon. D.Sc., Oxford. In 1911 the Geological Society of London awarded Prof. Brøgger its Wollaston gold medal (twenty years earlier he had been allotted the Murchison medal) at the hands of Prof. W. W Watts, then president. It was remarked that Prof. Brøgger was an accomplished chemist, skilful mineralogist, and great petrologist. His researches on the Cambrian and Ordovician rocks of his own country had indicated that he was a gifted palæontologist and stratigrapher. His detailed mapping and interpretation of the structure of the Christiania area and his explanation of the origin of the Christiania Fjord had proved him to be a tectonic geologist of a very high order.

The EARL OF IVEAGH, whose interest in the movements of science and appreciation of its needs are well known, has been Chancellor of the University of Dublin since 1908.

Prof. PORTER, dean of the Faculty of Science in University College (University of London), occupies there the chair of physics. Honorary secretary of the Institute of Physics, he is a past president of the Röntgen Society and of the Faraday Society.

Prof. F. G. BANTING was born at Alliston, Ontario Educated at the Alliston Public and High Schools, he graduated in the medical faculty of the University of Toronto. From a physiological post in the University of Western Ontario, London, Canada, he returned to Toronto to become a lecturer in pharmacology. He now occupies the chair of medical research established lately in the University. Prof. Banting, with Prof. J. J. R. MacLeod, received in 1923 the distinction of the Nobel prize in physiology and medicine for their discovery of insulin.

Prof. BENEDICT, who occupies the chair of applied mathematics and astronomy, and is dean of the College of Arts in the University of Texas, was born at Louisville, Kentucky, U.S.A. He was educated at the Universities of Texas, Harvard, and Virginia Sometime an assistant in the Leander McCormick Observatory of the University of Virginia, he also held a mathematical professorship in Vanderbilt University.

Prof. LIVERSIDGE, the veteran chemist and mineralogist, was born at Turnham Green, Middlesex. His studies were pursued at the Royal School of Mines, South Kensington, Royal College of Chemistry, and Christ's College, Cambridge Appointed so far back as 1873 to the chair of chemistry in the University of Sydney, he occupied that post for thirty-five years. He has rendered distinctive service to science and technical education in Sydney, and also far beyond its boundaries He was a founder of the Australasian Association for the Advancement of Science, and was its honorary secretary for a number of years; afterwards he became president. Prof. Liversidge has written numerous memoirs on chemistry and mineralogy. He is Hon. LL.D., Glasgow.

Sir ARTHUR STANLEY, who was educated at Wellington College, entered the diplomatic service, filling various posts before retirement. He is chairman of the Joint Council of the British Red Cross Society and Order of St. John, and is also treasurer of St. Thomas's Hospital. Sir Arthur is especially interested in the work of the British Empire Cancer Campaign. He is a Commander of the Legion of Honour.

Prof. BARR, Regius professor of civil engineering and mechanics in the University of Glasgow from 1889 until 1913 (earlier he held a similar chair at the Yorkshire College, Leeds), was born at Glenfield, Renfrewshire. In collaboration with Prof. W. Stroud he has invented several types of range finders. Of these, one designed for use at sea is extensively employed in the British Navy. Prof. Barr is Hon. LL.D., Glasgow and Birmingham.

Societies and Academies.

LONDON.

Royal Society, November 4.—H. C H. **Carpenter** and S. **Tamura**: Experiments on the production of large copper crystals. Crystals exceeding 4 in. in length have been grown in polycrystalline copper strip of section 0·5 in. × 0·125 in. by the method of critical strain followed by appropriate heat treatment These crystals, however, are not, strictly speaking, single crystals, since they contain numerous twins which may be oriented in so many as three directions. It has not been found possible to produce large copper crystals by this method without at the same time producing twins. The complete removal of strain in recrystallised copper strip is only achieved by prolonged heating. On account of the presence of twins, the large crystals thus prepared only possess about one-third of the ductility of polycrystalline copper. Their tenacity, however, is almost the same. Their ductility is still more inferior to that of single-crystal copper prepared direct from the liquid which is free from twins.

H. C. H. **Carpenter** and S **Tamura**: The formation of twinned metallic crystals. The principal cause of twinning seems to be crystal growth. Deformation is an indirect cause of twinning, merely because it causes subsequent growth on annealing. In some cases the orientation of annealing twins indicates that they have grown along certain crystallographic directions; most frequently they are rectilinear. The capacity for forming annealing twins appears to be closely related to the atomic arrangement in the crystal lattice Those metals which crystallise in the face-centred cubic, tetrahedral cubic, and face-centred tetragonal lattices produce annealing twins after suitable treatment, whereas metals possessing other atomic arrangements have not been found to produce them. Metals which crystallise in the close-packed hexagonal lattice, *e.g.* zinc and cadmium, have no possible planes of twinning, and what is called twinning in these metals is probably parallel growth.

G. I. **Taylor** and C. F. **Elam**: The distortion of iron crystals. Specimens cut from crystals of iron were subjected to uniform distortion both in compression and in tension, and the distortion analysed and the orientations of the crystal axes determined by X-rays. Distortion is due to slipping in a direction parallel with the perpendicular to a {111} plane. This plane of slip had different orientations with respect to the crystal axes in different specimens, and its orientation round the direction of slip was determined chiefly by the direction of stress A uniform shear, for which the direction of slip is a crystal axis while the plane of slip is not a crystal plane, arises from a condition of slipping in which the particles of the material stick together in rods instead of in planes. This conception of the mechanism of distortion in iron accounts for the fact that the general direction of the slip lines which appear on a polished surface coincides with the trace of the plane of slip and has no direct connexion with the crystal axes.

W. **Rosenhain** and A. J **Murphy**: The metallography of solid mercury and amalgams. Carbon dioxide snow has been employed to attain the low temperature required, and specimens having a smooth surface have been obtained by solidification against a glass surface or by polishing. The cast surfaces have been etched electrolytically in hydrochloric acid and examined microscopically.

C. F. **Elam**: Tensile tests of large gold, silver and copper crystals. Crystals of gold, silver and copper

8 in. long and 0·25 in. in diameter have been prepared by lowering a graphite tube full of the molten metal slowly through an electric tube furnace, so that freezing proceeds from the bottom upwards. The position of the crystal axes was determined by means of X-rays, and the rods extended in a tensile testing machine. The crystal axis of the specimen moved in the same direction as in aluminium during extension. As these metals have the same crystal structure as aluminium, it was concluded that distortion was similar in every case, and that gold, silver and copper crystals distort by slipping on a (111) plane in a (110) direction. The crystals all harden during the process of deformation, but when the shear stress is plotted against the extension, the form of the curves is different for each metal.

R. E. **Gibbs**: The polymorphism of silicon dioxide and the structure of tridymite. The structure of tridymite was similar to that of ice, *i.e* D_{6h}^{4}, with four molecules per cell, in which $a=5·03$ and $c=8·02$. The framework can be considered as a close-packed arrangement of oxygen atoms of diameter about 2·6, whilst the silicon atoms occupy the spaces between four neighbouring oxygens It is probable that the structures are ionic in nature, being variations of a two-to-one packing of oppositely charged ions. Possible modes of β-β transitions lead to the idea that these sluggish changes are characterised by a change of partners between neighbouring ions On other hand, the α-β transition, at least in the case of quartz, is merely a small atomic rearrangement not sufficiently drastic to involve a change of neighbours. The α-states are probably created by distortions of the β-forms involving lower symmetry and possibly larger cells. α-tridymite is orthorhombic, having a cell $a=9·9$, $b=17·1$, $c=16·3$, in which the units must be polymerised groups $n\mathrm{SiO}_2$, where n is larger than two and probably equal to eight The existence of a third form α' of tridymite resembling the ordinary α-form was confirmed.

Twenty-six papers were read by title only.

Royal Microscopical Society, October 20.—A. **Piney**: A method of silver impregnation of Zenker-fixed sections. The method is only a modification of Bielchowsky's technique and is designed to apply to tissues fixed in mercuric chloride solutions. The essential point is the removal of all traces of the mercuric salt, followed by removal of the iodine, which was employed for this purpose. The wax is removed from the section with xylol, and the section is then placed in 0·4 per cent. iodine in 80 per cent. spirit for 10 minutes. Some of the iodine is removed by soaking the section for 30 minutes in 70 per cent. alcohol, but the remainder is got rid of by immersion in 0·25 per cent. sodium thiosulphate dissolved in 50 per cent. alcohol (not in water as recommended by Heidenhain). The section is now washed in water for an hour, and then immersed in 0·25 per cent. potassium permanganate in water, swilled in distilled water, placed in 5 per cent. aqueous oxalic acid for 20 minutes, washed for 2 hours in running water, and then stained by the Bielchowsky method. Toning with 1 per cent. gold chloride and fixation with 5 per cent. hypo are an advantage, as is also counterstaining with Weigert's iron hæmatoxylin and van Gieson's solution. The method is particularly adapted for the demonstration of reticular fibrils in hæmatopoietic tissues.

PARIS.

Academy of Sciences, October 11.—V **Grignard** and P. **Muret**: Pyrosulphuryl chloride. In the production of this substance by the reaction between sulphur trioxide and carbon tetrachloride there are difficulties in purification. Utilising the reaction between carbon tetrachloride and chlorsulphonic acid, the conditions have been studied with the view of obtaining a purer product. The decomposition resulting from rise of temperature has also been studied.—Henri **Jumelle**: New observations on tombak tobacco. The identification of the species is complicated by the fact that there are several tombak tobaccos. One tobacco sold under that name has proved to be *Nicotiana rustica*. It contains a high proportion of nicotine (6-12 per cent) and may be of service as a source of nicotine for viticultural or horticultural purposes.—T. **Rado**: The calculation of the area of curved surfaces —Paul **Flamant**: The continuity of the distributive transmutations and the extension of a transmutation defined for polynomials.—Paul **Dumanois**: The importance of the combustion yield in internal combustion engines According to the theory of combustion and detonation developed by the author in previous communications, a mixture of petrol and methyl alcohol should give a higher efficiency than petrol alone. Experimental proof of this is now given: the fuel used contained 70 per cent. of methyl alcohol and gave an increase of 15 per cent in efficiency over pure petrol.—Th. de **Donder**: The application of the quantification deduced from the Einsteinian gravific. —L. **Meunier** and G **Rey**: The action of ultraviolet light upon wool. Under the action of sunlight or the mercury vapour lamp, the condition of the sulphur in the wool is changed; part is converted into sulphur dioxide, which is partially oxidised to sulphuric acid. These changes can be followed by an indicator such as methyl red. Reactions of the insolated wool with nitroprusside, quinone, alloxan and ninhydrin are also described.—W J. **Richards**: The effect of α-rays on supersaturated solutions. It might be expected that α-particles would produce crystallisation in supersaturated solutions Negative results were obtained with solutions in water of sodium sulphate, potassium sulphate, calcium chromate and lithium carbonate. Negative results were also obtained with aqueous sugar solutions and with fused salol.—Louis **Grenet**: The limiting states of alloys.—M. **Ballay**: The Ludwig-Soret phenomenon in alloys. The concentration changes produced in solutions unequally heated are shown experimentally to exist in alloys, and this phenomenon must be taken into account in a general discussion of the phenomena of segregation.—V. **Hasenfratz** and R. **Sutra**: Some derivatives of harmalol and harmol.—Marcel **Frèrejacque**: Vaillantite, an agent of sulphomethylation. Formation of a new active camphorsulphonic acid. —H. **Prophète**: Contribution to the study of the wax of flowers: rose wax. Study of its unsaponifiable matter.—Germain **Chalaud**: The first phase of the evolution of the gametophyte of *Fossombronia pusilla*. —Jean Jacques **Trillat**: The action of X-rays of long wave-length on micro-organisms. The case of *B. prodigiosus*. These researches showed the bactericidal influence of primary X-rays of long wave-length.—Auguste **Lumière** and **Félix Perrin**: A new class of hypnotics. The dialkylphenylacetamides. Dipropyl-, propylallyl-, and diallylphenylacetamide have been prepared and possess hypnotic properties, but the ratio of their active dose to the toxic dose is rather high.—**Javillier** and H. **Allaire**: Phosphorus ratios in the tissues.

ROME.

Royal National Academy of the Lincei: Communications received during the holidays.—G. **Fubini**: The theory of R surfaces and their transformations.—

Giorgio Dal Piaz: The discovery of a supposed vein of post-glacial volcanic rock in the neighbourhood of Bressanone (Upper Adige).—**Giuseppe Corbellini**: A class of variety characterised by means of parallelism.—**V. Hlavatý**: Local parameters in a Riemann variety.—**J. Soula**: Functions defined by Dirichlet's series.—**Oscar Zariski**: The development of an algebraic function in a circle containing several critical points.—**Filippo Burzio**: Order of magnitude of quantities relative to the second ballistic problem. A formula for ballistic nutation.—**A. Weinstein**: Liquid jets with given walls.—**Bruto Caldonazzo**: An extension of Bernoulli's theorem. This theorem, which is valid for the stationary motion of a perfect fluid, is extended to meet certain cases of variable motion.—**Mentore Maggini**: Interferometric measurements on the four large satellites of Jupiter. Observations on the changes of figure and on the axial inclinations of these satellites are described.—**Vasco Ronchi**: Further concerning "flying shadows." D'Arturo's criticisms of the author's conclusions are refuted.—**Franco Rasetti**: The Doppler effect in sensitised fluorescence.—**G. Wataghin**: The ballistic hypothesis and the Doppler effect. The two treatments as yet known of the Doppler effect both lead to results unfavourable to the ballistic theory of this effect.—**G. Natta** and **F. Schmid**: Oxides and hydroxides of cobalt (ii.). The crystalline structure of the saline oxide of cobalt. The oxide Co_3O_4 crystallises in the monometric system and is isomorphous with magnetite. The size of the elementary cell of the crystalline lattice, which is of the spinel type, is 8·02 Å.U. and contains eight molecules. The density is calculated to be 6·21, which lies among the somewhat discordant experimental values.—**E. Repossi** and **V. Gennaro**: The minerals of the serpentine of Piossasco (Piedmont). The mineral species so far identified in this serpentine are ilmenite, magnetite, calcite, aragonite, diopside, granite, vesuvianite, chlorite, titanite, perowskite, apatite, and, probably, gavite.—**Sabato Visco**: The behaviour of the hepatic glycogen in fasting animals treated with insulin. The administration of insulin to fasting rabbits diminishes the loss in weight. The liver and spleen increase in weight, whereas the heart, kidneys, suprarenal capsules and lungs show slight and variable changes in weight. The amount of glycogen in the liver is increased very considerably by treating the fasting animal with insulin.

SYDNEY.

Linnean Society of New South Wales, August 25.—**C. H. Anderson**: A revision of certain Australian Rhenopodiaceæ. The paper embodies a critical examination of the two species, *Bassia tricornis* (Benth.) F.v.M. and *Bassia enchylænoides* F.v.M. A new genus is proposed to take in one of the species, and the other is transferred to the genus Kochia.—**E. Cheel**: Notes on *Melaleuca pubescens* Schauer and *M. Preissiana* Schauer. The author's view is that *M. pubescens* Schauer has priority, that the Victorian plants are merely forms of *M. pubescens*, and that the Western Australian plants known as "Ironwood" are glabrous forms of the same species.—**Rev. H. M. R. Rupp**: Description of a new species of Diuris from Barrington Tops, N.S.W. The species described as new is closest to *D. spathulata*, from which it differs in its venation, more prominent lateral lobes of the labellum, and in its short and thick column.—**A. M. Lea**: On some Australian Curculionidæ. The paper contains descriptions of two new genera and sixty-five new species, one of which belongs to Rhinomacer, a genus now first recorded as Australian.

Official Publications Received.

BRITISH AND COLONIAL.

Aeronautical Research Committee: Reports and Memoranda. No. 1019 (Ae. 230): Note on a Hot-Wire Speed and Direction Meter. By L. F. G. Simmons and A. Bailey. (C. I. Accessories, Instruments, 90.—T. 2088.) Pp. 7+7 plates. 9d. net. No. 1027 (Ae. 225): Test of Two Aerofoils, R.A.F. 27 and R.A.F. 28. By A. S. Hartshorn and H. Davies. (A. 3. a. Aerofoils-General, 104.—T. 2257.) Pp. 10+6 plates. 9d. net. No. 1038 (M. 47): Report on the Accelerated Ageing of 'Y' Alloy. By S. L. Archbutt and J. D. Grogan. (B. 1's. Metals, 55.—T. 2251.) Pp. 10+4 plates. 9d. net. (London: H.M. Stationery Office.)

South Australia. Department of Mines: Geological Survey of South Australia. Bulletin No. 12: Clay and Cement in South Australia. By R. Lockhart Jack. Pp. 120+4 plates. (Adelaide: R. E. E. Rogers.)

Annual Report for the Year 1925 of the South African Institute for Medical Research, Johannesburg. Pp. 37+2 plates. (Johannesburg.)

Development Commission. Sixteenth Report of the Development Commissioners for the Year ended the 31st March 1926. Pp. 157. (London: H.M. Stationery Office.) 3s. net.

Our Heritage—The Empire: a Report on some Aspects of a Tour of the King's Overseas Dominions undertaken chiefly in the Interests of Empire Migration and Settlement, 1925–1926. By Commissioner David C. Lamb. Pp. 40. (London: The Salvation Army.)

Report of the Progress of the Ordnance Survey for the Financial Year 1st April 1925, to 31st March 1926. Pp. 3+5 plates. (London: H.M. Stationery Office.) 1s. 6d. net.

Transactions of the Leicester Literary and Philosophical Society, together with the Council's Report and the Reports of the Sections, 1925–26. Vol. 27. Pp. 66. (Leicester.)

Smoke Abatement League of Great Britain. Seventh Report, covering the Nine Months October 1st, 1925, to June 30th, 1926. Pp. x+22. (Manchester.)

British Museum (Natural History). Picture Postcards. Set C17: British Sea Birds, Series No. 1, Gulls. 5 cards in colour. Set C18: British Sea Birds, Series No. 2, Auks and Cormorants. 5 cards in colour. (London: British Museum (Natural History).) 1s. each set.

FOREIGN.

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin." Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Livraison 3, Septembre. Pp. 217-380. 2.50 f. Vol. 8, Livraison 3-4, Juillet. Pp. 190-512. 5.00 f. (Buitenzorg: Archipel Drukkerij.)

CATALOGUES.

Microscopes and Accessories. Pp. 92. (London: C. Baker.)

Diary of Societies.

SATURDAY, NOVEMBER 13.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. E. M. Walker: The Study of History (2).

PHYSIOLOGICAL SOCIETY (at the London School of Medicine for Women), at 4.—R. T. Grant: An Observation on the Function of the Pericardium.—A. Levin: Fatigue, Retention of Action Current and Recovery, in Nerves of the Spider Crab.—T. Lewis and H. M. Marvin: Herpes Zoster and Antidromic Impulses.—R. W. Gerard, Prof. A. V. Hill, and Y. Zotterman: Energy Liberation of Nerve as a Function of Frequency of Stimulation.—R. W. Gerard: The Two Phases of Nerve Heat Production.—M. Lowenfeld, S. T. Widdows, M. Bond, and E. Taylor: Variations in Composition of Early Human Milk and Factors Influencing Them.—D. Woodman, H. B. Hewer, and M. L. Keene: Time of Appearance of Digestive Enzymes in the Human Fœtus.—W. C. Cullis, D. Rendel, and E. Dahl: Points in the Technique of the Ethyl Iodide Method.—Demonstrations by A. Levin: An Improved Device for Time-marking and Similar Purposes.—E. B. Hewer and M. F. L. Keene: Pineal and Choroid Plexus in the Human Fœtus.—G. Briscoe: Records of Different Types of Respiratory Movements.

MONDAY, NOVEMBER 15.

ROYAL MEDICO-PSYCHOLOGICAL ASSOCIATION (at British Medical Association, Tavistock Square), at 4.—Dr. A. Adler: The Cause and Prevention of Neurosis.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—J. A. Steers: The East Anglian Coast.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—J. Rosen: Address.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—J. E. Southcombe: Recent Research on Friction and Lubrication.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—H. V. Lanchester: Bridges and Traffic.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—J. C. McKerrow: Evolution and Contingency.

ROYAL SOCIETY OF ARTS, at 8.—Prof. H. L. Callendar: Recent Experiments on the Properties of Steam and High Pressures (Howard Lectures) (1).

HUNTERIAN SOCIETY OF LONDON (in Cutlers' Hall, Warwick Lane, E.C.), at 8.45.—Sir Humphry Rolleston, Dr. G. Little, Dr. L. Williams, and others: Discussion on Medicine and the Press.

TUESDAY, NOVEMBER 16.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. G. W. C. Kaye: The Acoustics of Public Buildings (Tyndall Lectures) (3).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Viscount D'Abernon: German Currency: The Collapse and Recovery, 1920–1926 (Inaugural Address).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. G. D. Hale Carpenter: The Biology of *Glossina palpalis* in connexion with Sleeping Sickness.

—R. I. Pocock: (*a*) The External Characters of the Patagonian Weasel (*Lyncodon patagonicus*); (*b*) The External Characters of *Thylacinus sarcophilus* and some related Marsupials.—H. Munro Fox: General Report on the Cambridge Expedition to the Suez Canal, 1924.—G. H. Lockett and W. S. Bristowe: Observations on the Mating Habits of the Web-spinning Spiders.

Institution of Civil Engineers, at 6.—T. B. Hunter and A. L. Ball: H.M. Dockyard, Rosyth.

Institution of Electrical Engineers (East Midland Sub-Centre) (at Leicester), at 6.45.—L. M. Jockel: Boiler Plant.

Royal Photographic Society of Great Britain (Scientific and Technical Group), at 7.—Dr. K. C. D. Hickman: A Chemical Aspect of Sulphide Sensitivity.—S. O. Rawling: The Sensitivity of Photographic Emulsions. Part II. Hydrion Concentration and the Silver Bromide-Thiocarbamide Complexes.

Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—W. W. E. French: Chairman's Address.

Institution of Electrical Engineers (North-Western Centre) (at Engineers' Club, Manchester), at 7.

Institution of Automobile Engineers (Wolverhampton Centre) (at Engineering Club, Wolverhampton), at 7.30.—G. F. Mucklow: The Effect of Reduced Intake-Air Pressure and of Hydrogen on the Performance of the Slow-Speed Solid Injection Engine.

Institution of Engineers and Shipbuilders in Scotland (at 39 Elmbank Crescent, Glasgow), at 7.30.—D. M. Shannon: Diesel Engines.

WEDNESDAY, November 17.

Society of Glass Technology (Anniversary Meeting) (at Sheffield University), at 2.45.—W. Butterworth, sen.: Presidential Address.

Electrical Association for Women (at 15 Savoy Street, W.C.2), at 3.—Miss M. Partridge: A Talk on Tariffs.

Royal Meteorological Society, at 5.—E. W. Bliss: The Nile Flood and World Weather.—D. Brunt: (*a*) An Investigation of Periodicities in Rainfall, Pressure and Temperature at certain European Stations; (*b*) The Period of Simple Vertical Oscillations in the Atmosphere.

Geological Society of London, at 5.30.—Dr. C. J. Stubblefield and Dr. O. M. B. Bulman: The Shineton Shales of the Wrekin District, with Notes on their Development in other parts of Shropshire and Herefordshire.

Institution of Civil Engineers (Students' Meeting), at 6.30.—J. E. W. Monkhouse: Address.

Institution of Electrical Engineers (South Midland Centre) (Wireless Section) (at Birmingham University), at 7.—Prof. C. L. Fortescue: Address.

Institution of Electrical Engineers (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.

Merseyside Aquarium Society (at 1 Falkland Road, Egremont), at 7.30.—A. Wilkinson and J. Gould: Exhibition of Pond-Life, etc., under the Microscope.

Royal Society of Arts, at 8.—T. Brough: Artificial Silk.

Institute of Chemistry (London and South-Eastern Counties Section), at 8.—Annual General Meeting.

C.B.C. Society for Constructive Birth Control and Racial Progress (at Essex Hall, Strand), at 8.—Dr. Marie Stopes: The Birth Control Movement To-day after an Eventful Year (Presidential Address).

Eugenics Society (at London Day Training College), at 8.—Discussion on Mental and Physical Deterioration; Differential Birth-rate. Chairman: Sir Bruce Bruce-Porter. Speakers: Dr. D. Ward Cutler and Dr. C. V. Drysdale.

Royal Microscopical Society, at 8.—Dr. H. A. Baylis: Pwdre Ser—The "Rot of the Stars."—M. T. Denne: A New Apparatus for Casting Paraffin Imbedding Blocks.—Dr. C. Tierney: Caballero's Technique for Mounting Diatom and other Type Slides.

THURSDAY, November 18.

Royal Society, at 4.—Special General Meeting.—At 4.30.—Major W. S. Patton and E. Hindle: Reports from the Royal Society's Kala-azar Commission in China. Nos. 1-5.—*To be read in title only.*—R. Hill: The Chemical Nature of Hæmochromogen and its Carbon Monoxide Compound.—H. Gremels and R. Bodo: The Excretion of Uric Acid by the Kidney.—Prof. C. H. Browning, Prof. J. B. Cohen, S. Ellingworth, and R. Gulbransen: The Antiseptic Properties of the Amino Derivatives of Styryl and Anil Quinoline.—T. S. P. Strangeways and F. L. Hopwood: The Effects of X-rays upon Mitotic Cell Division in Tissue Cultures *in vitro*.—Sir Charles Sherrington and R. S. Creed: Observations on Concurrent Contraction of Flexor Muscles in the Flexion Reflex.—Prof. S. B. Schryver and H. W. Buston: The Isolation of some hitherto undescribed Products of Hydrolysis of Proteins. Part III.—Prof. J. A. Crowther: The Action of X-rays on *Colpidium colpoda*.

Linnean Society of London, at 5.—Miss E. R. Saunders: A Remarkable Specimen of Matthiola.—The President: The Recent International Congress of Plant Studies, Ithaca, New York.—Miss A. R. Chesters: The Vascular Supply of the Bracts of Some Species of Anemone.

Royal Institution of Great Britain, at 5.15.—Dr. R. R. Marett: The Archæology of the Channel Islands. I.: Palæolithic Period.

Child-Study Society (at Royal Sanitary Institute), at 6.—Miss Barbara Low: The Cinema.

Institution of Electrical Engineers, at 6.—Dr. A. Ekstrom: The Applications of Electricity to Agriculture (Lecture).—J. W. Beauchamp: Exhibition of a Film entitled American Agriculture and Farm-house Electrification.

Institution of Automobile Engineers (London Graduates' Meeting) (at Watergate House, Adelphi), at 7.30.—S. Miall: Worm Gears.

Institute of Chemistry (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at North British Station Hotel, Edinburgh), at 7.30.—J. A. Watson: Some Chemical Aspects of Geology.

Chemical Society, at 8.—R. F. Hunter: The Unsaturation of Heterocyclic Ring Systems. Part I. The Benzthiazole and 1:2 Dihydrobenzthiazole System.—R. F. Hunter and H. Morland: The Unsaturation of Heterocyclic Ring Systems. Part II. The 2-amino 4-keto Tetrahydrothiazole System.—G. A. R. Kon and J. H. Nutland: The Chemistry of the Three-Carbon System. Part X. The Mobility of Some Cyclic Ketones.

Royal Society of Tropical Medicine (Laboratory Meeting) (at London School of Hygiene and Tropical Medicine), at 8.15.—Demonstrations by Drs. H. B. Newham, P. H. Manson-Bahr, C. M. Wenyon, H. H. Scott, J. G. Thomson, P. A. Buxton, J. W. A. Cameron, Aldo Castellani, C. A. Hoare, A. C. Stevenson, and H. M. Shelley.

Royal Aeronautical Society.—Flight-Lieut. R. S. Capon: Methods of Performance Testing and Analysis.—Major J. S. Buchanan: The Two-Seater Light Aeroplane Competitions, 1926.

Institution of Mechanical Engineers (at Manchester).—Prof. E. G. Coker: Elasticity and Plasticity (Thomas Hawksley Lecture).

Institution of Mining and Metallurgy (at Geological Society).

FRIDAY, November 19.

Tuberculosis Society (at Royal Society of Medicine), at 5.—Dr. Strandberg: The Treatment of Laryngeal Tuberculosis by Heliotherapy and Artificial Light.

Royal College of Physicians of London, at 5.—Dean Inge: Racial Degeneration (David Lloyd Roberts Lecture).

Society of Chemical Industry (Liverpool Section) (at Liverpool University), at 6.—F. H. Carr: Chemical Industry and its Relationship to Delicate Plant and Animal Products.

Institution of Mechanical Engineers, at 6.—T. A. F. Stone: Electric Locomotives: a Method of Classifying, Analysing, and Comparing their Characteristics.

Royal Photographic Society of Great Britain, at 7.—F. C. Tilney: Pictorial Tradition.

Photomicrographic Society (at 4 Fetter Lane), at 7.—Members' Evening.

Junior Institution of Engineers, at 7.30.—B. J. Axten: Short Wave Wireless Communication.

Royal Society of Medicine (Electro-Therapeutics Section), at 8.30.—Dr. W. J. Turrell: The Physico-chemical Action of Interrupted Currents in Relation to their Therapeutic Effects.

Society of Dyers and Colourists (Manchester Section) (at Manchester).—W. F. A. Ermen and S. H. Jenkins: The Action of Caustic Soda on Cotton Cellulose.

SATURDAY, November 20.

Royal Institution of Great Britain, at 3.—Rev. E. M. Walker: The Study of History (3).

British Mycological Society (at University College).

PUBLIC LECTURES.

SATURDAY, November 13.

Horniman Museum (Forest Hill), at 3.30.—H. N. Milligan: The Life of a Sea-Urchin.

SUNDAY, November 14.

Guildhouse (Eccleston Square), at 3.30.—Dr. E. E. Fournier d'Albe: Eyes and Ears of the Future.

MONDAY, November 15.

Royal Institute of Public Health, at 4.—Prof. W. W. C. Topley: Quantitative Experiments in the Study of Infection and Resistance (Harben Lectures). (Succeeding Lectures on November 18 and 22.)

Royal Society of Medicine, at 5.15.—Prof. H. J. Fleure: Racial Characters of the Human Skin and Racial Types in relation to Health (Malcolm Morris Memorial Lecture).

Birkbeck College, at 5.30.—Dr. E. Deller: University Education in the United States.

TUESDAY, November 16.

King's College, at 5.30.—A. H. Hannay: The Modern Problem of Form and Content in Art.

WEDNESDAY, November 17.

Parents' National Educational Union (at Shelley House, Chelsea Embankment), at 5.—Dr. Elizabeth Sloan Chesser: The Development of Personality.

London School of Economics and Political Science, at 6.—S. Downes: The Uses of 'Powers' Machines.

THURSDAY, November 18.

College of Nursing (Henrietta Street, W.1), at 5.30.—Dr. J. A. Hadfield: The Contribution of Psychology to Social Hygiene.

King's College, at 5.30.—Prof. A. P. Laurie: Modern Research on Fifteenth-Century Methods of Oil Painting, and its Application to the Work of Modern Artists.

University College, at 5.30.—Miss E. Jeffries Davis: Some London Place Names. (Succeeding Lectures on November 25, December 2, 9, and 16.)

FRIDAY, November 19.

University of Durham College of Medicine (Newcastle-upon-Tyne), at 4.45.—Dr. C. Singer: The History of Medicine.

London School of Economics, at 5.—Prof. Cyril Burt: The Vocational Adviser and the Young Delinquent.—A. E. Cutforth: Amalgamations. (Succeeding Lecture on November 26.)

Institute of Chemistry, at 8.—F. C. Robinson: The Chemist in the non-Ferrous Metallurgical Refinery (Streatfeild Memorial Lecture).

SATURDAY, November 20.

Horniman Museum (Forest Hill), at 3.30.—H. MacLeod: Eclipses of the Sun.

SUNDAY, November 21.

Guildhouse (Eccleston Square), at 3.30.—Dr. G. C. Simpson: Meteorology in the Service of Man.

CONGRESS.

November 16.

National Conference on Milk in relation to Public Health (at King George's Hall, Caroline Street, W.C.1).

SATURDAY, NOVEMBER 20, 1926.

CONTENTS.

PAGE
Science and Spiritualism 721
Education, Science and Mr. H. G. Wells. By Prof. Henry E. Armstrong, F.R.S. 723
Our Bookshelf 728
Letters to the Editor:
The Structure of Catalytically Active Copper.—Dr. F. H. Constable 730
Magnetic Properties of Single Crystals of Nickel.—W. Sucksmith and Dr. H. H. Potter . . 730
Invention as a Remedy for Unemployment.—W. A. Benton 731
A Breeding Ground for the Nursehound (*Scyliorhinus stellaris*) in the Fal Estuary.—Dr. J. H. Orton . 732
Application of the Drop Weight Method to the Determination of the Surface Tension of Colloidal Solutions.—Prof. William D. Harkins . . 732
Tertiary Man in Asia: The Chou Kou Tien Discovery.—Dr. Davidson Black. 733
Action of Magnetic Fields on the Refractive Index of Carbon Dioxide Gas.—Prof. P. N. Ghosh and P. C. Mahanti 734
Electron Displacement *versus* Alternate Polarity in Aliphatic Compounds. Prof. G. Berger . . 734
Science and Psychical Research.—Dr. R. J. Tillyard, F.R.S. 735
Active Nitrogen.—E. J. B. Willey 735
Liveing's Fire-damp Indicator.—Sir W. Galloway 735
The Imaginary Roots of Equations.—Dr. H. C. Pocklington, F.R.S 735
Reflex Regulation of Posture. By Dr. F. M. R. Walshe 736
Some Recent Advances in Astrophysics. By Prof. E. A. Milne, F.R.S. 738
Obituary:
Prof. W. J. Hussey. By F. W. D. 740
News and Views 741
Our Astronomical Column 745
Research Items 746
Progressive Lightning. By Prof. C. V. Boys, F.R.S. 749
The Detection of Icebergs. By C. S. W. . . 750
The Total Solar Eclipse of January 14, 1926 . . 751
Dopes and Detonation 753
University and Educational Intelligence . . . 753
Contemporary Birthdays 754
Societies and Academies 754
Diary of Societies and Public Lectures . . . 756

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Science and Spiritualism.

THE recent correspondence in our columns on the attitude of men of science towards psychical research—particularly that branch of it which is usually called the 'physical phenomena of spiritualism'—has made it clear that the divergence between the two main views is as great as ever and shows no sign of compromise or conciliation. No useful scientific purpose would be served, therefore, by the publication of further letters on the subject.

The conservatism of official science in these matters is not unnatural. The conflict between the determination to accept only that which is based on irrefragable evidence, and that which relies on 'authority' and tradition, is as old as science itself. This conflict is as stern now as it ever was, and certain elements have lately arisen which enjoin a redoubled vigilance. The War gave a great impetus to the shadier forms of spiritualist activity and incidentally endowed unscrupulous mediums with large material resources. It is not surprising that these resources have encouraged the founding of 'psychic colleges' with resounding titles, and given a spurious air of scientific authority to the ordinary round of mediumistic pursuits. The capture of the citadel of official science would remove the last obstacle to the domination of public affairs by the new cult.

The distinction between spiritualism and psychical research is a somewhat artificial one. Spiritualism was the inspiring and driving force which founded the Society for Psychical Research in 1882. The S.P.R. founders were largely the Fabians of spiritualism. Their object was to sift the physical and mental phenomena of spiritualism and to sort out those to which they could give their adherence without loss of self-respect or scientific standing. The results of the labours of this Society have been published in thirty-six stately volumes, covering such varying subjects as hallucinations, telepathy, levitations, duplex personality, and haunted houses.

The late Sir William Crookes devoted four years to spiritualistic investigations (from 1870 until 1874) and announced the most amazing results. He then closed that chapter for the rest of his life, for reasons which, owing to the deliberate destruction of the necessary documents, it is now impossible to gauge. The forty-six years' activity of the S.P.R. has failed to duplicate Crookes's phenomena, or indeed to shed any light on them at all. With the doubtful exception of some sittings with Eusapia Paladino in 1909, and a few recent experiments not yet concluded, the evidence, for example, for telekinesis ('table-turning') and 'teleplastic' (or 'ectoplastic') structures has been entirely negative.

Nor can the evidence accumulated elsewhere be said to be more convincing. The work mostly quoted in favour of the existence of 'teleplasm' is Dr. von Schrenck-Notzing's "Materialisationsphänomene," which gives several hundred photographs of this mysterious substance. This work was of sufficient importance to lead to the study of its author's medium by the S.P.R. and by a Committee of the University of Paris. The official reports of both these bodies pronounced the phenomena observed to be quite inconclusive. Another attempt made by an academic body, this time the University of Vienna, to corroborate such phenomena, led last year to an equally pronounced failure. Thus Crookes's failure to convince the Royal Society may be said to have been the precursor of a consistent series of similar failures.

The tragic case of the late Dr. W. J. Crawford, of Belfast, is instructive. Here was a university lecturer of some distinction whose leaning towards mysticism made him an easy victim of a family of artisans with alleged mediumistic faculties. He devoted four years to their examination and endeavoured to duplicate and surpass the records of Crookes and Schrenck-Notzing. The 'invisible operators' who ruled the procedure led him on step by step until his records became the very travesty of scientific method, and gross imposition was presented in terms of his own psycho-physical guesses and speculations. When his career ended in suicide and an attempt was made to repeat his results, the repetition, which duly occurred, only served to reveal the *modus operandi* of the 'circle,' which was anything but spiritual. Such a *dénouement* is not, of course, unknown in purely physical science. Blondlot's *N*-rays were the subject of some fifty scientific papers, and his 'discovery' was recognised by the award of a substantial prize by the Paris Academy of Sciences. It is only natural that the caution wisely displayed by many physicists with regard to *N*-rays should be doubled and trebled when certain phenomena long discredited are presented in a new guise even on apparently unimpeachable authority.

Sir William Crookes in 1874 walked about in a well-lighted room with what he believed to be a 'spirit' on his arm, a 'spirit' resembling a girl of eighteen. No such amazing privilege has been vouchsafed to any man of scientific eminence since then. The phenomena obtained by scientifically trained observers have been poor in comparison with that high-water mark. This may be due to their 'unsympathetic' attitude, or it may be due to a wider knowledge of the chances of error and the means of deception. Investigators in search of ectoplasm have to be content with what looks like skin-bags or lengths of chiffon. As the control becomes stricter the results become poorer. When the control becomes rigid the phenomena cease altogether. Tha is the general rule, and it admits of only one interpretation.

The demands made upon the scientific investigato are nowhere more severe than in the cases of 'spiri photography' and the 'direct voice.' As the spiri 'extras' are not visible to the ordinary observer, we must suppose that they do not reflect ordinary light and are to that extent immaterial. Spiritualists usually meet this argument by saying that the effect on the photographic plate is not produced by light of any known wave-length but is a direct action on the plate itself. We must, therefore, assume that the invisible or disembodied artist can draw a likeness of a deceased friend of the sitter on the plate in such a way as to produce a correct negative. The difficulty of this feat is greatly increased if we remember that clairvoyants claim to see these spirit friends hovering about the sitters in the very attitudes shown on the photographs. Rather than face the innumerable difficulties in the way of a consistent theory conforming to the spiritualist view, most investigators will prefer to regard all so-called spirit photographs as examples of the almost numberless methods of deception which may be, and have been, practised in this most elusive department of spiritualist activities.

In the case of the 'direct voice,' we are confronted with even more formidable difficulties. There is nothing more 'spiritual' or less 'material' about a voice than there is about a brick wall, though the unscientific person may think otherwise. Where exactly does the material nature or structure of the direct voice begin? Do the spirits produce the necessary air waves direct at some focus in the air? One spiritualist view often met with is that the 'spirits' materialise a larynx and sufficient in the way of lungs and mouth cavities to produce the sounds heard. This does not make the matter any clearer. It is much easier to assume deception, more especially as fraud in this case is easy and 'convincing' and control extremely difficult, owing to the lack of orientation shown by most human ears in the dark. Here again the *onus probandi* must weigh heavily on those who claim that there is positive evidence.

The difficulties placed in the path of the observer all tend to make control more difficult and deception easier. Modern mediums work in total darkness or the dimmest of red light. The observer is not allowed to prescribe conditions. So long ago as 1880, Mr. Stainton Moses, an eminent spiritualist, said: "In 99 cases out of 100, people do *not* get what they want or expect. Test after test, cunningly devised, on which the investigator has set his mind, is put aside, and another substituted." Mediums may, by the rules of the game, fail as often as they like and substitute other tests of their own devising. The patience displayed by expert investigators during some of their test sittings is astonishing. Hour after hour will go by without anything happening. The medium will fall asleep and wake up again. When anything does happen, if only the production of a rubber film (or something resembling it) from the mouth of the medium, it is eagerly scrutinised and carefully recorded.

Nobody can complain of unwillingness on the part of scientific men to investigate any phenomena offering a chance of extending the boundaries of knowledge, and the rewards, both material and social, of any such extension are very great. But after half a century of growing disappointment with spiritualistic phenomena, the number of qualified volunteers naturally shows signs of diminution. On the other hand, the flood of charlatans and impostors increases day by day. The 'new revelation' imported from the United States in 1852, with its combination of 'supernormal' telegraphy with Pentecostal gifts and Delphic oracles, has obtained almost undisputed sway over the mind of the masses thirsting for signs and wonders and determined at any price to believe.

It is for science to stem the tide of superstition and sift the true from the false. We are quite justified in assuming, with Sir Oliver Lodge, that man's future outlook on the universe will be very different from the orthodoxy of 1926. Such an evolution is bound to take place even on purely physical grounds, as indeed is shown by the prodigious changes in physical conceptions since 1895. But the fundamental principles of the scientific method will not change, and no set of phenomena which depends for its occurrence, not upon ascertainable laws, but upon the whim of invisible operators not amenable to a court of law, can appropriately form part of the subject matter of natural science.

In spite of all failures and discouragements, it is highly desirable that a competent body should exist for making out a *prima facie* case in favour of any alleged new phenomena of the class we are discussing. Such a body we have in the Society for Psychical Research, which has admirably fulfilled its functions in spite of material limitations such as do not hamper the wealthy 'colleges' of spiritualism. This Society has already done good work by its study of telepathy, hallucinations, and duplex personality. It includes people of the most diverse views, and can be relied upon to welcome any evidence of really unknown phenomena. It might possibly be associated usefully with the recently formed National Laboratory of Psychical Research, which is equipped with the means of studying psychical and related phenomena, but that should be easily arranged if desired. In the present state of this matter it is wisest and best for official science to wait for the recommendation of such a society before devoting any attention or labour to alleged 'supernormal' occurrences. The very use of the word 'supernormal' instead of 'abnormal' suggests that these occurrences belong to an order raised above the normal order of the universe (which would, of course, remove them from the province of science). That there may be such a supernormal order of things no philosopher can *a priori* deny, but the use of the word is too unpleasantly suggestive of a hieratic domination now happily overcome to be palatable to scientific men, and they will hesitate before installing the 'medium' in the high place from which, after much fighting and suffering, they have driven his ecclesiastical predecessor.

Education, Science and Mr. H. G. Wells.

The World of William Clissold: a Novel at a New Angle. By H. G. Wells. Vol. 1. Book the First: *The Frame of the Picture;* Book the Second: *The Story of the Clissolds—My Father and the Flow of Things.* Pp. 245. 7*s.* 6*d.* net. Vol. 2. Book the Third: *The Story of the Clissolds—Essence of Dickon;* Book the Fourth: *The Story of the Clissolds—Tangle of Desires.* Pp. 247-601. 7*s.* 6*d.* net. Vol. 3. Book the Fifth: *The Story of the Clissolds—The Next Phase;* Book the Sixth: *The Story of the Clissolds—Venus as Evening Star;* The Epilogue: Note by Sir Richard Clissold. Pp. 603-885. 7*s.* 6*d.* net. (London: Ernest Benn, Ltd., 1926.)

ALTHOUGH the critics have not been stirred by volumes 1 and 2 of William Clissold's achievement, there should be wigs on the green over volume 3, if it be not above them. Book V. is masterly in many ways—the less said of VI. the better, perhaps. No writer, other than the author, could have preferred the indictment he does against our public-school system and the ancient universities.

The attempt is made, in a preface, to justify the contention that the book is a novel: there is no novel in it: true it is, the story is told, ostensibly, by one William Clissold or through his brother Dickon but William is himself again, as he ever will be: from beginning to end, we are dealing with autobiography and early in the recital the writer gives himself away in saying—"Autobiography, provided that it be not too severely disciplined may be an almost inexhaustible occupation. Nothing is altogether irrelevant. Whatever interests me or has ever interested me is material." This, in a few clear words, is the book. It is a medical treatise—largely on social pathology.

The author is a photographer, working with a lens stopped down to a low aperture but of no great depth of focus, giving very clear pictures of superficial appearances. A photographer neither analyses nor constructs—he must record what is before him. However much he may fake his picture in development, out in the open he must take what is offered him by Nature and, at most, can await a favourable light and so play with the shadows.

At the moment there is what amounts to little short of a conspiracy to represent science and religion as moving along the same path. They never can, unless and until we make a religion of our knowledge and recognise that, therefore, religion must be imperfect and ever correcting and shifting its boundaries. Science is ultimately the search after truth. Who can say what religion is? For every one the word has a different meaning. Our William, be it remarked, is a little fuzzy in his high lights. He can't be satisfied with what he has and may have and then leave it to the other fellow to have his turn, but hankers for more. He is so spoilt by frequent reprinting, that he must contemplate a new edition of himself, no doubt with special binding:

> "To me it is far easier to suppose that this present unfolding of consciousness and will is only a birth and a beginning and that I am not merely myself but a participator in a Being that has been born but need not die."

Surely, he is here but seconding a vote of thanks to "that chap Oliver Lodge." Still, "belief in a living personal God—slight vestiges": we all have more or less as an ineradicable inheritance from primitive man.

The lapse into such anthropomorphism is proof how difficult it is for intelligence to prevail over convictions forced upon youth. The great problem before us soon in schools will be—how far we are entitled to go in retarding and repressing mental growth by forcing an 'established faith,' without explanation or qualification, upon children: whether parent and especially teacher be justified in misleading by baldly repeating assertions which have no authority other than tradition. The struggle is between knowledge and ignorance. Our William defines the position clearly and boldly:

> "I do not know how Protestantism will end. But I think it will end. I think it will come to perfectly plain speaking and if it comes to perfectly plain speaking it will cease to be Christianity. There is now little left of the Orthodox Church except as a method of partisanship in the Balkans. The League of Nations may some day supersede that and then the only Christianity remaining upon earth will be the trained and safeguarded Roman Catholic Church. That is less penetrable, a world within a world, it shields scores of millions securely throughout their lives from the least glimpse of our modern vision."

Teachers of science, and examiners, are equally concerned. Over and over again, when advocating *the teaching of scientific method*, I have been told by my friends—"You must teach something definite: students ask for assurance and will not countenance any philosophic doubt": examiners, too, ask for positive answers. Tennyson's lines are not yet accepted even of science:

There lives more faith in honest doubt,
Believe me, than in half the creeds.

The attitude of all the schools is not merely unscientific but is one tending to systematise untruthfulness. Our William, at least, can think of better times:

> "I can discover in all my world nothing enduring, neither in the hills nor in the sea, nor in laws and customs nor in the nature of man, nothing steadfast except for this—a certain growth of science, a certain increase of understanding, a certain accumulation of power. But there is that growth of science, there is that increase of understanding, there is that accumulation of power. I do not know why it should be so but so it is. It gathered its force slowly before man was. It goes on now with accumulating speed and widening scope and on it I build my working conception of the course of life. Man, unconscious at first, begins now, in an individual here and an individual there, to realise his possibilities and dream of the greatness of his destiny. A new phase of history is near its beginning. But it has not begun. Such science as we have brings us suggestions rather than direction."

William Clissold is not all religion, though considered under the conventional classification of *Wein, Weib* and *Gesang*, it has a limited range of subject. Wine is only once referred to—a single bottle of Château Margaux 1917, not a great vintage, produced at lunch by Sir Rupert Yorke. Still, this suffices to incite William's reflections upon Sir Rupert's sexual and religious outlook. It appears also to have led him to refrain from referring to certain questions he had intended to raise—the projected exchange of opinion would have been "as possible as with a pensive lion in the zoo." Pity it is perhaps that he has not met with more pensive lions in the course of his career and has not thereby been forced to concentrate upon some definite line of action.

After an over-full dose of *Weib*, we get music in the form of a study of futurism. Our William's swansong foreshadows a metamorphosis of mankind—new ways of living—one terrestrial anthill: this he regards as the necessary, the only possible, continuation of human history. He contemplates the organisation of a central police bureau to co-ordinate the protection of life, property and freedom throughout the world, without distinction of persons under an universally accepted code. In fact, the lions and lambs are all to lie down comfortably together. The coal strike was only begun when the book was issued. The history of Ireland, the love lost between the States of Europe, the growing development during many years past of local self-government in Great Britain—such items are left out of account.

The men of large material influence are to reconstruct the world upon broader, happier and finer lines. Their first struggle is to be with the Press. Civilisation must be by newspapers. Open, candid, full and generous, these are the qualities the newspaper of the new life must possess. It must suppress nothing. It must bring to every mind capable of receiving it the new achievement of human and organising power, the victories of conscious change. The daily papers of educated people half a century ahead may be a tenth of the size and ten times the price of the present "wildly flapping caricatures of contemporary happenings." The Press apparently is to be the work of the men of affairs. Our William says, quite truly, the daily paper is a daily disappointment—but to how many? He has found but one newspaper that comforts his soul and that is NATURE, to which flattering reference is made. "Domestic bye-products," such as sons, will have to justify their sonship—there is to be a diminution of inheritance in property. The new social life will be aristocratic in the sense that it will have a decisive stratum of pre-eminent and leading individuals who will wield a relatively large part of the power and property of the community but it will be democratic in the sense, that it will open to every one with ability and energy to join that stratum and participate to the extent of his or her ability or energy. In the formal picture presented to us of the world republic, we shall be fully adult—a state to which few come now, doubtfully and each one alone:

> "We shall put away childish things, childish extravagances of passion and nightmare fears. Our minds will live in a living world-literature and exercise in living art; our science will grow incessantly and our power increase. Our planet will become like a workshop in a pleasant garden and from it we shall look out with ever-diminishing fear upon our heritage of space and time amidst the stars. We shall be man in common and each one of us will develop his individuality to the utmost, no longer as a separated and conflicting being but as a part and contribution to one continuing whole."

Who shall say that our author is not an optimist and Holist?

The contemplated metamorphosis of mankind, our William contends at an early stage of his dream, demands a life based on broader and sounder common ideas, expressed in new terms and new artistic forms, accompanied by nervous and other physiological changes. This necessity to change and expand extends from man's soul to man's chemistry.

It is strange that a reader of NATURE and a pupil of the Royal College of Science should be so Lamarckian as to proffer such doctrine or believe that it can be realised within any period that is worth our consideration. The lesson of Tutankhamen's tomb seems to be lost upon him. Obviously, he has little knowledge of what is known in science. We have learnt sufficient of man's vital chemistry *to know*, that it proceeds along lines which are little short of fixed. This must be so. If open to variation away from our type, we should be all over the shop, to use a vulgarism. Still, the human mind is strangely variable—subject at all times to the caprice of chemical change, every function apparently controlled by a chemical secretion. The woman, at regular intervals, we know, is heavily drugged. Male desire, of which our William has much to say in Book VI., is probably of chemical origin, due to chemical changes induced by mental processes.

Coming down to sense; human control of the world, as our William says, has been a control in detail; there has been no comprehensive control—because there has been no comprehensive understanding. Hence his indictment of our educational system in Book V. It is worth noting, he makes the point, that the mind of youth is the primitive, medieval mind—conservative and reactionary:

> "Few minds are mature enough and stout enough before thirty to achieve a genuine originality. The originality of the young is for the most part merely a childish reversal of established things. The independence of the young is commonly no more than a primitive resistance to instruction. The youthful revolutionary is merely insubordinate and his extremist radicalism an attempt to return to archaic conditions, to naturalism, indiscipline, waste and dirt. The youthful anti-revolutionary turns back to mystical loyalties and romance."

It is necessary to educate the young for the new order. Sections 14 and 15 on supersession of schoolmasters and an inquest on universities must be studied to be appreciated—almost every word is telling. On an experience of sixty years, I am prepared to vouch for the substantial accuracy of the indictment. Much that is said, I have said over and over again.

Present-day education is nothing short of a pretentious farce—taking into account the changed and fast-changing state of the world. It promotes inaction, where action is needed above all things. It degrades and only accidentally promotes intelligence. It is in the hands of a class of men who are eyeless to the needs of the times, of men who never will respond to the call that is now made upon the teacher. Yet parents and guardians smugly accept what is and make no attempt to improve the conditions. Even our William, being a man of words, only half sees what is, what might and what should be. Education was begun in the monasteries, to serve clerical ends. We have long since got rid of monasteries—Henry VIII. did that for us. It were now time that we abolished the monastic in education. Only don't let us substitute co-education, the emasculating invention of the Evil One. The effect of the monasteries was of small account in comparison with that now being exercised by the survival of the system of training they instituted—it will yearly become a greater peril to us. Our William is explicit on this point:

> "... the last human beings in the world in whom you are likely to find a spark of creative energy or a touch of imaginative vigour are the masters and mistresses of upper middle-class schools ... these schoolmasters and schoolmistresses, ... to whom we entrust nearly all the sons and daughters of the owning and directing people of our world, are by necessity orthodox, conformist, genteel people of an infinite discretion and an invincible formality. Essentially they are a class of refugees from the novelties and strains of life. I do not see how, as a class, they can be anything else. ... The whole crowd of upper-class youth has been picked over again and again before the schoolmasters come; the most vigorous and innovating men have gone in for diplomacy, the law, politics, the public services, science, literature, art, business, the hard adventure of life; and at last comes the residue. ... Its [the school's] mentality is the mentality of residual men.
>
> "That is a neglected factor which has to be reckoned with in the history of the British Empire during the last hundred years. That is something the foreign observer has still to realise. A larger and larger proportion of its influential and directive men throughout this period have spent the most plastic years of their lives under the influence of the least lively, least enterprising, most restrictive, most conservative and intricately self-protective types it was possible to find. We have bred our governing class mentally, as the backward Essex farmer bred his pigs, from the individuals that were no good for the open market. The intelligent foreigner complains that the Englishman abroad has been growing duller and stiffer in every generation."
>
> . . . .
>
> "The clue to the manifest change in character that Britain and its Empire have displayed during the last hundred years, the gradual lapses from a subtle and very real greatness and generosity to imitative imperialism and solemn puerility is to be found, if not precisely upon the playing fields of Eton, in the mental and moral quality of the men who staff the public schools."

A true bill. Italy, the one country where there is government, has no public schools. No other explanation is possible of the way in which the courage is gone out of us—of our loss of the art of government, the courage to govern, never more obvious than in the present coal strike—of the disappearance of the naturalist—of the decline of industry, *e.g.* the textile trade. The schools, to-day, it should be added, are greatly aided: golf and the motor-car serve to complete their insidious effect upon character.

Our William is nothing if not thorough—he would improve the public school and schoolmaster out of existence but recognises the need and desirability, under our present social condition, of schools of the preparatory class, largely staffed by women and not very big, where children up to fifteen could have a quasi-family life. (*N.B.*—The public school gone, these would be rid of the curse of the 'Common Entrance' examination.) From fifteen onwards, the more directly a boy lives in contact with the real world, the better alike for the real world and himself. The reality of education for every one over fourteen, in a modern state, lies more and more outside any class-room; the fewer the school-made values a boy has, the juster will be his apprehension of reality. The new system will be one of special schools, studios and laboratories for arts, sciences, language and every sort of technical work. The style of work will be new.

All this is essentially sane. I saw the danger in early days and went so far as to express my opinion by saying, that I would not send my sons to a public school to save their lives and kept my word but was lucky in having at my door what was long, probably, the best day-school in London, if not in the country. I have also always held, that seventeen was the *very latest age* up to which a boy should be kept under monastic school conditions. I took my four boys away at that age and sent them to places of higher instruction, *where they were free to become men.* I have every cause to be satisfied: they may not be saints but neither are they serious sinners and the kick has not all been taken out of them.

The *Times*, on October 13, contained a most feeling obituary notice of Dr. E. A. Abbott, long well known as headmaster of the City of London School and a noted scholar. He is brought into comparison with F. W. Walker, the famous headmaster of St. Paul's School. We are told that Abbott, who relished Walker's half-cynical frankness of speech, used to relate how the latter showed him over his grand new school buildings at Hammersmith and how, when he (Abbott) expressed his admiration of everything and especially of the magnificent chemical laboratories, Walker replied: "Yes, they are all very well in their way; but, as we two are alone here, I may venture to say (lowering his voice to a confidential whisper) that you and I know that this sort of thing *is not education.*"

Surely such an episode is disgraceful to both men. If 'this sort of thing' were not education, why introduce it? If introduced, surely it was the headmaster's duty to see it made education. That two such men were able to scoff at a discipline that furnishes the key to the comprehension of life is but proof of the hopeless narrowness and impenetrability of the classical and literary mind. Their attitude is that of most if not all our headmasters. 'Science,' we know, is a failure in schools—are the headmasters doing anything to improve the teaching, knowing as they must that to-day its dictates dominate the world?

Our William has something to say about science specifically but first let it be noted, that he extends his scepticism about schools to universities, particularly to "the universities for juveniles like Oxford, Cambridge, Harvard and Yale." We are all alive to the fact, that these are continuation boarding-schools, not free institutions as are the German universities. He is justified in his indictment, that there is a growing discontent with Oxford and Cambridge among those who have undergraduate sons—"sending their boys trustfully and hopefully to these over-rated centres, they find themselves confronted with pleasant, easy-going evasive young men up to nothing in particular and schooled out of faith, passion or ambition." I have said already, our William is an incomparable draughtsman. We must be prepared, he considers, to cut out this three or four-year holiday at Oxford or Cambridge and their American compeers from the lives of the young men we hope to see playing leading parts in the affairs of the world. So do I. We shall not get through with youths that are born tired, without method in their minds, such as we have to-day, who lapse into 'research' but make it an armchair occupation and put neither heart nor guts into the work.

To pass to specific science, our William's presentation of the Royal Society is of a piece with his appreciation of the universities. Perhaps it is worth while occasionally to see ourselves as others see us. He reports a meeting with his brother Dickon, at which the brother fingers his first paper in the *Phil. Trans.* The comments he makes are amusing and delightful parody.

> "'Blastopore of the snail,' he objected. 'Fancy poking about at the blastopore of the snail! It's—indelicate. And cryo-hydrates! This chap Oliver Lodge seems to be all over them. Wonder what they are. Well, this is your affair, Billy. It's up to you to display the name of Clissold properly in these Philosophical Transactions. If that is the end of life. Not my pitch. Not in the least my pitch. I wouldn't try to see even a stethoscope through these Philosophical Transactions. No.'"

This is a confirmation, from outside, of the view I have often expressed, that the *Phil. Trans.* spell cremation, the *Proceedings* 'decent burial' of scientific discovery.

The brother, who has made his fortune out of advertising, then suggests giving the "dull old Philosophical Transactions" a real spirited Xmas number, a genuine advertisement display, with which "Temptation of St. Antony" won't be in the same field. The final opinion expressed by Dickon, to meet his brother's objection, that advertising would be vulgar, is again a noteworthy criticism:

> "'If there's anything vulgar about modern advertising it's because it's been so concerned about pills and soap and pickles. Just a passing phase. A man or a class or a religion or—anything that will not advertise isn't fit to exist in the world. It means it doesn't really believe in itself. To want to exist and not to dare to exist is something beneath vulgarity. . . . That's why I have such a contempt for your rotten, shy, sit-in-the-corner-and-ask-the-dear-Prince-of-Wales-to-dinner-once-a-year-Royal Society. If the soap-boilers did no more for soap than your old Royal Society does for science,' said Dickon, 'nobody would wash.'"

Formerly, the opinion of the Society was often consulted in matters of importance to the State; now, the Department of Scientific and Industrial Research is more and more usurping this office. The individual original scientific worker, like the naturalist, may easily soon be ruled out of existence and an unimaginative being put in his place. We confine our activity to publishing work which is either largely premature and unfinished or even better left unpublished. Few attend the meetings and, at these, soft nothings are said and no one dare criticise. "We work submerged, we talk by no more than twos and threes," says our mentor. This is the way of the Society. It cannot be brought, it makes no attempt, to realise, how essential it is to organise the forces of science into a living body—what it could do if it formed itself into a great consultative scientific House of Peers. The only office it effectively serves is that of back-patting and bemedalling the supposed élite of the craft.

As our William truly remarks, "No great creative development can go on in modern social life beyond a certain point without a literature of explanation and criticism." We have no such literature: the result is that work is done and little use made of it. We keep no more than a casual profit-and-loss account and never seek systematically to balance our books. Our knowledge is never properly sifted and sorted and its values determined—no logical order is observed in filling in the blanks.

May it not be true that few would wash, if no more were done for soap than we do collectively for science? Is it policy to go on producing, paying insufficient attention to quality and demand, without taking proper steps to popularise and sell? Industry, to-day, we know is largely engaged in producing and forcing the sale of unnecessary goods: this is the manufacturers' conspiracy. If we are not coming very near to producing goods and leaving them to rot, we are doing little to secure digestion of the food we provide. We finish nothing. To take an example. Cane sugar is now made, all but pure, in millions of tons and yet chemists cannot tell the manufacturer what it is—how its atomic bricks are built together. Children are put to such work, not experts: to-day, these are engaged in the study of poison gases.

Research work is fast being made an entirely selfish, narrow occupation, when not carried out for industrial purposes. A bureaucratic class of academic workers is fast growing up, fit for little more than drawing-room service, without practical outlook. We need a few Fords to introduce efficiency into the research machine—Mr. Ford is said to have a greater annual turnover of work-people than any other employer, which means that he takes the efficiency of the worker into account: our up-growing civil service, research system does not: the threatened result is that 'research' will become a merely parasitic occupation. The term will disappear from the field of practice.

We work submerged, says our William. We hand on our impressions and vague intentions only by the most fragmentary hints. In education nothing is done to record, preserve and utilise successful trials of method. Sanderson left no record of method behind him and to-day, apart from his buildings, Oundle has nothing to show of his influence—it has reverted to the primitive school type. His Home of Vision has no vision in it. One teacher succeeds another without ever considering his predecessor's methods. The Finsbury Technical College was proclaimed a success but its methods are on the dust heap.

Before attempting to form a world directorate, we need to run our own little shanty: to take notice of one another and be sympathetic and work together to make it really habitable for all. Not only leaders are needed but the apparatus also is not there. It is all very well to repeat Carlyle's saying, that the modern university is an university of books—the books are not there. Even in leisure hours, you cannot live on the dull-as-ditch-water-doings of a no-sight family, with or without spoons. Writers of the day have no knowledge within them to use, thanks to their schooling. Here is our William's future opportunity: he is only fifty-nine and has time to turn over many new leaves. Let him write up to his professions, to show, if possible, how the new and necessary knowledge may be brought home to youth and made of some general avail. He has recognised his and our limitations, in his preface, in a single line, which is probably the most significant in the book, in saying of men of the type of "the devout Mr. Belloc, the aristocratic Duke of Northumberland, the political Mr. Ramsay MacDonald," that he can only comment upon such types. *Their ultimate processes are inconceivable to him.*

We are all cryptic beings and no one of us is open to the complete inspection of his fellow-man. We differ vastly in mentality. This is why Oxford is obdurate and will teach nothing that is needed by the world to-day. The word-slingers it trains throw from empty slings—at times perhaps a few very beautiful stones from the past but not the bullets of to-day. By a strange process, by securing control of the schools by men of its own type, it has made itself a community of one type of mentality, with but few escapes from its rigidity: the mechanism for the appreciation of modern things is not built into the type. We shall never improve our system of education and make it fit the needs of the times until we take into account, in the most liberal manner possible, the strange variability of the human mind. Society being composed of all sorts and conditions of men, to provide for all will always be very difficult, the less, however, the more we are alive to the differences and not too immodest in our individual opinions.

HENRY E. ARMSTRONG.

Our Bookshelf

A Practical Treatise on Outbreaks of Fire. By Sidney Gompertz Gamble. Pp. xii + 543. (London: Charles Griffin and Co., Ltd., 1926.) 30s. net.

THE author of this book held for twenty-six years the position of second in command of the London Fire Brigade, and prior to this had the experience of seventeen years as borough surveyor and chief officer of the fire brigade in a provincial town. The knowledge thus obtained and embodied in his book causes it to appeal strongly to members of fire brigades and to all concerned in minimising fire risks. The volume is divided into five parts dealing respectively with (1) natural science, legal and general matters; (2) fires and their causes, together with insurance; (3) means of suppression, material and personnel; (4) fire prevention and construction of buildings from the fireman's point of view; (5) miscellaneous matters. Besides providing a great deal of information with which the fireman in service ought to be acquainted, presented in a form which he can appreciate and use, the book contains much that is of interest to the layman. The section dealing with the causes of fires makes very interesting reading, and many of the various cases are illustrated by photographs; this section also deals in detail with dangerous trades, and discusses the precautions which should be observed in them. Another section contains much that will be of value to the officer whose duty it is to report on suspected cases of arson and incendiarism. Fully illustrated details of automatic and other systems of fire notification are included as well as sprinkler systems.

A feature of the book which assists in rendering it very readable is the historical notes freely scattered among the pages. The illustrations of fire appliances from the earliest times down to those in present use are extremely good, and the historical account of the progress of the fire-engine is especially interesting. The principles on which modern pumps work are explained adequately, and multiple centrifugal pumps are included. Fire prevention and panic in places of public resort is a wide subject which concerns the whole community, and the author devotes a great deal of space to it. Such buildings are classified, and each type is treated separately. Remembering the wide experience which Mr. Gamble has had in London, his opinions must be taken as authoritative, and will be invaluable to surveyors under public bodies. We have nothing but praise for this book, and consider that the author has rendered service, not only to the members of his own profession, but also to the public, in presenting so much that is of value in such an acceptable form.

Ergebnisse der exakten Naturwissenschaften. Herausgegeben von der Schriftleitung der *Naturwissenschaften.* Fünfter Band. Pp. iii + 329. (Berlin: Julius Springer, 1926.) 21 gold marks.

THIS collection of articles by leading continental men of science possesses a great amount of interest for students of physical science, both pure and applied. Thus, we have an article on planetary radiation by Prof. Schoenberg, which is followed by a comprehensive treatment of the measurement of photographs by Dr. Seliger, and by an article on dynamic meteorology by Prof. Wegener. Prof. Bjerrum gives a very interesting account of the electric forces between ions and their effects, and Prof. Pringsheim gives an account of work on the photo-electric effect in gases, in which he describes the recent work of Foote, Mohler, and Auger. The article on atomic disintegration, by Dr. Kirsch, gives a survey of the experimental results obtained in Cambridge and Vienna, and the author attempts to interpret these results in terms of the explosion theory advanced by Pettersson. The experimental proof of the statistical nature of the law of radioactive decay is treated in a further section, by Prof. Kohlrausch, who pays particular attention to the work of Frl. Bormann, which provides, in his opinion, the first conclusive experimental proof of the correctness of the fundamental assumption on which the law is based. The absorption of gases under the influence of electrical discharge and allied phenomena are considered in full in an article by Dr. Pietsch, to which are appended several pages of references. Finally, we have an excellent and up-to-date account of the Compton effect by Drs. Kallmann and Mark.

Edward Thring, Maker of Uppingham School, Headmaster 1853 to 1887. By W. F. Rawnsley. Pp. iv + 103. (London: Kegan Paul and Co., Ltd., 1926.) 3*s.* 6*d.* net.

EDWARD THRING and Sanderson will rank as the two English headmasters of the last generation who left most personal mark upon their scholars and built up great schools on the foundations of small, ancient, and neglected grammar schools. Such reconstruction was a familiar feature of the last half-century, but Uppingham and Oundle will always recall the names of their re-founders. Thring's work was in one way more heroic than Sanderson's, because he did it in the teeth of an obstructive and unsympathetic body of governors, while Sanderson was supported by the generous and loyal help of his.

In this short account of Thring's career, Mr. Rawnsley gives a vivid picture of the man and explains his extraordinary personal influence. Thring had in a high degree that combination of humour, sharpness, sympathy, and devotion which makes the strongest appeal to the English boy. Numerous examples are given of all these and of his cardinal principle in education that every boy is good for something and that you must make him work by appealing to his individual interests. Thring's own interests lay mainly in music and literature, and one does not hear anything of science or history. In this respect he and Sanderson would seem to have been rather complementary to one another. Both stand out as worthy types of the individuality of the great headmaster. F. S. M.

A Text-Book of Experimental Psychology: with Laboratory Exercises. By Dr. Charles S. Myers and F. C. Bartlett. Third edition. Part 2: Laboratory Exercises. Pp. viii + 121. (Cambridge: At the University Press, 1925.) 7*s.* net.

IT is satisfactory to note that this excellent text-book is now in its third edition. The student who has carefully worked through these exercises will have gained considerable practice in the very difficult art of psychological experiment. There is a fairly common belief that psychology can be evolved from the writers' inner consciousness without the limiting effects of an appeal to facts demanded by other branches of knowledge. Much futile discussion and many fantastic theories would be avoided if all exponents of psychology could have the discipline of working through this book.

There are four sections, designed to cover about a year. The first part deals with the technique of psychological experiment, the second with problems of the special senses, the third with perception and the higher thought processes, while the fourth is supplementary, giving additional experiments.

This revised reprint will be very useful.

Die Gattung Synedra in systematischer, zytologischer und ökologischer Beziehung. Von Dr. Konrad Gemeinhardt. (Pflanzenforschung, Heft 6.) Pp. iv + 88 + 4 Tafeln. (Jena: Gustav Fischer, 1926.) 6 gold marks.

THIS monographic treatment of the abundant diatom genus Synedra will appeal chiefly to the specialist, but is not without points of general interest. The author supports a classification based on the features of the valves rather than on the characters of the chromatophores and throws out a suggestion that nuclear structure may afford a basis for distinguishing the larger groups of diatoms. No proper spindle is formed during nuclear division in Synedra, and a centrosome is lacking. In the considerable section devoted to ecological data it is made clear that all species of Synedra require water with a certain minimum lime-content. It is significant that, in the course of more than a year's continuous observation, no auxospore-formation was observed.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Structure of Catalytically Active Copper.

THE nature of the change that occurs on the activation of a metallic catalyst by alternate oxidation and reduction, or by continued use, and the change that occurs during sintering, has been an open question (cf. *Proc. Roy. Soc.*, A, vol 107, p 277; vol. 110, p. 283). The solution of this problem definitely would go far towards establishing the theory of centres of activity on an indisputable foundation, since it is necessary to show that both the area and the nature of the surface change (cf. the discussion by Hinshelwood, "Kinetics of Chemical Change in Gaseous Systems," Clarendon Press, p. 194).

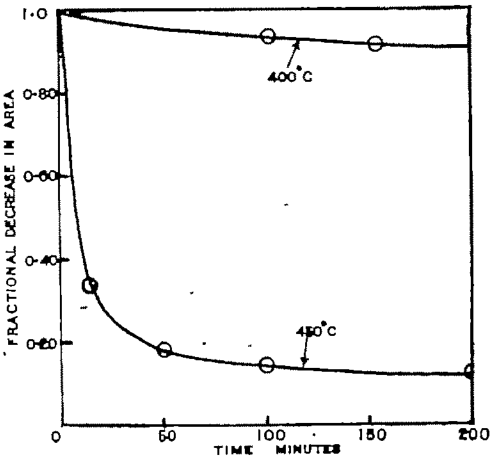


FIG. 1.

Now the observations of Dunn (*Proc. Roy. Soc.*, A, vol. 111, p. 210) on the use of interference colours, in following quantitatively the growth of the oxide film on copper, give a method of estimating the linear rate of growth of the oxide covering the individual grain compared with that on 'inactive copper.' Palmer (*Proc. Roy. Soc.*, A, vol. 103, p. 444) showed that the conductivity of a mixed copper–copper oxide film was directly proportional to the copper content of the supported film; thus the rate of fall of the conductivity of the film is a measure of the mass of copper being oxidised in unit time, and a method is available for estimating the massive rate of growth of the oxide compared with that on 'inactive copper.'

Let a be the thickness of the oxide film, S represent the area of surface, and C be the electrical conductivity of the mixture of oxide and metal. Let the suffix 1 denote the values of these quantities for an activated or sintered catalyst, at time t after the commencement of the oxidation at constant temperature; and the suffix 2 represent the same variables either for the film before activation, or for the fully activated film before annealing.

Then

$$\frac{\left(\frac{da}{dt}\right)_1 \cdot S_1}{\left(\frac{da}{dt}\right)_2 \cdot S_2} = \frac{\left(\frac{dC}{dt}\right)_1}{\left(\frac{dC}{dt}\right)_2} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Thus S_1/S_2 can be evaluated, and we have a method of measuring the increase of area on activation, and the decrease of area on sintering.

The observations for the activation of a catalyst present experimental difficulties, owing to the irregular nature of the first reduction and oxidation in many cases; but they are of great theoretical interest and, so far, seem to indicate that the increase in area of the supported copper films on successive reduction is not large. The nature of the surface alters considerably, since the linear rate of oxidation increases markedly.

In the case of sintering, the observations can be made with accuracy; the nature of the surface is changed since the linear rate of oxidation falls, and the increase in surface area is marked. Continued exposure to high temperature does not cause the area to diminish indefinitely, but a definite limit is reached corresponding to each temperature. The effect of annealing a supported copper film at 450° C. and 400° C. is shown in the accompanying diagram (Fig. 1), the results being worked out by the method previously described.

The relative rate of increase of thickness of the oxide film slows down very considerably, as the time of sintering is increased. Dunn's conclusions (*loc. cit.*) that "the structure of a metal may be brought out owing to the variation of the oxidation rate of different crystal faces," and that "For a definite time of oxidation each crystal face will be characterised by a different colour," seem to provide indisputable evidence that, as well as the area change that occurs during activation and sintering, there is also an unmistakable change in the nature of the surface.

F. H. CONSTABLE.

St. John's College,
Cambridge.

Magnetic Properties of Single Crystals of Nickel.

THE magnetic properties of single crystals of iron have been examined by Webster (*Proc. Roy. Soc.*, 107, p. 497, and 109, p. 570), Honda, Kaya, and Masuyama (NATURE, May 29, 1926), and more recently Gerlach (*Zeit. für. Phys.*, 38, p. 828, 1926). Considerable differences have been shown to exist between the magnetic properties of the polycrystalline metal and the single crystal.

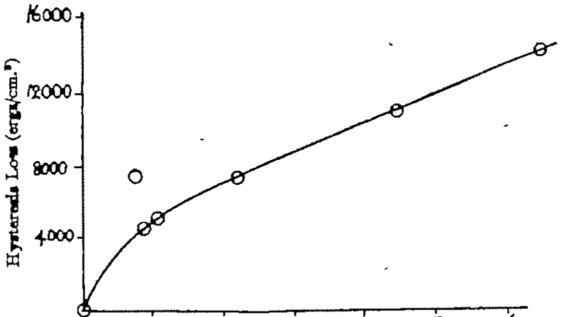


FIG. 1

We have recently succeeded in preparing crystals of nickel of several cubic centimetres in volume, from which specimens large enough for magnetic measurements can be obtained. The present note contains an account of a preliminary investigation on the variation of hysteresis loss with grain size. The specimens used were cylindrical rods of 20 mm. by 2 mm. diameter. The hysteresis loss, as in the case of iron, decreases with the number of grains in the specimen, as shown in the accompanying graph (Fig. 1) and table.

Number of Grains in Specimen.	Hysteresis Loss (ergs/cm ^{3}).	Coercive Force (Gauss).
$2 \cdot 8 \times 10^4$	14,600	13
$2 \cdot 7 \times 10^4$	11,100	10
$6 \cdot 4 \times 10^3$	7,300	5
12	5,150	4·3
8	4,500	3 7
1	<290	<·5
7	7,600	5

The hysteresis loss for a single-crystal specimen was less than the experimental error, and was certainly less than 1/50 of that for ordinary nickel. The point off the curve was obtained with a specimen containing seven grains. In this particular case the etch pattern indicated that the grains were considerably distorted. For the specimens containing eight and twelve crystals respectively, the demagnetising factor was appreciably greater than for the other poly- and single-crystal rods of the same dimensions. In these two cases it is significant that most of the crystals occupied the whole cross-section of the rods. Gerlach's experimental results for iron indicate the presence of similar phenomena in that metal

The intensity of magnetisation of the single crystal specimen in an effective field of 300 gauss was 565 units. Saturation was not complete in this field.

Further experiments on the magnetisation and magnetostriction along the different crystalline axes are in progress.

W. SUCKSMITH.
H. H. POTTER.

Physics Department,
University of Bristol,
October 14.

Invention as a Remedy for Unemployment.

THE very interesting analysis of the relationship of present patent law and patent procedure to invention and to the unemployment problem, which appeared in NATURE of September 18, should serve to stimulate clear and earnest thinking on a subject of great national importance.

A storm of indignant protest is always aroused if any one has the temerity to suggest that Great Britain is falling behind in the application of science to industry, or in the practical application to useful ends of newly discovered scientific truths I am, nevertheless, of the opinion that, except perhaps in the allied fields of steam and marine engineering, it would be difficult indeed to prove that some such declension from our former pre-eminence has not taken place. It would be a wearisome task, and certainly provocative of controversy, to recite the evidence in support of this view, but an unprejudiced observer who considers, for example, the course of invention during recent years in such fields of useful activity as incandescent gas-lighting, electric traction, alternating-current engineering, or in the design of type-writing, addressing, and calculating machinery, will find it difficult to resist the conclusion suggested above.

That this failure to lead in the realm of commercial invention is not due to any diminution in the mental energy or native ingenuity of the race is abundantly evident from the splendid achievements of British scientific workers during the first quarter of the twentieth century.

It is probably true that since the death of Faraday the international reputation of British science has never stood higher than it does to-day.

I would in particular direct attention to the astonishing experimental skill and inventive ingenuity which have distinguished the work of our physicists. Without citing any names or making any detailed and, possibly, invidious comparisons, it may safely be claimed that in this respect no other nation has surpassed—if any have equalled—the freshness and power of attack exhibited by British workers.

Even in the realm of organic chemistry, in fields formerly almost abandoned to foreign labourers, the achievements of British investigators and inventors during the last eight or nine years constitute a truly wonderful record of steady progress in one of the most difficult of applied sciences. The same story of rapid and successful attack can be told in connexion with the manufacture in Great Britain of optical and heat-resisting glasses.

In all this there is abundant room for encouragement; for it makes clear the fact that where we are failing to lead in applied invention and applied scientific method, the failure is not due to lack of inventive ability.

It suggests that in countless instances invention is inhibited and inventors discouraged by the fact, still lamentably true, that the average Englishman possessing money—the man to whom new ideas are brought for development—is hopelessly at sea in respect of general scientific knowledge and general manufacturing processes. More often than not he is a gentleman, a man anxious to act fairly towards his fellows, and a man not unenterprising—quite willing, in fact, to risk money wherever he believes there is a reasonable chance of winning more—but the words the inventor uses and the drawings he exhibits are expressions in an unknown tongue.

The man of money remembers more of the Greek and Latin he laboriously learned at school than of the fragments of mechanics or chemistry he imbibed under the head of 'Science' He turns the inventor down because he does not understand.

This inability does not prevail to anything like the same extent in the United States of America or in Germany. Generally speaking, in those countries the man who commands money knows at least enough of mechanics, or physics—knows enough about *things* as distinguished from *words*—to take a very intelligent interest in what an inventor has to say.

That makes all the difference.

A classical education may be the best possible preparation for any calling that succeeds it—I happen to think this is so—but the price Great Britain has paid, and is paying now, for the past almost total neglect of science in our public schools is incredibly big.

Until science, and 'knowledge of things,' take their proper place in our great schools, invention will continue to languish and inventors to cross the Atlantic.

Reform of the patent laws may certainly help the cause of invention, but alone it will not do nearly enough.

I would warmly advocate a more thorough and a wider official search, as in Germany and in the United States. I would also advocate the establishment of a British petty patent similar to the German *Gebrauchsmuster*, so as to eliminate the absurdity of giving the same kind of protection to a man who 'invents' a method of making some simple object out of sheet-metal instead of casting it, as to the inventor of the steam turbine.

The issue of such patents as are suggested above is one of the least creditable branches of the Patent Office's activity during recent years.

The encouragement of real inventiveness will unquestionably diminish unemployment. Even in the case of 'process' and 'cheapening' patents, any temporary increase of unemployment thus created is more than balanced by increased production, and the consequent absorption of more and more men into employment Generally speaking, the world is always hungry for goods, if the goods are useful and the price is right.

W. A. Benton.

Research Department,
W. and T. Avery, Ltd.,
Soho Foundry, Birmingham.

A Breeding Ground of the Nursehound (*Scyliorhinus stellaris*) in the Fal Estuary.

During recent years I have had considerable experience on the oyster-beds and adjacent grounds in the Fal Estuary, and as a result of observations made at various times I consider that the greater part of the Laminarian zone in that estuary forms an extensive and regular breeding ground for the nursehound (*Scyliorhinus stellaris* = *Scyllium catulus*). In the autumn of 1924 a few egg-cases containing embryos of this shark-like fish were dredged on Laminaria on the Falmouth North Bank, Carclase, and on other grounds in ¼ to 1¾ fathoms. (A chart of the grounds of this region is given in my report on a "Survey of the Fal Oyster Beds," 1926.) During the summer of 1926, egg-cases have been frequently taken on Laminaria at Turnaware Bar—which is situated about 1¼ miles farther up the estuary than the grounds just mentioned—and young ones recently escaped from the egg-case have been seen at low water on this ground on several different occasions Young nursehounds have also not infrequently been taken in oyster-dredges in autumn.

During the recent spring tides, the Laminarian zone at Brown Rose Bar—about 1 mile below Turnaware—was being examined for oysters, and, in an area of not more than 20 square yards, 8 egg-cases of the nursehound containing eggs or embryos, as well as a few empty purses, were found, probably others were on the ground and not seen Two of these egg-cases had been laid within the last few days, and had the thong-like horny extensions of the corners of the case wrapped round the whole of the anastomosing roots of a bunch of old Laminaria stipes. In one instance the new egg-case had been attached to a group of stipes which also carried older egg-cases at a higher level Four of the egg-cases contained embryos respectively about 12·5 cm. and 10 cm. long, both with internal gills, and two about 6·0 mm. long It is interesting to note that Ford (*Jour Mar. Biol. Assoc.*, vol. 12, p. 492, 1921) estimated that embryos would begin to have the gills covered at a length of about 10·0 cm. Thus the collection of egg-cases contained eggs or embryos of four different ages, and therefore of four different spawnings.

While examining one egg-purse in its natural position under water, two *Nassa reticulata*, sometimes called dog-whelks, were observed with their probosces inserted in a natural crack in the case, where the base of one corner thong arises from the body of the case. After observing the Nassæ for a few minutes, each was pulled off separately and at least half an inch of pink proboscis pulled out of the case. On opening the case, however, to see what damage had been done, there was found no trace of either yolk or embryo and only a remnant of albumen. As the purse was fixed in an upright position in the water, and the Nassæ were at the lower end, it was possible—but not probable—that they might have eaten the large amount of yolk generally found in the eggs, but on examining the other egg-cases, one similar in age to that attacked by the whelks was opened and also found to contain nothing but albumen, although the egg-case was intact and full of albumen.

It is clear, therefore, in this latter instance, that the nursehound had made an egg-case and had omitted—perhaps forgotten—to put an egg in it. The contents of both these purses were healthy in so far as they had no noxious smell. It is not improbable that Nassæ and similar forms may normally attack the embryos of the nursehound and its allies at the vulnerable natural slits in the egg-case (described by R. S. Clark, *Jour. M.B.A.*, vol 12, p 584, 1922).

It is well known that the nursehound breeds regularly in the gullies at Wembury Bay West, inside the Mewstone, near Plymouth, but there the egg-cases are usually attached to the strong, stockily growing sea-weed Cystoseira. It would seem, therefore, that so long as the nursehound can lay its egg-cases in fairly shallow water—on the south coast of England—the fish may use either Laminaria or Cystoseira and probably any other weed so long as it be strong and permanent enough. It is necessary that the weed used for attachment should remain *in situ* for nine months to a year, and perhaps longer, to enable the embryo to develop fully, and presumably the spawning fishes know that both Cystoseira and Laminaria are both strong enough and permanent enough even in a situation near low-water mark to serve their purpose, Cystoseira, from observation, grows certainly for more than one year, and is so firmly rooted that it is either difficult or impossible for a man to pull the weed off the rock. *Laminaria saccharina*, the species used by the nursehound, may shed its frond at the end of one summer's growth, but the stipes to which the egg-case is attached remains *in situ* and strong for a much longer period. The problem of how the nursehound found out that Laminaria and Cystoseira would suit its purpose is only one more of the millions of evolutionary problems awaiting explanation.

J H. Orton

Marine Biological Laboratory,
The Hoe, Plymouth, October 21

Application of the Drop Weight Method to the Determination of the Surface Tension of Colloidal Solutions.

In connexion with some work by Henry N. Harkins and myself on the surface tension of certain colloidal solutions, it seemed essential to hold the drop used for the determination at almost full extension any desired length of time before it was allowed to fall As usual, the drop was allowed to fall from a tip of horizontal circular cross-section into a stoppered weighing bottle (method of J. L. R. Morgan) The weighing bottle was immersed in a thermostat, and was kept dry on the outside by an enclosure of glass and brass, such as was used by Harkins and Brown. This is shown diagrammatically in Fig. 1. The new modification consisted in supporting the supply bottle entirely by the rod A, which was supported in turn by a microscope stand upheld by a heavy tripod which rested on a pier outside the thermostat. The rod was made so small that there was no contact with the inside of the tube C′. There should also be no contact between the stopper of the bottle E and the inverted capillary U tube upon which the tip D is ground, since the adjustment of the level of the bottle E must transmit no vibrations to the hanging drop.

The form of the drop which hangs from the tip D depends both upon R/a and R/h. Here R is the radius of the tip, a is the square root of the capillary constant, and h may be designated as the 'pressure-height,' which is the difference in height between the bottom of the drop and the level the liquid in the bottle E would have provided the area of its meniscus were infinite.

The method was applied to pure liquids by Dr. Paul Gross, and it was found that the accuracy of the drop weight method is thereby increased considerably, so that the precision of the new method is to within a few hundredths of one per cent. To apply the method the cross-hair of the telescope of a cathetometer is adjusted by trial with the hanging drop, so that its level corresponds to the lowest level at which the bottom of the drop may be held without falling. To attain this level the height of the meniscus in E is adjusted by trial to the proper height by the use of the coarse and fine adjustments of the microscope stand. If the proper technique is used, the drop may be held at practically full extension for as many hours as may be desired. A study of the relation between the pressure-height and the stability of the hanging drop was carried out by Dr. Gross, and the results will be presented in a later more complete discussion of the improvements in the drop-weight method. The modifications introduced do not of necessity lengthen the time necessary for a determination of surface tension, since the greater certainty with which the proper conditions may be attained makes it possible to reduce the number of drops used, and in much work on colloidal solutions only one drop needs to be allowed to fall in the final determination.

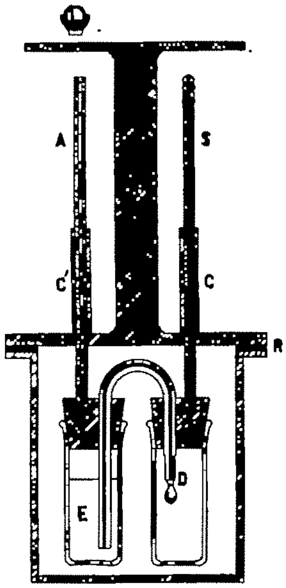


FIG. 1.

For those who prefer to use the less accurate ring method, a method which as commonly used has been in error by so much as ten per cent. or more, it may be mentioned that Dr. T. F. Young, Y. C. Cheng, and the present writer have recently determined experimentally the corrections for this method. The use of these corrections reduces the error to one per cent., and it is hoped that the work now under way will still further reduce this to one-tenth per cent.

WILLIAM D. HARKINS.

University of Chicago,
September 16.

Tertiary Man in Asia: the Chou Kou Tien Discovery.[1]

A RICH fossiliferous deposit at Chou Kou Tien, 70 li [about 40 kilometres] to the south-west of Peking, was first discovered in the summer of 1921 by Dr. J. G. Andersson and later surveyed and partially excavated by Dr. O. Zdansky. A preliminary report on the site was published by Dr. Andersson in March 1923 (*Mem. Geol. Surv China*, Ser. A, No. 5, pp. 83-89), followed in October of that year by a brief description of his survey by Dr. Zdansky (*Bull. Geol. Surv. China*, No. 5, pp. 83-89). The material recovered from the Chou Kou Tien cave deposit has been prepared in Prof. Wiman's laboratory in Upsala and afterwards studied there by Dr. Zdansky. As a result of this research, Dr. Andersson has now announced that in addition to the mammalian groups already known from this site, there have also been identified representatives of the Cheiroptera, one cynopithecid, and finally two specimens of extraordinary interest, namely, one premolar and one molar tooth of a species which cannot otherwise be named than *Homo ? sp.*

Judging from the presence of a true horse and the absence of Hipparion, Dr. Andersson in his preliminary report considered that the Chou Kou Tien fauna was possibly of Upper Pliocene age, an opinion also expressed by Dr. Zdansky. It is possible, however, in the light of recent research, that the horizon represented by this site may be of Lower Pleistocene age. Whether it be of late Tertiary or of early Quaternary age, the outstanding fact remains that, for the first time on the Asiatic continent north of the Himalayas, archaic hominid fossil material has been recovered, accompanied by complete and certain geological data. The actual presence of early man in eastern Asia is therefore now no longer a matter of conjecture.

While a complete description of these very important specimens may shortly be expected in *Palæontologia Sinica*, the following brief notes may be of interest here. One of the teeth recovered is a right upper molar, probably the third, the relatively unworn crown of which presents characters appearing from the photographs to be essentially human. The posterior moiety of the crown is narrow and the roots appear to be fused. The other tooth is probably a lower anterior premolar, of which the crown only is preserved. The latter also is practically unworn, and appears in the photograph to be essentially bicuspid in character, a condition usually to be correlated with a reduction of the upper canine.

The Chou Kou Tien molar tooth, though unworn, would seem to resemble in general features the specimen purchased by Haberer in a Peking native drug shop and afterwards described in 1903 by Schlosser. The latter tooth was a left upper third molar having a very much worn crown, extensively fused lateral roots, and from the nature of its fossilisation considered by Schlosser to be in all probability Tertiary in age. It was provisionally designated as *Homo ? Anthropoide ?* It is of more than passing interest to recall that Schlosser, in concluding his description of the tooth, pointed out that future investigators might expect to find in China a new fossil anthropoid, Tertiary man or ancient Pleistocene man. The Chou Kou Tien discovery thus constitutes a striking confirmation of that prediction.

It is now evident that at the close of Tertiary or the beginning of Quaternary time man or a very closely related anthropoid actually did exist in eastern Asia. This knowledge is of fundamental importance in the field of prehistoric anthropology, for about this time also there lived in Java, Pithecanthropus; at Piltdown, Eoanthropus; and, but very shortly after, at Mauer, the man of Heidelberg. All these forms were thus practically contemporaneous with one another and occupied regions equally far removed respectively to the east, to the south-east, and to the west from the central Asiatic plateau which, it has been shown elsewhere, most probably coincides with their common dispersal centre. The Chou Kou Tien discovery therefore furnishes one more link in the already strong chain of evidence supporting the hypothesis of the central Asiatic origin of the Hominidæ.

---

[1] Announcement of the Chou Kou Tien discovery was first made by Dr. J. G. Andersson on the occasion of a joint scientific meeting of the Geological Society of China, the Peking Natural History Society and the Peking Union Medical College held in Peking on October 22, 1926, in honour of H.R.H. the Crown Prince of Sweden.

DAVIDSON BLACK.

Department of Anatomy,
Peking Union Medical College,
Peking, China.

Action of Magnetic Fields on the Refractive Index of Carbon Dioxide Gas.

A. GLASER (*Ann. d. Physik*, 75.4, pages 459-488, and *Ann. d Physik*, 78.4, 641-658), in determining the susceptibility of diamagnetic gases, noticed that, under a definite magnetic field, the susceptibility decreases as the pressure of the gas is decreased, approximately proportional to the pressure. For a certain pressure range, however, there is a deviation from the above law, and the law of variation, instead of being linear, follows approximately a parabolic law, and above and below this range the linear law has different characteristics.

Working to detect any relationship between the refractive index and pressure, Fraser (*Phil. Mag.*, April 1926, pp. 885-890), using the Jamin refractometer, failed to notice any change in the refractive index when the gas is subjected to a sudden magnetic field of about 184 gauss within a pressure range of 0·001 to 8 mm.

The present authors have noticed a decided change in the refractive index of pure dry carbon dioxide gas, when subjected to a constant magnetic field of 3600 gauss, acting transversely to the direction of propagation of light and the pressure gradually increasing from 10 mm. to 400 mm. A Michelson type of interferometer was used for the purpose, and all parts were carefully selected to be non-magnetic. The graph (Fig. 1) shows the relation between the shift of fringes and the pressure variation within the range 10 mm. to 400 mm. for air and carbon dioxide. In the case of air, the magnetic field has no influence whatever on the refractive index, whereas with carbon dioxide the fringe shift nearly follows a parabolic path in the same region of pressure, as has been noted by Glaser. This shows a decided orientation of the molecules under the magnetic field, at least in the case of a dipolar gas of the type of carbon dioxide.

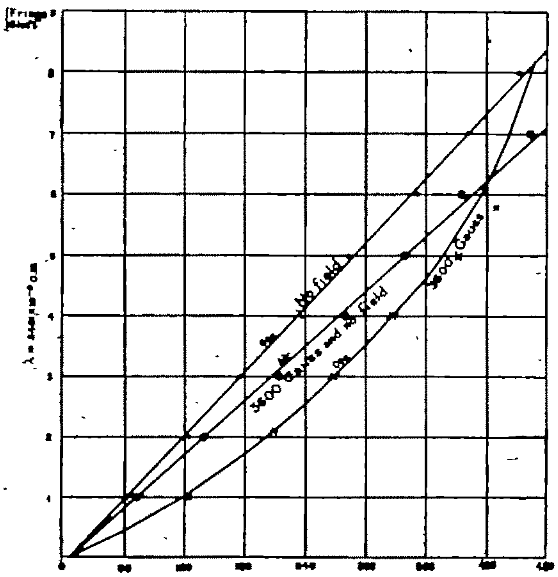


FIG. 1.

Experiments are in progress to determine the change with different temperatures and other dipolar gases.

P. N. GHOSH.
P. C. MAHANTI.

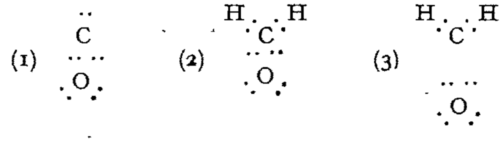
University College of Science and Technology,
92 Upper Circular Road, Calcutta,
September 29.

Electron Displacement *versus* Alternate Polarity in Aliphatic Compounds.

ADHERENTS of the theory of induced alternate polarity in carbon compounds consider in their deductions also the general electron displacement effect of Lewis's theory; some partisans of the latter theory, however, question the reality of the alternate effect, especially so far as open-chain compounds are concerned. (Cf. H. F. Lucas and co-workers, *J. Am. Chem. Soc.*, 46, 2475 (1924); 47, 1462 (1925).)

It seems to me that recent results of V. Henri and Sv. A. Schoú [*C. R. Acad. Sci. Paris*, 182, 1612 (1926)] afford strong evidence in favour of the alternate effect. Making use of spectroscopic data, these authors succeeded in determining the distances between the atoms in some simple organic molecule, in the gaseous state. They find for the distance between the carbon and oxygen atoms in carbon monoxide 1·02 Å.U., whereas the same distance in formaldehyde is found to be 0·9 Å.U. It is just such a *decrease* of the distance carbon to oxygen by the presence of the two hydrogen atoms, that would be expected on the basis of the alternate polarity theory.

Indeed, let us suppose for the sake of comparison that in carbon monoxide the four binding electrons are lying at equal distances from the nuclei of the two atoms (1). In formaldehyde, then, according to the alternate effect and considering the positivity of the hydrogen atoms, the carbon atom must become less positive, *i.e.* it attracts the electrons of its octet, and together with them the oxygen nucleus, nearer towards itself (2).



On the contrary, the general Lewis effect would require a displacement of the binding electrons towards the oxygen nucleus, and thus an *increase* of the distance between carbon and oxygen (3).

In phosgene, $COCl_2$, the reverse effects would be expected according to both theories on account of the negative chlorine atoms; the data for distances are, however, not yet available in this case.

If one assumes a triple bond in carbon monoxide (cf. Lewis, "Valence," 1923, p. 127), the above conclusions become doubtful, since it is not known how interatomic distances are influenced by the transition of bonds; only a direct comparison of the distances in formaldehyde and phosgene could afford conclusive evidence then.

G. BERGER.

Department of Organic Chemistry,
University of Agriculture,
Wageningen, Netherlands,
October 5.

Science and Psychical Research.

My departure for New Zealand having been delayed for a month, perhaps I may be allowed a short reply to Sir Bryan Donkin's remarks in Nature of Nov. 6. Sir Bryan and myself have come much closer in our views, apparently, but he still misunderstands some of the main points both in my original article and following letter. The term ' supernormal phenomena ' certainly includes both ' physical ' and ' mental ' phenomena of the type under discussion ; on that we are agreed. But Sir Bryan goes on : " In the mental part, however, are included practically all the various ' phenomena ' known generally under the term ' spiritualistic,' " or, later in his letter, ' ghostly.' It is here that I disagree. The genuine psychical researcher does not allow that these may be termed either, since both words connote a hypothetical explanation of the phenomena which we hold is not yet proven. Sir Bryan keeps trying to tie me down to an acceptance of the spiritistic hypothesis, whereas the whole of what I have written shows clearly that I am studying the evidence with an absolutely open mind Another remark of his, " Seeing that the present discussion has been mainly concerned with these [*i.e.* the mental] phenomena," suggests that he cannot really have read carefully what I have written. Throughout, I have emphasised the importance of the *physical* phenomena, not the mental, and it was Sir Bryan himself who, by his narrowing of the field to the mental phenomena, attempted to deprive me of my chief argument.

As regards the subject of *trance*, Sir Bryan and I are alike in not knowing what it is. The only difference in our attitudes, I take it, is that I consider it a phenomenon worthy of scientific study, whereas Sir Bryan does not. I wonder whether Sir Bryan considers the phenomenon of *sleep* to be worthy of scientific study, or whether he would take the stand of the physicists who (mostly, but not all) maintain that the only phenomena which science may properly take account of are those which can be always repeated accurately under given experimental conditions. If I put Sir Bryan to bed and tell him to go to sleep, can he always do so ? Is sleep any the less a fit subject for scientific study because it cannot be produced to order in an experiment ? Trance, if anything, is more amenable to such procedure than is sleep. It is therefore undoubtedly a fit subject for scientific study. My complaint is that those who have the necessary knowledge and training refuse to become interested in these things ; they seem to think that the year 1926 marks the culmination of human knowledge in some way, and that there is nothing more to learn about life except on the purely mechanistic side My whole article was really a protest against this view.

R. J. TILLYARD.

The Athenæum,
Pall Mall, S.W.1.

Active Nitrogen.

Further experiments have tended to confirm the work recently published by Dr. Rideal and myself upon the energy and nature of active nitrogen.

A study of the effect of the admission to the afterglow of a number of gases, elementary, compound, and mixed, shows that in no case so far examined does any chemical action resulting in the formation of definite compounds occur when the critical increment of the gas introduced exceeds *c.* 45,000-50,000 cal./gm. mol.

Experiments upon the action of active nitrogen upon the metals in the form of fine filaments show that catalytic decay takes place at their surfaces and in some cases (*e.g.* copper) is very marked The efficiencies of the metals in this respect depend upon the stability of their nitrides. Calculations from the data obtained here again show that the energy of active nitrogen is *c.* 45,000 cal /gm. mol.

The decay of the afterglow has been measured by optical methods, and it has been found that the process is in all probability bimolecular with respect to the active nitrogen, but termolecular in reality since the total pressure appears to exert a marked influence, as suspected by Lord Rayleigh.

The line of reasoning adopted by Dr. Ludlam and Mr. Easson is sensibly the same as that of Saha and Sur. It is quite probable that an unstable compound such as N_2I_2 or a quasi-molecule of sorts is first formed when the iodine vapour is admitted to the afterglow, but is then broken up by collision with another molecule of active nitrogen, the energy liberated going to produce the line they mention. The nitrogen halides are notoriously unstable compounds and hence probably highly endothermic.

An alternative explanation is suggested by the presence of the β and γ bands in the spectrum of the afterglow. While the weight of evidence appears to be against their being really part of the true nitrogen afterglow bands, they invariably appear when the gas is purified in the usual manner. Since they extend at least so far as $\lambda 2154$, collisions between molecules of iodine and those of nitrogen or nitric oxide at this level may result in the appearance of the line in question.

This explanation could easily be tested by increasing the intensity of the β and γ bands, by the addition of oxygen, as in the recent experiments of Johnson and Jenkins (*Phil. Mag.* Sept. 1926) ; an increase in the strength of this iodine line should then follow. It is surely not at all legitimate to attempt an evaluation of the energy of active nitrogen from the spectral phenomena to be seen in the presence of such factors of totally unknown magnitude.

E. J. B. WILLEY.

Laboratory of Physical Chemistry,
Cambridge, October 27.

Liveing's Fire-damp Indicator.

Some years ago I made frequent use of Mr. Liveing's very ingenious instrument, referred to in Nature of October 30, p. 626, and I found its indications to be both accurate and excellent. The only drawback to its use in those days was the shaking which accompanied the turning of the handle to produce the glow, as this made accurate observation of the percentage of fire-damp somewhat difficult.

W. GALLOWAY.

17 Park Place, Cardiff,
October 30.

The Imaginary Roots of Equations.

Prof. C. Runge has informed me that the method I gave under the above title in Nature of October 30, p. 627, has already been given by him in the " Encyclopädie der mathematischen Wissenschaften," vol. I. 1, p. 431. I need scarcely add that I was not aware that I had been anticipated when I sent my letter to Nature. H. C. POCKLINGTON.

6 Blenheim Crescent,
Leeds.

Reflex Regulation of Posture.[1]

By Dr. F. M. R. WALSHE.

TO those interested in the physiology of the nervous system, the history of our knowledge of the neuro-muscular mechanisms underlying posture must form one of the most fascinating chapters in the records of the science, and it is but fitting that any account of it should be prefaced by an expression of homage to Sir Charles Sherrington, to whose labours we owe the entire foundation of that knowledge.

Sherrington's investigations, in the course of which muscle tonus has been revealed as a purposive reflex reaction and the basis of all postural activity on the part of the musculature, are now thoroughly embodied in physiological thought and do not require detailed reference. It is of interest, however, when we recall the vicissitudes through which the term 'tonus' and our conceptions of muscle tone have passed to refer briefly to the experimental preparation which in the hands of Sherrington, and later in those of Magnus of Utrecht, has provided the key to the elucidation of those intricate neuro-muscular processes which underlie reflex posture. I refer to the decerebrate preparation. Prior to its discovery and description the nature, and even the very existence, of muscle tonus were subjects of conflicting opinion and observation. Numerous investigators had sought for this peculiarly elusive form of muscular activity in the single muscles of cold-blooded animals, and such glimpses of it as had been gained were too restricted in extent and too fugitive for any clue to its nature to be apparent. "To glimpse at the aim of a reflex," as Sherrington has remarked, "is to gain hints for further experimentation on it . . . the larger the muscular field involved in the reflex effect, the plainer usually its purpose."

The decerebrate cat is an animal in which the brain stem has been severed in the region of the tentorium, the section putting out of action all that part of the brain, including the forebrain, which lies anterior to the posterior corpora quadrigemina. Such a preparation may be called a ponto-spinal animal. Following this procedure, there appears an abnormally heightened tonus selectively distributed in those muscles which maintain the animal in its habitual standing posture—in other words, in the group of 'antigravity muscles.' This hypertonus has been called 'decerebrate rigidity,' and its intensity and characteristic incidence throughout the skeletal musculature have made possible a minute analysis not alone of the origin and nature of muscle tone, but also of its significance. Decerebrate rigidity is reflex standing. It will be apparent, therefore, that the discovery of this preparation opened a new and most fruitful era in the physiology of the nervous system.

Briefly, we have in muscle tone an enduring reflex muscular contraction of low intensity, endowed with a quality of plasticity in virtue of which the muscle can maintain a steady tension at varying muscle lengths, and readily overset transiently by intercurrent reflex reactions of phasic or movement type. It is a proprioceptive reaction, the stimulus arising in the muscle engaged in the reflex and consisting of those variations in tension produced by the voluntary motor activities of the animal (Sherrington and Liddell). It is believed that the tonic contraction is of the same nature, and is a function of the same elements in the striated muscle fibre as that seen in the muscle engaged in movement (phasic contraction), its peculiar qualities depending on the fact that now the elements respond in rotation, groups of individual muscles giving asynchronous series of responses.

In that beautiful analysis of reflex reaction which Sherrington has embodied in his book, "The Integrative Action of the Nervous System," he has pointed out that the skeletal musculature is controlled by two great reflex systems, which in the intact animal are in turn controlled by the cerebral cortex. Each system influences its own groups of the musculature, employing them in characteristic fashion. One system, the phasic system, is concerned with short-lived muscular movements and the arcs involved are predominantly spinal. The flexion reflex is a typical example in the group. The other, or tonic, system with which we are now concerned maintains and regulates that steady tonus or tonic contraction which is the basis, the raw material, of posture. Between the two systems there is a close and harmonious relationship, or, in Hughlings Jackson's apt phrase, "a perfect co-operation of antagonism." Every movement starts from and ends in a posture, and even the most superficial observation of some voluntary purposive movement betrays the existence of these two elements. For the effective performance of some movement of a limb it is essential that the organism as a whole should be oriented with reference to gravity and other external forces. The minute experimental analysis of muscular movement confirms this impression and has revealed the activity of the two systems mentioned above.

The tonic reflex system includes the autogenous reaction in the muscle which we call muscle tone, and also a complex series of controlling reactions by means of which tone is adapted to follow up the numerous and diverse movements made by the intact animal.

These regulating tonic reactions arise in the otolith organs of the labyrinths, in proprioceptive nerve endings in the muscles and tendons throughout wide regions of the body, and also in the nerve endings in the body wall which subserve the sense of pressure.

In 1909, as he relates, Magnus chanced to be working with a decerebrate preparation and noticed when he turned the animal from the lateral into the supine position that the extensor hypertonus of its limbs underwent an appreciable increase with the adoption by the limb of an attitude of more complete extension. Further, when the head was so flexed upon the trunk that the line of the mouth made an angle of 45° above the horizontal, an additional increase was seen to set in after a latent period of several seconds. These modifications of tone, and afterwards of limb posture, persisted so long as the new position of the head which had given rise to them was maintained.

---

[1] Opening paper of a discussion on "Reflex Posture" before Section I Physiology) of the British Association at Oxford, August 9.

Simultaneously and independently, Sherrington observed that with the animal in a fixed position, rotation of the head to one side caused a similar increase of extensor tonus in the two limbs of the side to which the snout pointed. Extirpation of the labyrinths left the reaction intact, but division of certain cervical posterior roots abolished it. It therefore arose in proprioceptors in the neck musculature.

These observations formed the starting-point of Magnus's great work upon reflex posture, and have resulted in the discovery and classification of an extremely complex series of tonic reactions, which in sum make up the nervous mechanism by which normal postural activity is attained. In addition, Magnus has revealed the existence of a group of phasic reactions arising in the semicircular canals, and these with the tonic reflexes under discussion constitute the whole reflex mechanism of normal co-ordinated muscular activity.

Magnus and de Kleijn found that by imposing variations in the position of the animal's head in relation to the horizontal plane of space certain constant modifications of limb tonus, and therefore limb posture, could be produced. Further, after bilateral labyrinth destruction, variations of head posture in relation to the trunk also elicited certain other constant tonic reactions. These two groups are the so-called tonic labyrinthine and neck reflexes and together make up a group of 'standing reflexes.' By appropriate manipulation of the head by the observer, the animal can be made to take up a wide range of attitudes, corresponding to those habitually adopted by the animal during life. They found, however, that although it could stand, the decerebrate animal, if overturned, lay like a log and had no power of reflex control over the posture of its head. It was clear, therefore, that there must exist in the intact animal other tonic reactions governing head posture. Transection of the brain stem immediately anterior to the mid-brain led to the discovery of these other reactions. The mid-brain animal, for so such a preparation is called, does not exhibit hypertonus, but tone of normal intensity. It can stand, walk, and jump, and if overturned at once actively reassumes the normal sitting posture. If thrown from a height it lands upon its feet. The reactions by which these results are obtained are purely reflex, and the animal is a reflex automaton.

Further analysis of the preparation's activities has revealed the existence of a group of labyrinthine, neck and body 'righting reflexes,' in virtue of which the animal is able to maintain its head right side up in the world. This righting of the head sets in train secondarily all the other reactions by which the trunk and limbs are in turn brought into line with the head. Slow motion kinematograph photographs of the cat falling through space reveal the successive tonic and semicircular canal reflexes described by Magnus and his collaborators. First the head is righted, the anterior and the posterior portions of the trunk follow in turn, and finally, in virtue of phasic semicircular canal reactions, the limbs are outstretched so as adequately to receive the body weight as the animal reaches the ground. The ease and accuracy with which each of the various tonic and phasic reactions separately analysed by Magnus can be followed in such photographs are the most convincing demonstration of the minute accuracy of his observations.

In apes there is added to these labyrinthine and proprioceptive reactions a group of retinal righting reflexes of tonic character.

The reflex arcs of the various reactions we have been considering lie entirely within the limits of spinal cord and brain stem and do not pass through the cerebellum or basal ganglia. There is laid down, then, in the central nervous axis of the animal a mechanism which makes possible all the phasic and postural activities of the intact animal. By an automatic mechanism the animal is kept right side up in the world.

It is to observations made at the bedside by the clinician that we must turn to determine whether or not the laws governing the regulation of posture in a wide range of animal forms—from guinea-pig to ape—hold also for man. The evidence accumulated during the past fifteen years goes conclusively to show that they do.

Warned by the difficulties which the pioneer investigators met with in their animal experiments, the clinician has sought for a form of hypertonus resembling experimentally produced decerebrate rigidity. The student of nervous diseases is familiar with several forms of tonic muscular contraction of considerable intensity, but all except one of these may readily be dismissed as bearing no resemblance to the condition in question. It might be thought that in man a condition of decerebration is not compatible with continued existence, and indeed complete bilateral decerebrate rigidity is one of the rarest observed phenomena. We have, however, in the hypertonus, or spasticity, of the residual hemiplegia left after a cerebral hæmorrhage or softening, a unilateral state of tonic muscular spasm in the limb muscles which is manifestly qualitatively identical with decerebrate rigidity. It arises as a proprioceptive reflex in the muscle concerned, and destruction of the muscle's afferent nerve supply abolishes it. It is plastic, and easily overturned by the same phasic reflexes as have this effect in the animal. It may persist undiminished for years. It has a selective incidence in the limb musculature: in the extensor, or antigravity, muscles of the legs, but in the flexors of the arms. This altered incidence in the upper limbs of man is related to the profoundly altered functions of the fore limbs in this erect animal, and the reasons for so thinking need not now concern us. Further, it has recently been shown that the tonic neck and labyrinthine reflexes of Magnus and de Kleijn may be present in these rigid and paralysed limbs, following the same rules which govern their occurrence and form in the decerebrate animal.

In addition it has been possible to recognise in a very familiar clinical phenomenon the existence of another group of tonic reflexes, arising in the proprioceptors of the normal limb and acting upon the paralysed limbs. It has long been known, and every hemiplegic subject soon discovers the fact for himself, that when with the normal arm the subject makes some forceful, tonically sustained, voluntary movement, the contralateral paralysed limb goes into strong tonic spasm and takes up a new attitude, which is sustained for so long as the voluntary muscular act evoking it. The form, latency, and duration of this so-called 'associated movement' shows it to be a tonic reflex of the same type as those described by Magnus. Further, in favourable cases, a beautiful interaction between labyrinthine, neck and limb reactions may be observed if we combine changes in the position of the subject's head both in relation to space and to his trunk.

It is clear, in short, that the tonic reactions of Sherrington and of Magnus are present in the human subject. In a single personally observed case of complete decerebrate rigidity in the human subject, in which physiological 'decerebration' was performed by a tumour compressing the mid-brain, a perfect decerebrate rigidity with tonic neck reflexes and phasic flexion and crossed extension reflexes were obtainable.

These observations upon the subjects of disease and injury of the nervous system are of a double interest. They serve to correlate the work of the experimental physiologist with that of the clinical observer, they bring the human subject into line with animals lower in the scale. Further, they illustrate the value to the clinician of experimental physiology. For many years the labours of clinical neurologists have accumulated a vast mass of 'physical signs' of disease, which have been used empirically as aids to diagnosis; but so far as possessing other meaning was concerned they remained like the jumbled pieces of a mosaic. Thanks to the light received from the physiological laboratory, it is now possible to piece them together into a coherent and intelligible pattern, and they have become manifestations of a dissolution of nervous function, pregnant with physiological significance. Thus may the clinician not only derive information of inestimable value to him in his analysis of the phenomena of disease, but he may also, in a measure, repay some of his debt to the physiologist by carrying over the latter's animal observations to man.

Some Recent Advances in Astrophysics.[1]

By Prof. E. A. MILNE, F.R.S.

OF late years astronomers have become increasingly despairing as to what the stars are doing—in what direction they are evolving, how they produce the energy they radiate, whether (and if so why) some of them pulsate, how the stars are born and whether they die. At the same time astronomers have become increasingly confident as to what the stars are really like. It is proposed here to deal briefly with one province of this less speculative side of astrophysics, namely, that which is described, broadly speaking, as the subject of stellar temperatures and stellar spectra.

What are called the 'effective temperatures' of the stars have been determined by measurement of their colour, much in the same way as the temperature of a piece of red-hot iron may be estimated from its colour. With the piece of iron, we may measure either the total radiation leaving each square centimetre of its surface, or the ratio of the intensities of radiation for two different constituents of its spectrum. From either of these measurements we may infer the other. Both types of measurement are possible for the sun, and by the work of Abbot, Plaskett, and Fabry and Buisson, they have been shown to be in general agreement. For the stars in general, only the colour type of measurement is possible. It is true that of recent years the heat radiated by the stars has been measured directly, but such measures by themselves yield no more information than a determination of apparent magnitude. Colour-measures, however, by the use of Planck's law, yield the amount of radiation leaving each square centimetre of the star's surface—a quantity expressed parametrically by the effective temperature, or surface brightness.

The importance of this quantity lies in the fact that the total radiation leaving the surface per second is precisely the amount generated in the interior per second, assuming a quasi-steady state. Two examples of its employment in fundamental calculations may be mentioned. The amount of light from a star (a quantity given by the apparent magnitude) reaching the earth is equal to the product of the surface brightness into the solid angle subtended by the star. Hence a determination of surface brightness plus one of apparent magnitude is equivalent to a determination of the angular diameter of the star as seen in the sky from the earth. The confirmation of such estimates by the direct measurement of angular diameters at Mount Wilson by means of the Michelson interferometer affords a useful check on one of the steps in the reasoning, namely, the deduction of radiation per unit area per second from an observation of colour. The second example is that of the estimate of the densities of the components of a double star. The density-ratio of the components may be readily calculated in terms of the ratio of the surface brightnesses, the mass-ratio, and the difference of the apparent magnitudes. In this way it was inferred that the companion of Sirius must have a density some 60,000–70,000 times that of Sirius itself, and the verification of this by Adams at Mount Wilson, by measurements of the Einstein shift in the lines of the spectrum, has been one of the most sensational scientific events of the past year.

The effective temperature, however, is not the temperature of any particular portion of the star. The question arises, Is there any method of determining the actual temperature in the surface regions of a star, which alone we can directly observe? Have we a thermometer? The answer is in the affirmative. We can use the atoms volatilised in the atmosphere of a star as their own thermometer, by observing the absorption spectrum they produce.

The theory depends on the recent progress in atomic physics. It has long been known that the spectra of the great majority of stars fall into a single linear sequence, in which, as we pass by ascending effective temperatures from the red stars to the blue stars, some lines decrease in intensity, others increase, attain a maximum and decrease, others again only appear far on in the sequence. Such a linear array of spectra could scarcely be due to differences in chemical composition, and it was emphasised by Russell and others that in some way the ordered sequence of spectra must be related to the sequence in effective temperatures. The true explanation, however, was only discovered in 1920, by Saha.

---

[1] Substance of a lecture delivered before the Manchester Literary and Philosophical Society on October 19

It was Saha who first pointed out that at high temperatures the atoms composing stellar atmospheres must dissociate into ions and free electrons according to the same laws of thermodynamics used by chemists to calculate molecular dissociations. Given the ionisation potentials of the atoms, the degree of dissociation is a function of temperature and pressure—to be precise, the partial pressure of the free electrons—and for a given pressure the ionisation increases with the increasing temperature. Consequently, for each element we shall have first the spectrum of the neutral atom, then that of the once-ionised atom, followed in turn by that of the twice-ionised atom, and so on. At the highest temperatures the spectrum of the neutral atom should completely disappear, in general. Further, the absence of an element from a stellar spectrum does not necessarily mean the absence of the element from the stellar atmosphere. It may only mean that the lines it is capable of producing in its then stage of ionisation are outside the accessible range of spectrum.

It is necessary to distinguish the ultimate lines of an atom in any given stage of ionisation from the remaining lines. The ultimate lines are absorbed only by the atom or ion in its normal, or unexcited stage. The theory shows immediately that the ultimate lines of a neutral atom should steadily decrease in intensity with increasing temperature: the ultimate lines of an ionised atom should increase at first, slowly attain a maximum and then decrease as further ionisation ensues. Calcium provides an illustration of both types of lines.

Intermediate between successive stages of ionisation we have atoms in excited states, with corresponding absorption spectra. Only a minute fraction of the atoms are in any given excited state at any instant, but the fraction is a definite one given the temperature and pressure, on the assumption of thermodynamic equilibrium. Moreover, this fraction has a comparatively sharp maximum. It is easy to see that a maximum must occur. At lower temperatures, comparatively few of the atoms are excited. As the temperature increases the excited fraction of atoms in the given state of ionisation increases, but the total number of atoms in the given state decreases owing to the next stage of ionisation setting in, and ultimately all the atoms pass into the next stage of ionisation. The number of excited atoms is thus practically zero at both low and high temperatures. In between it must have a maximum.

Following the method of Saha, it has been found possible to calculate at what temperature such a maximum should occur. We then identify the maximum in the number of excited atoms with the observed maximum of the corresponding absorption lines in the stellar sequence. We thus arrive at a truly thermometric scale of stellar temperatures. The most recent and detailed comparisons of observed and theoretical maxima are those contained in the researches of Miss Payne, of the Harvard College Observatory, and the following is her table of temperatures.

Class.	Temperature.	Class.	Temperature.
K_5	3,000°	A_0	10,000°
K_0	4,000°	B_8	13,000°
G_0	5,000°	B_3	17,000°
F_0	7,500°	$B_{1\cdot5}$	18,000°
A_5	9,000°	B_0	20,000°

At present there still remains an empirical element in the temperature scale. It is necessary to assume a value for the pressure—the partial electron pressure—in stellar atmospheres, and to assume that the pressure is the same in all stars. The removal of this empiricism promises to open up a still more important line of work. A synthetic theory of the structure of a stellar atmosphere would not in fact deal with the pressure at any particular level. Starting with the value of gravity at the surface of the star, and the atomic absorption coefficients, it would proceed to calculate the distribution of atoms through the atmosphere, taking due account of the varying effects of selective radiation pressure on the individual atoms. Ultimate lines, for example, will give rise to much more intense radiation pressure than lines corresponding to excited states. Different classes of atoms will thus be at different horizons in the atmosphere, and so at different pressures. The nature of the spectrum itself controls the pressure, and so in turn the degree of ionisation. This double relatedness of spectra to ionisation, due to the intervention of radiation pressure, may lead after further study of stellar spectra not only to an improved temperature scale with the empiricism removed, but further to determinations of surface gravity and to astrophysical determinations of relative, perhaps even absolute, atomic absorption coefficients. The possibility of the latter type of determination serves to remind us that astrophysics contributes to atomic physics as well as borrows from it.

A further by-product of the theory is the determination of the relative abundances of the different elements in stellar atmospheres. Observations of maxima provide temperatures, and are independent of relative abundances: each maximum is a thing *per se*. But the places of first or last appearance of a line in the stellar sequence depend on the amount of the corresponding element available, and in the hands of Miss Payne have been used to estimate the relative abundances. It must suffice to state that the abundances bear a relation of rough similarity to the abundances of the same elements in the crust of the earth, with the exception of hydrogen and helium, the behaviour of which is anomalous.

It has already been mentioned that intensities of spectral lines are connected with the surface values of gravity. Empirical connexions of line-intensities with the absolute luminosities of the corresponding stars are now well known: they are another aspect of the same phenomenon. By a method originated by Kohlschütter, Adams and Joy, they are now used at many observatories to determine the parallaxes of stars spectroscopically. In conclusion, reference may be made to a similar method recently developed in the brilliant work of Ch'ing-Sung Yü at the Lick Observatory. He has investigated the continuous absorption spectrum associated with the limit of the Balmer series of hydrogen. This spectrum is produced by the ionisation of hydrogen atoms: its intensity is a measure of the fraction of hydrogen atoms remaining un-ionised. Yü has found empirically that it is a function of colour-temperature and of absolute magnitude. The method eliminates one unsatisfactory feature in the method of Adams and Joy, namely, the use of different empirical reduction curves for stars of different types. Yü's photometric measures determine colour-temperature and hydrogen absorption from the same spectrogram, and from these two quantities the absolute magnitude may be inferred. It is too early to estimate the ultimate value of the method, but it is at once a new weapon for the determination of parallaxes by calibration on known stars, and a challenge to theoretical investigators.

Obituary.

PROF. W. J. HUSSEY.

PROF. W. J. HUSSEY died suddenly in London on Thursday, October 28. He reached England on October 23 with Mrs. Hussey and with Mr. and Mrs. Rossiter. They proposed to leave for the Cape on October 29, taking with them a large telescope of 27 inches aperture and 41 feet focus. This was to be installed near Bloemfontein, Prof. Hussey remaining until the building was completed and leaving Mr. Rossiter in charge to carry out an extensive programme of double star observations. Prof. Hussey had only lately recovered from an attack of pleurisy, but seemed fairly well on October 27, when he gave an address to the British Astronomical Association.

William Joseph Hussey was born at Mendon, Ohio, on August 10, 1862, and graduated B.S. of the University of Michigan in 1889. For some years he taught mathematics in the University of Michigan, and was acting director of the Detroit Observatory. In 1892 he was appointed assistant professor of astronomy at the Leland Stanford Junior University, afterwards succeeding to the chair. From Leland Stanford it was a natural transition to the post of assistant astronomer in the Lick Observatory, not many miles away.

Hussey's knowledge and enthusiasm were such as to enhance the high traditions of this famous observatory. Barnard and Burnham had left, and their places were filled by Aitken and Hussey. The first important work Hussey undertook was the re-observation and discussion of the double stars observed by Otto Struve. The results form vol. 5 of the Lick Observatory publications. Hussey measured many close and difficult double stars which were only within reach of the largest telescopes. Among them may be instanced δ Equulei, which has an elliptic orbit, and the two stars are only separable when near elongation. He followed this star closely and found it to have a period of 5·7 years, one of the shortest known, while previous observers had supposed the period to be about double this length. It may be interesting to note that he determined the parallax of this star by a combination of line of sight determinations of linear velocity with the determinations of angular movement resulting from double star measures.

In 1899 Hussey joined Aitken in a systematic examination of all stars between the pole and -22° down to $9{\cdot}0^{m}$ or $9{\cdot}1^{m}$ to discover which of them were double. They worked on this programme from sunset to sunrise, and when Hussey left in 1906 to be professor of astronomy and director of the observatory of the University of Michigan, he had discovered so many as 1327 new double stars. Here he was engaged in spectroscopic work and in building and organising a new observatory. In 1911 the directorship of the observatory of La Plata was added to that of the University of Michigan. Before his resignation of this post in 1917, he had discovered 312 new southern double stars.

In 1902 Hussey was appointed to make telescopic tests of the suitability of sites in South California and Arizona for a solar observatory, and strongly advocated the selection of Mount Wilson. From 1917 he had in mind the possibility of the establishment of an observatory in the southern hemisphere specially for double star work. Three years ago he visited South Africa, and was very favourably impressed with the site of Bloemfontein. A personal friend from college days, Mr. Lamont, has recently provided funds for a telescope, designed and built under Hussey's direction, with an object-glass by Zeiss. This telescope was completed and was being taken to Bloemfontein at the time of Prof. Hussey's death. We understand that arrangements have been made to go forward with the establishment of this observatory, and that Mr. Rossiter left for South Africa on November 5. This, we may be sure, would have been in accordance with Prof. Hussey's wishes.

Prof. Hussey had many friends among English astronomers, who admired his gifts of industry and enterprise, and were always pleased when occasions like eclipse or other expeditions brought him to London and gave an opportunity of meeting him. He had been a foreign associate of the Royal Astronomical Society since 1903.

F. W. D.

WE regret to announce the following deaths:

Prof. F. M. Caird, emeritus professor of clinical surgery in the University of Edinburgh and a past president of the Royal College of Surgeons of Edinburgh, who worked as a student under Lister, on November 1, aged seventy-three years.

Dr. W. Romaine Newbold, Seybert professor of moral philosophy in the University of Pennsylvania, who wrote on suggestibility, automatism and kindred phenomena, on September 26, aged sixty years

Dr. Francis E. Nipher, emeritus professor of physics in Washington University, St. Louis, whose work covered aspects of gravitating nebulæ, wind pressure, and the electric discharge, on October 6, aged seventy-eight years.

Dr Franz Pfaff, formerly professor of pharmacology and therapeutics at the Medical School of Harvard University, on September 26, aged sixty-six years.

Dr C. A. Waldo, emeritus professor of mathematics in Washington University, St Louis, known for his work on warped surfaces, on October 1, aged seventy-four years.

News and Views.

ON Saturday, November 27, the authorities of the town and cathedral of St. Albans will commemorate the six hundredth anniversary of the election of a prelate famous in the history of the Abbey—Richard of Wallingford, Abbot 1326–1335. This fact has interest for men of science and archæologists, for Wallingford was a scientific pioneer, as well as a distinguished abbot. At Oxford, where he was a student and doctor in the 'Hall' maintained by the leading Benedictine houses for the reception of promising youths from their local schools, he won fame as a mechanician and astronomer, almost as a magician. In this he shared the lot of 'Friar Bacon,' whose follower, though not immediate pupil, he was; it seems that that pioneer genius started what might have been a great school of science at the university. Wallingford was the author of scientific treatises, one of which, "The Rectangulus," survives in MS. to this day. Many of the scientific instruments he invented are preserved, either actually or as reproductions, in the Ashmolean Museum, and were the basis on which later men could work. His scientific *chef d'œuvre*, however, was the astronomical device 'Albion' ('all by one'), which showed "the action of the tides and the revolutions of the planets."

THE above commemoration will be attended by Sir Frank Dyson (the Astronomer Royal), Prof. H. H. Turner, Dr. R. T. Gunther, and other scientific men (including representatives of the Clockmakers' Company), and will take the form of a service in the Abbey of St. Albans at 4 P.M., at which a wreath will be placed on Wallingford's tomb, and his prayers used. Later, there will be a gathering in the Town Hall, when papers will be read on Wallingford's work as man of science and abbot, and there will be a small exhibition of his scientific instruments. It is hoped that this will include the actual instrument 'Albion,' for it was acquired from the Royal Commissioners at the time of the dissolution of the abbey, by a local 'Squire,' and it has ever since been an heirloom in his family. The instruments will be explained by Dr. Gunther. The service and gathering are, naturally, public, and any one desiring more information on the matter should apply to the Hon. Secretary, Wallingford Commemoration, Kingsbury Knoll, Verulam Road, St. Albans.

ACCORDING to a recent message of the Stockholm correspondent of the *Times*, the following awards of Nobel prizes have been made: The reserved prize for physics for 1925 between Prof J Franck of Göttingen and Prof. Hertz of Halle; the prize for physics for 1926 to Prof Jean Perrin; the prize for chemistry for 1925 to Prof. Richard Zsigmondy; the prize for chemistry for 1926 to Prof. The Svedberg. Prof. Franck is professor of physics and director of the physical laboratory in the University of Göttingen and is the author of many papers on atomic structure, ionisation by collision, and related topics. Prof. Perrin is professor of physical chemistry at the Sorbonne; he is the author of a standard work on atomic chemistry which has passed through many editions and has been translated into French and German He was elected a foreign member of the Royal Society in 1918. Profs. Zsigmondy and Svedberg are both best known for their work on the colloidal state. Prof. Zsigmondy is professor of inorganic chemistry in the University of Gottingen; he has worked largely on the gold sols, and his book on colloids and the ultra-microscope has been translated into English. A recent volume, "Das Kolloide Gold," by Prof. Zsigmondy and P. A. Thiessen, is the first of a new series of monographs in which the scattered work on the physics and chemistry of colloids is being brought together under Prof. Zsigmondy's guidance. Prof. Svedberg, professor of physical chemistry at the University of Upsala, has carried out numerous and fundamental researches on colloidal solutions of the suspensoid type and has made noteworthy contributions to our knowledge of the chemistry of photographic processes.

AT a luncheon given on November 12 by the Imperial College of Tropical Agriculture to the Dominion Prime Ministers and representatives, Mr. Amery made the important announcement that 96,000*l*. out of the 100,000*l*. which Lord Milner set out to obtain as an endowment fund for the College has now been raised. Sir Arthur Shipley, who presided, pointed out the great need there is for agriculturists who have been thoroughly trained in tropical agriculture, men of this type are wanted everywhere, and it is this want that the Trinidad College is hoping gradually to satisfy. One of the difficulties is that there is not at present a sufficient supply of schoolboys with any biological training. Sir Arthur deplored the fact that it is now possible for a student to take honours in a Natural Science Tripos at Cambridge without taking at least one biological subject. At the present moment the market for chemists and engineers is gravely overstocked, whereas there is an appalling dearth of entomologists and mycologists. This state of affairs the College is endeavouring to redress. Both Mr. Bruce, the Prime Minister of Australia, and Mr. Coates, the Prime Minister of New Zealand, stated that they took the greatest interest in the College, although neither was able to make any immediate promise to provide funds for its enlargement.

IT is doubtless true that the number of fatal flying accidents to service flying officers this year—more than seventy to date—large as it is, is in diminishing ratio to the number of hours flown as compared with previous years since the War. It is probably true also that many of the accidents which occur are due to errors of judgment on the part of the pilots. The number of accidents is sufficiently large, however, to occasion concern and to re-emphasise the need for more and more research in connexion with the design and construction of aircraft, and obviously for the exercise of more care in the selection of pilots and more care in their training. Whether the private aircraft construction companies should be granted subsidies with which to carry out their own research programmes, the suggestion made by Mr. Handley Page in his letter published in the *Times* on November 12, or whether it would be better for the Royal Aircraft Establishment to undertake aircraft construction as well as design, is a debatable question. It is obvious that Great Britain, however favourably it compares with other countries as regards accidents, has still to carry out much research work before a type of aircraft is evolved which will combine stability with manœuvring capacity. There is still much work to be done in connexion with the elimination of the possibility of fire on 'crashing,' and other safety precautions. There is little doubt that every aeroplane accident, whether it is a service machine or a commercial machine involved, shakes the confidence of potential passengers in the safety of air travel and reacts unfavourably against the development of commercial air services.

On November 23, the centenary occurs of the death of Johann Elert Bode, the famous German astronomer. Born at a time when scientific studies in Germany were recovering from the set-back brought about by the disastrous Thirty Years' War, Bode was the first to diffuse a general taste for astronomy among his fellow-countrymen. He was the Lalande of Germany, and his name is known to every one as the author of "Bode's Law." That law, it is true, is to be found in the writings of Titius, Wolf, and others, but it was Bode who first directed attention to it. His world-wide reputation, however, rested on other grounds. The son of a schoolmaster, and born in Hamburg, January 19, 1747, Bode at the age of twenty-one years published a popular treatise on astronomy and an essay on the transit of Venus of 1769. Three years later Frederick the Great made him astronomer to the Berlin Academy of Sciences, in which position he did much to stimulate astronomical studies. His well-known "Astronomische Jahrbücher" were commenced in 1774; two years later he published an essay on the constitution of the sun, and in 1778 made known the law bearing his name. He closely followed Herschel's newly discovered planet, and it was he who named it Uranus when Herschel would have called it Georgium Sidus. His "Uranographia," or Great Celestial Atlas, appeared in 1807 and contained observations of about 17,000 stars. Long regarded as the head of German astronomers, he was younger than Mayer, but among his contemporaries were such as Harding, Gauss, Schumacher, Struve, and Encke.

The opinion among engineers of the value of a training in the scientific principles of the profession has altered greatly during the past twenty years, and there are few, even among the older school of engineers, who do not now recognise the advantages of such a training. But although few subjects have been more widely discussed, there are still wide differences of opinion as to how, when, and where such a training is best obtained, and as to exactly what it should include. Should it be obtained at a technical school in evening classes, or in a full-time course at a university? Should it precede, be carried on simultaneously with, or follow a course of practical training in works or office? Should the university attempt anything in the nature of practical training? How long should the period of practical training last? In a paper read at a meeting of the North-East Coast Institution of Engineers and Shipbuilders on October 29, Principal Sir Theodore Morison, of Armstrong College, Newcastle, suggested the formation of a committee of the Institution with the view of giving an authoritative answer to these and other cognate questions.

The outcome of Sir Theodore Morison's suggestion will be of interest, and we look forward to a report of the discussion of the paper. Numerous committees of engineers have considered the subject in the past in Great Britain and other countries, without by any means exhausting its possibilities. Since the report of the committee of the Institution of Civil Engineers on engineering education some years ago, the scope of engineering has in many respects changed, and the ideal scheme of fifteen years ago is not of necessity best fitted to satisfy to-day's requirements. Such a committee has recently been considering the subject in the United States of America. Perhaps the most interesting part of its report is the general insistence on the importance of cultural subjects, and of a thorough grounding in the general physical principles of engineering. The idea of specialising until a late period of the course, and even then of too pronounced specialisation, is in general deprecated. We are of the opinion that this is a very sound view. We believe that the majority of the engineering schools of the universities of Great Britain do aim at giving this sound fundamental training. At the same time, provision should be made at certain selected universities for highly specialised courses of post-graduate standing. At the moment, this would appear to be the weakest part of the university training of engineers in England. Such a committee as the one suggested might well consider what courses of this nature might most usefully be instituted.

It seems probable that in the immediate future the development of electricity supply in Ireland will rapidly increase. At present it is more backward in this respect than any country in Europe. The consumption in Northern Ireland is 43 units per head of the population, and in the Free State only 16 units per head. This compares with a consumption of 2500 units in Norway, 900 in Switzerland, and 140 in Britain. In his presidential address to the Irish section of the Institution of Electrical Engineers, Mr. Kettle, the city electrical engineer to Dublin, took a favourable view of the future of electricity supply in Ireland. He said that the Shannon scheme is not mainly a 'power' scheme. It is more a 'transmission' scheme comparable to the Swiss Central Board arrangement and the British Government scheme. He admitted, however, that the promoters of the Shannon scheme seem to anticipate that it will be a commercial success from its commencement—an altogether too sanguine view to adopt. The Free State has anticipated the ordinary course of events by about ten years, but having put its hand to the plough it cannot turn back. The country has been definitely committed to the scheme, and the fullest co-operation with other schemes is necessary in order to make it a success. A second Shannon Power Bill is apparently expected in the near future and it will probably deal with the supply and control of the entire electricity supply of the Irish Free State. A transmission scheme has been outlined for Northern Ireland, but the authorities there appear to be disposed to proceed more gradually than those of the Free State. There is not much difference between the two schemes except that one would use coal and the other water power. Mr. Kettle thinks that both networks should be so designed that they can be combined to form an all-Ireland scheme at a future date.

THE story of Clerk Maxwell has hitherto been mainly confined to biographical details of his life and general career. As, however, it is now nearly fifty years since he died, it is possible to see how much his work has influenced the development not only of physics but also of applied engineering. In particular, every radio expert claims him as one of the great pioneers of electrical communication because of the invaluable help his electromagnetic theory of light has been in the development of their art. In the October issue of *Electrical Communication* Mr. Rollo Appleyard begins a series of articles on the pioneers of electrical communication by an eloquent eulogy of Maxwell. In 1856 Maxwell accepted a professorship at Aberdeen. In 1860 he became a professor at King's College, London, and in 1871 he became professor of experimental physics at the Cavendish Laboratory, Cambridge. It has to be remembered that from 1851 to 1865 very rapid progress had been made in submarine telegraphy, and many data in connexion with electrical phenomena had been collected which Maxwell had to interpret from the theoretical point of view. His great paper on the "Dynamical Theory of the Electromagnetic Field" was published in 1865. On this paper the electrician has built his practical theory of the working of the alternating current transformer and much of the modern theory of electrical communication. Maxwell admitted electricity to the rank of a physical quantity, but he warned us against assuming too hastily that it was either matter or a form of energy. He considered that it was proved that electricity could not be annihilated and that it could not be created. He has left us a memory of individual thought and achievement which has rarely been rivalled in the history of the world.

PROF. A. P. LAURIE delivered a lecture to the students of the Royal Academy, London, on Wednesday, November 10, on "The Theory of Colour and its Application to Painting." Modern pictures in oil vary frequently and lower considerably in tone in the course of years. One cause of this is the yellowing of the oil, and an investigation was undertaken to see whether some other cause was not also present. Pigments may be regarded as translucent particles of varying refractive index, and the light received from their surface will consist partly of light reflected from the first surface struck by the ray of light, and partly by light transmitted through the pigment, and then reflected. The first reflection will consist principally of white light. The ratio between the reflected and the transmitted ray varies according to a somewhat complex formula with the difference between the refractive index of the medium in which the pigment is ground and that of the pigment itself. Thus, if the refractive index of a linseed-oil film increases with age, the result will be gradually to lower the tone of the pigment ground in it. Experiments have shown that in nine months the change is sufficient to affect the opacity of white lead and the tint of cadmium yellow. A rough table was then prepared of the principal bright pigments used by artists, these pigments being arranged in the order of transparency by examination in media of higher and higher refractive index and also in their spectrum order, so as to enable artists to pick out those least affected by the two changes taking place in linseed oil. These experiments throw new light on the methods of oil painting in the fifteenth and sixteenth centuries; the painters of that time were evidently experimentally aware of both of these properties of linseed oil and based their technique upon these facts with the view of keeping up the colour key of their pictures.

THE thirteenth Thomas Hawksley Lecture was delivered at the Institution of Mechanical Engineers on November 5 by Prof. E. G. Coker, the subject chosen by the lecturer being "Elasticity and Plasticity." After a brief historical introduction, Prof. Coker described the advances which have been made in recent years in the science and technique of photo-elasticity. An interesting feature of this part of the lecture was the description of the apparatus now used for measuring the applied load, which depends upon the elastic deformation of a steel ring loaded diametrally. Photo-elastic methods are employed to determine the most suitable form of ring, and a mechanical multiplying device fixed within the ring serves to record visually the diametral extensions. Prof. Coker then outlined the mathematical theory of photo-elasticity, in regard to the determination of the principal stresses both by direct measurement of the lateral strains, and by Filon's development of Clerk Maxwell's method of integration along the lines of principal stress, using as an illustration of the latter the dovetailed joint used for steam turbine blades. Dealing next with the subject of elastic breakdown, Prof. Coker described the various attempts which have been made to discover a law governing failure under all systems of stress, and referred particularly to those involving combinations of the single criteria proposed by Rankine, St. Venant, and Guest, and to the strain energy theory of Haigh and its modification by von Mises. A most interesting portion of the lecture was devoted to the subject of plasticity, the researches of Prandtl, Hencky, and Nadai being brought under review, particularly in their application to the phenomena associated with the pressure of a die in a steel plate. The manner in which the soap film method used by

Griffiths and Taylor for the determination of stress distribution in torsion can be extended to the case of plastic strain was described, and the lecture concluded with a review of the present state of knowledge regarding the application of optical methods to the determination of plastic stresses.

MR. P. A. BUXTON, of the London School of Tropical Medicine, to whose researches in the New Hebrides reference was made in the article on West African Development which appeared in NATURE of November 6, writes to correct a rather important misapprehension of his conclusions regarding the relation between malaria and abortion. In commenting on the omission in Mr. Ormsby Gore's report of any reference to Mr. Buxton's important memoir on "The Depopulation of the New Hebrides," the statement was made that "it seems fairly well established from the recent researches of Mr. Buxton in Melanesia that malaria is one of the principal determining causes of abortion and still-births." This was based on the statements on page 425, vol. 19, *Trans. Roy. Soc. Trop. Med. Hyg.*, to the effect that "abortion is common in all the islands of Melanesia"; the probability "that methods of obtaining abortion, which have been known [to the natives] from time immemorial, have been used more and more frequently within the last half-century," partly due to increasing monogamy, the outcome of the white missionary's zeal; and the supposition "that unprovoked abortion is common in the New Hebrides, owing to the malaria, and therefore any procedure which is adopted to produce abortion will occasionally be followed by the desired result, even if it is intrinsically harmless." Too much has been read into this last statement, for Mr. Buxton writes: "My conclusions may be summarised thus: malaria and the practice of abortion (not abortion caused by malaria) are both concerned in the disappearance of these peoples. But I have never showed, or tried to show, that malaria caused enough abortions to make it a factor in the depopulation, and it seems improbable that this is so, for the depopulation is an event of the last century and the malaria is an indigenous disease.'

REFERRING to our note in the issue of November 13, p. 708, on the distances at which the 'concentration shoot' off Portland on October 30 was heard, Prof. A. E. Boycott writes stating that the firing was heard very clearly in the open near Aldenham, Hertfordshire, about 125 miles from Portland, and was mistaken at first for thunder. There was a fairly strong north wind blowing. Dr. R. T. Gunther, 5 Folly Bridge, Oxford, states that the firing was distinctly heard on the towing-path near Oxford and it also caused the windows of his house to rattle. Oxford is about 110 miles from Portland.

IN the issue of *Science* for October 1 there is a short but interesting contribution from Dr. Edgar F. Smith on Priestley's life in America, whence he withdrew in 1794 from the animosity to which his religious views had given rise in England. Priestley's daily life in his adopted home is briefly described, and his manifold activities summarised. Persecution followed him across the Atlantic, mainly on account of the anonymous attacks on him which are stated to have been written by William Cobbett, "an Englishman whose pen, dipped in gall, spared the venerable scientist in no wise." He was, however, a friend of American divines. Priestley's advanced views on education are compared with those of Herbert Spencer, and the article is a sympathetic account of a man who has not, perhaps, had the credit paid to him which is his due.

IT is announced in *Science* that the John Fritz Gold Medal of the American Societies of Civil, Mining and Metallurgical, Mechanical and Electrical Engineers for 1927 has been awarded to Elmer Ambrose Sperry, of New York, for the development of the gyro-compass and the application of the gyroscope to the stabilisation of ships and aeroplanes.

AT the annual general meeting of the Cambridge Philosophical Society, the following officers were elected for the session 1926–27: *President*, Dr. H. Lamb; *Vice-Presidents*, Mr. G. Udny Yule, Prof. J. T. Wilson, Prof. A. Hutchinson, *Treasurer*, Mr. F. A. Potts; *Secretaries*, Mr. F. P. White, Mr. R. H. Fowler, Mr. H Munro Fox, *New Members of Council*, Prof. T. M. Lowry, Dr. H. Jeffreys, Dr. F. J. W. Roughton, Mr. F. T. Brooks.

IT is now announced that the Proceedings of the Optical Convention, 1926, held at the Imperial College of Science and Technology, South Kensington, on April 12–17 last, will be ready in the first week of December. The book is in two cloth-bound and fully illustrated quarto volumes, each of more than 500 pages, and contains the presidential address and the papers read at the Convention, with a full report of the discussions thereon. The address of the Secretary of the Optical Convention is 1 Lowther Gardens, Exhibition Road, London, S.W.7.

A NATIONAL Coal Products, Chemical, and Engineering Exhibition, arranged by the Manchester Section of the Society of Chemical Industry with the assistance of Provincial Exhibitions, Ltd., was opened at the City Hall, Manchester, on November 16 and will remain open until November 27. Scientific exhibits have been obtained from the fuel departments of the universities of the north of England, from the Fuel Research Board, and from the Lancashire and Cheshire Coal Research Association, and there are models, diagrams, and photographs of special interest to those engaged in the mining and utilisation of coal. In connexion with the Exhibition, a Conference on Tar will be held on November 26; three sessions have been arranged, the chairmen of which are Prof. A. Smithells, chairman of the Fuel Section of the Society of Chemical Industry; Mr. T. Glover, president of the Institution of Gas Engineers; and Mr. E. Escott Wood, president of the Coke Oven Managers' Association.

THE Smithsonian Institution of Washington announces the dispatch of a botanical exploring expedition to Colombia under the leadership of Mr. E. P. Killip. Starting from Cartagena, the expedition will follow the valley of the Magdalena River to

Puerto Vilches and then cross over to Bucaramanga and Pamplona near the Venezuelan frontier. The expedition forms part of the programme decided on in 1917 by the Smithsonian Institution, the New York Botanical Garden, and the University of Harvard, for the systematic exploration of the four north-western states of South America, and continues the work begun in 1922 by Mr. Killip in the country around Buenaventura.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Two laboratory assistants at the Low Temperature Research Station, Cambridge—The Superintendent, Low Temperature Research Station, Downing Street, Cambridge (November 27). An assistant in mycology in the Pathological Laboratory, Harpenden, of the Ministry of Agriculture and Fisheries—The Secretary to the Ministry, 10 Whitehall Place, S.W.1 (November 29). A lecturer in chemistry at Armstrong College, Newcastle-upon-Tyne—The Registrar (December 1). Chemists, physical chemists and physicists for work under the Research Association of British Paint, Colour and Varnish Manufacturers—The Director of the Association, 8 St. Martin's Place, W.C 2 (December 2). An assistant lecturer in organic chemistry in the University of Leeds—The Registrar (December 6). A demonstrator in mathematics at the Royal College of Science, South Kensington—The Secretary, Imperial College of Science and Technology, South Kensington, S.W.7 (December 7). A professor of anatomy in the University of Lucknow — The Registrar (December 31). A principal of the Denbighshire Technical Institute—The Secretary and Director of Education, Education Offices, Ruthin (December 31). A lapidary (male) for the Department of Mines, Ottawa, Canada—The Secretary, Civil Service Commission, Ottawa, Canada (January 6). A professor of physiology in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (January 31). A principal of the University College of Wales, Aberystwyth—General Secretary of the College (January 31). A lecturer in geography at the Bedford Training College—The Principal, The Crescent, Bedford. A lecturer in mathematics in the Gordon College, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (marked " Lecturer ").

Our Astronomical Column.

COMET COMAS SOLA.—This comet is 1926 *f*, being the sixth to be detected during the year, but four of the six, also Neujmin's Comet, 1926 *g*, were periodic comets observed on their return to perihelion. Mr G Merton has photographed the new comet on two nights, and Mr. B. M. Peek sends the following notes on its physical appearance. With a 12-inch mirror, power 200, the diameter of the nebulosity is 1′ using averted vision Direct vision shows a coma of 15′ diameter, and a stellar nucleus of 12 mag., the total light being fully 11 mag.

Herr Ebell has deduced the following orbit, which is still uncertain owing to the distance of the comet and its slow motion:

T	1927, May 14·333 U.T.
ω	62° 48′
Ω	57 15
i	24 57
$\log q$	0·24405

EPHEMERIS FOR 0h U.T

	R A.	N. Decl.	log r.	log Δ.
Nov. 21	2h 40m 25s	7° 36′	0·4437	0·2614
29	2 32 25	8 19	0·4326	0·2548
Dec. 7	2 25 6	9 11	0·4213	0·2518
15	2 19 8	10 13	0·4097	0·2528

The comet is well placed for observation, being on the meridian before midnight. It is likely to become an easy telescopic object during December.

MODERN ASTRONOMY.—The July issue of *Natural History*, the journal of the American Museum of Natural History (vol. 26, No. 4), is an attractive number devoted entirely to astronomy. Prof. S. A. Mitchell (Director of Leander M'Cormick Observatory) writes on total solar eclipses, of which he has seen six, involving journeys of 50,000 miles in all. The three latest American eclipses of 1918, 1923, 1925 are described in great detail. That of 1923 had the best weather prospects, but the least successful results. Beautiful coloured reproductions of these three eclipses, by Mr. Howard Russell Butler, are given. He describes his method of working in the second article. He notes that there are three factors of colour—brightness or value, prismatic hue, saturation. He makes rapid outline sketches, indicating in shorthand the values of these factors for each region, and works the picture up from these, using photographs to improve the outlines. He also reproduces a coloured picture of a lunar crater lit by a low sun The sunlit portion is nearly white, with various faint tints. The part in shadow, lit by the sunlit walls and by the earth, varies from greenish brown to brown. The gibbous earth is shown, the ocean being blue, polar regions and solar reflection white, clouds and land light brown; the sky is dead black and star-studded.

Prof. G. E. Hale writes on solar tornadoes. He gives some beautiful spectroheliograms of prominences, filaments, and vortices, describing the paddle apparatus he has invented for imitating the latter. He mentions the curious change in polarity of sunspots at the beginning of new cycles, but points out that the change is not shared by the high-level hydrogen vortices, which seem to follow the same law of rotation as terrestrial storms. Incidentally, he refers to stars using their energy to build up the atom from electrons and protons. Inasmuch as other physicists are relying on the stars deriving their energy from the atom, to explain the immense duration of their life as suns, there would seem to be need of co-ordination, so that astronomers may not be liable to the accusation of forgetting the conservation of energy, and trying both to " eat their cake and have it "

W. J. Luyten writes on " island universes." He takes the recently adopted distances (ranging from a million light years) as fully established, and studies their size, etc., on this basis. He dates the " era of island universes " from Lord Rosse's discovery in 1845 of the great spiral nebula in Canes Venatici; but surely Sir William Herschel is entitled to the pioneer honours. Many of his estimates of the size and distance of these objects were of the same order as those adopted to-day.

Research Items.

ILLEGITIMACY AND RACIAL INVASIONS IN BRITAIN.—Dr. John Brownlee has published in *Man* for October an interesting note on the distribution of frequency in illegitimacy in the north of England and Scotland, and its relation to and bearing upon the evidence for racial migration. In the north of England there is a sufficiently close correspondence between the distribution of the round barrow and that of illegitimacy to suggest that this custom was introduced at the beginning of the Bronze Age, and that the invasion of Angles was not sufficient to do more than introduce a new racial element into this part of the country without modifying the custom. Information on illegitimacy in Scotland has been studied in more detail. The range of variation is much greater, the highest percentage of illegitimacy occurring in Aberdeenshire and in the southern districts of Scotland, especially Dumfries and Galloway. The Aberdeenshire district contains a larger proportion of broad-headed persons than any other part of Scotland; but the broad-headed population of the Aberdeenshire tombs is more closely allied to the type of central Europe than is that of Yorkshire and southern England. The percentage of illegitimate to legitimate births is 12 to 15, a rate comparable with that of central Europe. In Dumfries and Galloway there is no broad-headed association, the population being the most narrow-headed in Scotland; but here a close association with a certain type of hill-fort appears. This type of fort belongs to some period about the beginning of the Christian era. In the Norse settlements, Orkney, Shetland, and the western islands, the illegitimacy rate is low, but there are pockets in the north, chiefly adjacent to the coast, where the rate is high.

FOSSIL APES AND MAN.—In the recent issue of the *Bulletin of the Geological Society of China* (Vol. 4, No. 2) Dr. Davidson Black reviews our present knowledge of the distribution of the primates, living and extinct, with special reference to the ancient geography of Asia and its bearing on the ancestry of man. He accepts the principles enunciated by Dr. W. D. Matthew in his well-known essay on "Climate and Evolution" published in 1915, and refers to them repeatedly in his discussion of the subject. He especially emphasises the fact that at any one time the most advanced members of a group of animals must be nearest the original centre of its dispersal, while its lowest or most conservative members are farthest from this centre. Dr. Black then shows on a series of maps the present distribution of the several groups of primates, with the few known records of their extinct representatives. Central Asia, north of the Himalayas, is thus suggested as the region in which they successively originated and from which they were dispersed. Finally, Dr. Black shows the distribution of the known fossils on six maps which represent the continental lands of the successive Tertiary periods, according to Dr. A. W. Grabau. A discussion of these maps leads to the same conclusion, and Dr. Black looks most hopefully to an exploration of the Tertiary sediments in the southern foothills of the Tian-Shan mountains for the discovery of remains of the immediate ancestors of man. Both geologists and anthropologists will await the result with great interest.

FERTILITY IN THE COMMON MULE.—Dr. E. Warren (*Ann. Natal Mus.*, vol. 5, pt. 3, 1926) records an interesting case of fertility in a mule about the authenticity of which there appears to be no doubt. The mule is the result of a cross between a jack donkey and a dark chestnut mare, and was in foal to a hackney stallion. It was eight years' old when it first foaled and is believed to be in foal again. It produced abundant milk and suckled its foal in a perfectly normal manner. Dr. Warren describes the sire, the mule dam, and the foal in some detail with special reference to the degree of likeness of the latter to each parent. He finds that the extent of the prepotency of the parents, and the dominance of the characters, with respect to features which are diagnostic of the two species, horse and ass, vary within wide limits and range from nearly complete dominance to perfect blending.

AUSTRALIAN BIRDS.—The second edition of the official check-list of the birds of Australia has now been issued by the Royal Australian Ornithologists' Union. It has been published only after considerable deliberations on questions of nomenclature by a representative committee of Australian ornithologists and adheres fully to the code of the International Commission. The list gives for each bird the accepted generic, subgeneric, specific, and vernacular name, the range in Australia and beyond, references to the original use of the accepted name and to the standard works of Gould, Mathews, and other workers on Australian birds. A very useful appendix gives the derivations, pronunciations, and origin of all the scientific names used. The work appears to have been very thoroughly and completely done, and, as it has been compiled after due consultation with Mr. G. M. Mathews, who has worked intensively in this field of late years, the list may be regarded as authoritative. As such, it will prove invaluable to ornithologists generally and to museums in particular.

PLANT GROWTH IN THE SEA.—The third number of the *Journal of the International Council for the Exploration of the Sea*, edited by Dr. E. S. Russell and published in Copenhagen in August, keeps up the high standard of interest and utility of the first two numbers. The present issue contains an article on chemical factors concerned in plant growth by W. R. G. Atkins, and original papers by P. Jespersen, Oscar Sund, and C. H. Roberts, whose observations on the rate of absorption of atmospheric oxygen through thin films of fuel oils show how rapidly this may occur, and indicate that oil pollution does not markedly slow down the oxygenation of sea water, although it may be directly harmful to marine animals, since all the oils tested were found to be toxic to fish. In the first article, Atkins correlates a large amount of information concerning chemical factors, most of which has been obtained during the past ten years, as may be seen from the bibliography of more than fifty references. The information has not been brought together previously, and compilations of this kind are much wanted. A point of general interest which has arisen from these researches is the great fertility of the sea; from changes in alkalinity and hydrogen ion concentration it is calculated that the suspended vegetable organisms in the open water of the English Channel every summer use sufficient carbon dioxide in photosynthesis to produce 3 grams of dextrose from every cubic metre of water, or 250 metric tons of dextrose over an area of 1 square kilometre. This corresponds to the annual production of 1400 metric tons wet weight of vegetable plankton organisms per square kilometre in this district, a value which is confirmed by the amount of phosphate utilised annually.

Starch Formation in the Presence of Different Salt Ratios.—The real complexity presented to the investigator by 'calciphobe' and 'calciphile' vegetation is probably well indicated by some recent experiments by Dr. V. S. Iljin upon starch synthesis in the presence of salts of calcium and sodium (*Bulletin de l'École supérieure d'Agronomie*, Brno, 1925.) Leaves of plants were immersed in weak solutions of maltose or glucose in the presence of varying concentrations of chlorides of sodium or calcium and the concentration noted which brought starch formation to a standstill. Plants growing on soils of high calcium content still continued to form starch in the presence of high calcium concentration; on the other hand, even low concentrations of sodium salt prevented synthesis. Halophytes, on the other hand, continued to form starch in concentrations of sodium up to 0·35-0·5 *M*. Some species reacted in this respect at definite salt concentrations quite irrespective of the nature of the soil on which they were previously growing, whilst other species behaved quite differently when taken from soils rich or poor in calcium. Iljin concludes that we may not speak of 'phily' or 'phoby,' but only of the degree of tolerance of the plant to the injurious action of some salt. A plant particularly resistant to such injurious action may be placed at a considerable advantage in the struggle for existence in a soil in which the salt in question is present in a relatively high concentration.

Inheritance of Melanism in Lepidoptera.—Heslop-Harrison (*Journ. of Genetics*, 17, 1, 1926) continues the description and discussion of his remarkable experiments upon the inheritance of wing colour and pattern in the lepidopteran genus Tephrosia. He finds that, in interspecific crosses between *T. crepuscularia* × *T. bistortata*, melanism, introduced by the latter, remains, as it does within the limits of a species, a Mendelian recessive, that the progeny carrying two female characters (♀♀) out of a *bistortata* (female) × *crepuscularia* (male) mating are non-viable; that in back-crosses between *bistortata* (♀♀) and the two possible of the F_1 generation carrying two male characters (♂♂), one half of the ♀♀ dies; and that in the reciprocal *crepuscularia*(♀) × *bistortata* (♂♂) crosses, the sex-ratio among the offspring is undisturbed.

The Infection of Tree Roots by *Armillaria mellea*.—This root rot is one of the most serious of tree parasites and is usually assumed to enter through a wound. Considerable interest therefore attaches to the observation of S. M. Zeller (*Phytopathology*, 16, 479-484, July 1926), who gives grounds for thinking that if an infected root runs across a healthy root, even when both are of considerable age, infection gradually spreads to the healthy from the diseased root, layers of dead flakes being sloughed off the surface of the healthy root as new cork layers are formed in the bark parenchyma. With prune trees, evidence has also been obtained of the entry of the fungus through the little collar around the base of the emergence of a branch root, presumably as the result of the rupture of the bark parenchyma of the parent root during the emergence of the lateral.

The Possible Identity of different Mosaic Diseases.—An important paper upon this subject by M. N. Walker appears in *Phytopathology* (16, 431-458, July 1926). Cross inoculation with the mosaic diseases of cucumber, tomato, and physalis confirms other accounts as to the difference in behaviour of the virus in the expressed juices of these plants; thus tomato and physalis juice withstand ageing, drying, dilution, etc., whilst the virus of cucumber juices is much less resistant to such treatment as drying. On the other hand, the disease on tomato produced by injecting with cucumber mosaic shows the usual properties of tomato mosaic, and, conversely, the disease on cucumber obtained after inoculation from either physalis or tomato shows the usual great susceptibility of the extracted virus in cucumber juice. The conclusion would appear to be that the infective principle in each case was the same, and the differences in the properties of the extracted virus are to be attributed to the properties of the juice of the host plant.

A Tertiary Inter-basaltic Flora from Western America.—Dr. F. H. Knowlton has studied the fossil flora of the beds of clay and shale, named the Latah formation and found in Washington and Idaho (*U.S. Geol. Survey Prof. Paper* 140-*A*, 1926) These beds were formed by the obstruction of the drainage due to the advance of the great lava flows of the Columbian plateau, and are in places overlain by a later series of flows. The plants are unusually well preserved and are of interest as affording evidence bearing on the age of the lavas. Ninety-five forms are recognised, of which 51 are regarded as species new to science, 25 as species found in other areas, and 18 are not named specifically. As a whole, the flora is very modern in appearance, the oaks, elms, maples, and poplars being similar to certain living forms. Taxodium was one of the most abundant forms, and a Sequoia is also common, while Ginkgo is represented by a few specimens. Most of the new species are founded on remains of leaves, but a considerable number of remains of reproductive structures are present, some of which have not been specifically identified. The floras are regarded as showing affinities with those already described from beds of Miocene age The diatoms of the deposit are described by Dr. A. Mann, who describes 11 new species and some interesting twin forms.

New Theories of the Mother-Rock of Californian Petroleum.—In any oilfield the point of chief theoretical interest is the original source of the oil and the character of the organic matter whence it was derived. Since 1907 the generally accepted theory ascribed the bulk of Californian oil to Miocene diatomaceous shales, and the example has been used repeatedly to illustrate an almost ideal mother-rock, and further in advancement of the hypothesis of marine organic origin of petroleum. With the development of the great oilfields of the Los Angeles Basin, however, there has latterly been some doubt raised as to the validity of the diatomaceous shale theory; in fact, in one case, that of Santa Fé Springs, it would seem to be established definitely that the oil originated in younger formations, namely, the clay-shales of the Fernando group (Pliocene), since the deepest well, drilled to 7215 feet, was not abandoned until it was 2500 feet below the top of the rich oil-bearing sands, the last 1000 feet being barren beds; at the bottom of the well some fossiliferous Fernando beds were proved, thus showing that the Miocene (Puente) shales had not been reached. It is reasonably argued that the great thickness of barren beds present in the lower part of the Fernando formation inhibits the theory of a Miocene mother-rock for the Santa Fé Springs oil, since, had this older horizon been competent in this respect, the Fernando sands would have been successively richer in depth. The fact that Santa Fé Springs has been one of the largest oil-producing fields in the world (for many months in 1923 it was giving a daily production of more than

42,000 tons of oil), is further significant. Recent papers of G. C. Gester, J. E. Eaton, G. E. Cunningham, and T. F. Stipp in *Bulletins of the American Association of Petroleum Geologists* have done much to create the doubt of alleged oil-source in this region, in fact throughout California; but with the appearance of W. A. English's *Bulletin* (*No. 768*) on the Puente Hills Region (which includes part of the Los Angeles Basin), recently to hand from the United States Geological Survey, the alternative theory receives official support, and it is clear that we must prepare to modify considerably our faith in diatom-shales as ideal mother-rocks. Foraminifera, not Diatomaceæ, are the prominent organisms of the Fernando beds, especially of the oil-measures.

Coefficients of Expansion at Low Temperatures.—An accurate knowledge of the coefficients of expansion of solids at low temperature is necessary for testing theories of the solid state, and R. M. Buffington and W. M. Latimer have obtained expansion data for aluminium, copper, silver, rock salt, quartz parallel to the optical axis, and pyrex glass between 90° and 315° K. The Fizeau interference method was used, and a full description of the investigation is published in the *Journal of the American Chemical Society* for September. The coefficients of expansion of the crystalline solids, which change slightly more rapidly than do the specific heats, approach zero at low temperatures, in agreement with the prediction of Nernst. It was possible, from the data on aluminium, copper, and silver, to introduce terms depending on the constraints between the atoms into the equation for the entropy of solids, and the entropies of six monatomic solid metals are shown to be satisfactorily represented by the new equation.

Photography at Low Pressures.—The May issue of the *Memoirs of the Kyoto College of Science* contains a paper by Osamu Masaki on the effects of low pressure on the sensitivity of the photographic plate. Two pieces cut from the same plate were enclosed in two compartments in a glass-fronted brass box. The pressure in one of the compartments could be reduced to that of 0·005 cm. of mercury. The box was placed behind a rotating Hurter and Driffield wheel, the openings in which exposed strips of the plates for times in the ratio 1, 2, 4, 8, 16, etc. to the light of a 50-watt incandescent electric lamp of milky glass placed a metre away. The density of the film after development for 3 minutes was measured by means of a photoelectric cell and electrometer. In almost all cases the plates were more sensitive under reduced pressure, the effect being greater for slow than for fast plates. The reduction of pressure also reduced the tendency to fog. The greater part of these effects appears to be due to the drying of the emulsion, but some part is played by the removal of occluded gases under the reduced pressure.

Velocities of Diffusion in Gels.—The *Science Reports of the Tôhoku Imperial University* for July 1926 contain a paper by M. Watanabé on the relation between the diffusion velocity and the concentration of the diffusing substance. The equation $K = m\log C + n$, in which K is the value of $d/\sqrt{t}$ at the beginning of diffusion (d being the distance of the diffusion in time t), C the original concentration of the diffusing substance, and m and n constants, was found to hold at the beginning of diffusion of a salt from solution into a gel containing a reacting substance. O. von Fürth and F. Bubanovic consider that the equation holds if $K = \log d/\sqrt{t}$. For a limited range of concentrations it is clear that both formulæ apply, and Watanabé shows that this is due to the diffusion of the substances dissolved in the gel, which renders the results inaccurate. When a colloidal reactant was used the formula $d/\sqrt{t} = m\log C + n$, was found to apply over a wide range of concentration, while Fürth and Bubanovic's expression is limited to a few concentrations. In a further paper in this journal the formula is applied to the results of experiments on the diffusion of mixtures of copper and zinc sulphate solutions.

The Rate of Reaction of Nitric Oxide and Oxygen.—H. B. Baker has shown that carefully purified and dried nitric oxide and oxygen do not react; but under ordinary conditions combination takes place rapidly, and W. A. Patrick and R. L. Hasche have studied the effect of increased glass surface on the reaction velocity. In the *Journal of the American Chemical Society* for September, Hasche describes further experiments in which the influence of a paraffin-coated reaction chamber, and moisture, sulphur dioxide, and nitrogen tetroxide have been measured. It was found that moisture increased the speed of combination, and the decrease in velocity caused by the paraffin surface is thought to be due to a decrease in the amount of moisture. In the absence of water vapour, a period of induction of about 10 sec. was noticed at initial partial pressures of less than 14 mm. The effect of sulphur dioxide and nitrogen tetroxide was negligible.

Heat Loss and Frictional Resistance in Air Currents.—The relation between the heat lost by a hot surface when cooled by a current of air passing over it, and the frictional resistance experienced by the surface, has been subjected to investigation by many research workers. So early as 1874 Osborne Reynolds examined this question. That such a relation may exist appears clear from the fact that both the frictional resistance and the heat transference occur in association with the passage of momentum in the air in the neighbourhood of the surface. A further contribution to this subject has appeared in the Aeronautical Research Committee Report, R. and M. No. 1004 (H.M. Stationery Office, 1*s.* net). In this paper Miss D. Marshall has recorded two distinct series of tests. In the first place a short heated section of pipe, 5 in. in diameter, was cooled by a current of air forced through it, the heat transmitted being estimated from the rising temperature of the air. In the second test, thin rings of nickel heated electrically were supported in a wind channel, the transmitted heat being measured from the energy supplied to the ring. In this latter case the effect of artificially roughening the surface of one of the rings was specially investigated. In common with previous experiments, a considerable discrepancy is found to exist between the observed heat transmission and that calculated from the measured surface friction, a difference of 20 per cent. being found in the case of the smooth rings. In the case of the roughened rings, however, fairly close agreement is found over a considerable range of speed. Thus it will appear that the effect of surface roughness is much greater than would be anticipated, the dimensions and form of the irregularities constituting quite an important factor. The investigation must prove of considerable interest in its bearing on the surface friction of thin plates in the neighbourhood of the leading edge, for these results are in fairly good agreement with the law of surface friction deduced by Blasius from Prandtl's theory of the boundary layer. This agreement extends both to the law of variation of frictional resistance with speeds and the actual value of the forces.

Progressive Lightning.

DR. N. ERNEST DORSEY (*Jour. Franklin Inst.*, 201, pp. 485-496, April 1926) in America, and Dr. G. C. Simpson (*Proc. Roy. Soc.*, A, vol. 111, No 757, May 926) in England, have recently published papers n which they have discussed from theoretical considerations the start and progress of a lightning flash, and in a recent number of NATURE (August 7, p. 190) hese two authors discuss the question again, and even if they do not arrive at opposite conclusions they, nevertheless, are not by any means in accord

So long ago as 1900 I made some apparatus with a view to obtain by experimental means, if possible, some evidence as to the progressive character of the lightning flash; but before dealing with this I think it well to refer the two authors to a paper by Dr H. H. Hoffert (*Proc. Phys. Soc.*, 10, 1890, pp 176-179) which appears to me to bear on the subject, and which I think they have overlooked. Dr. Hoffert desired to test an assertion which I had made in a discussion on a paper by Mr. Whipple (NATURE, May 16, p. 71, 1889), to the effect that very often the lightning flash was multiple; two, three, or many more succeeding one another very rapidly along exactly the same path, which I thought was obvious to every one, but the truth of which, nevertheless, was not readily accepted. He therefore exposed a camera during a very heavy thunderstorm in the direction in which the frequent flashes were seen, and kept it wagging rapidly to and fro. So far as he knew, he exposed the plate to a single flash only. In the first place he obtained a triple photograph of the flash he had seen, the three images being widely separated. They are all identical in form, bearing out fully what I had said, but the photograph showed much more than this, and it is these other points that bear, so I think, on the later theoretical discussion. I have three prints which Dr. Hoffert gave me at the time, which are entirely untouched

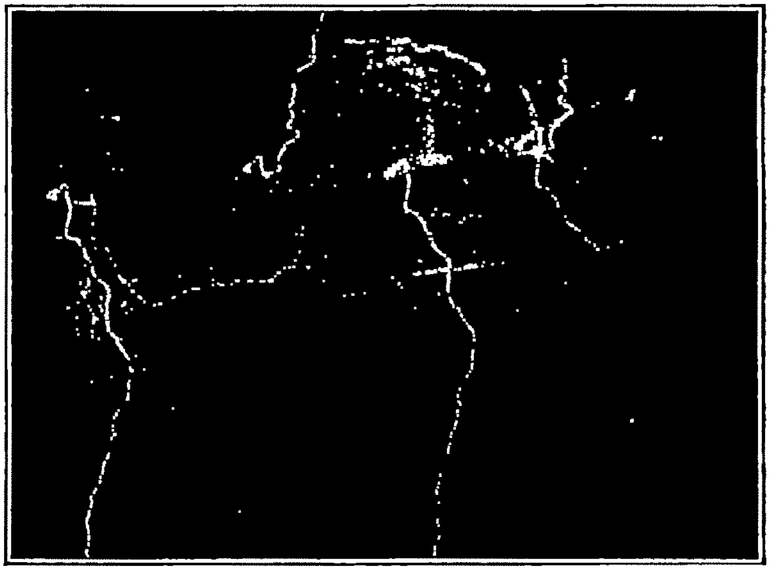


FIG. 1

The print accompanying the paper is exceedingly faithful and true for the purpose of illustration, and there is a skeleton diagram with reference to which Dr Hoffert gave a very full discussion of all that is shown. The point of greatest interest in connexion with the controversy above mentioned is the almost certain conclusion that a flash within the cloud and terminating (or starting ? C V.B) at a point from which the main flash started preceded this by a very evident interval. The other point of interest is that this region remained luminous all that time and until the third main flash had occurred; also that the more marked angles in the main flash, which may have been foreshortened portions directed towards the camera, also remained luminous in the intervals between the three main flashes. These were more in the upper part of the flash from which branches directed towards the ground emanated, and the branches were far more conspicuous in the first of the three main flashes. The lower part was devoid of branches and of continuous luminosity. Reproduced herewith is one of Dr. Hoffert's prints (Fig. 1), but I doubt if the more delicate features can be reproduced. It would be better added to Dr. Simpson's collection if it interests him.

Before describing my apparatus of 1890 I should like to refer to an observation which I made about the year 1876, as in a life's observation of lightning the phenomenon then accompanying every flash is one which I have seen on no other occasion. It may have some bearing on the conclusions of the two authors. A storm one evening in the autumn had passed directly over the village of Wing in Rutland and moved away to the north, leaving a clear starlit sky above the thundercloud, with the stars of the Great Bear in their lowest position far above. When the storm was distant about ten miles and more, for every flash seen in the rain cloud and below, and simultaneous with it, there were one or more very slender flashes of typical lightning form from the cloud upwards and many times as long as the usual kind of lightning below According to my recollection, these reached one-third or perhaps half-way towards the stars of the Great Bear, and in one instance there were seven of these flashes going simultaneously into the clear sky.

Coming now to the year 1900, I wished to obtain some experimental evidence, if possible, of the progress of the lightning flash The impression that there is a downward direction in a flash is very common, and occasionally observers believe one has an upward direction. Without paying too much attention to impressions of this kind, and yet not ignoring them altogether, I desired to make a conclusive test, and to get any information possible as to the beginning or to the progressive character of the flash The scheme was to use a pair of identical camera lenses (specially selected for stereoscopic photography) and to mount these on a disc which could be rotated by hand through gearing at any desired speed In the apparatus I then made I could drive them at any speed up to about forty turns a second. The lenses were four inches apart, centre to centre; the two images of a lightning flash would then be carried in opposite directions at any speed up to about forty feet per second, and if the flash in each part of its length should be 'instantaneous' a difference in time between the two ends of the flash of about $\frac{1}{16000}$ second would be observable. If, for example, the flash were a vertical line and the lenses at the moment were one above the other, one image would be tilted in one direction while the other would be tilted in the other direction, and the more so the greater the duration. If the lightning were not at any part 'instantaneous,' by which I mean if it lasted long enough for its image to be broadened —that is, $\frac{1}{1000}$ second or more—the two images would fade away, but on opposite sides, and the sharp side would still be available for comparison. If the lenses should happen to be on the same level, then one image would be lengthened and the other shortened, and measurements between well-defined kinks would show this. Similarly for other positions of the lenses there should be both tilting in opposite directions and change of length. If the duration of the illumination at each point in the flash should be sufficiently short the stereoscopic method of observation seemed to promise to be most convenient. For this purpose it would be necessary to cut a print, taken from the 10 × 8 backed plate used to receive the images, into two parts, and to slide the two parts so as to bring the two images to stereoscopic distance, and so that the motion due to the lenses was parallel to the line joining the eyes. If then they were maintained strictly parallel to their former positions, the effect of the movement due to the lenses, if apparent, would be to make the stereoscopic image appear to leave the plane of the paper; and owing to the extreme delicacy of the stereoscopic sense, this might be as valuable a test as a micrometric one and much more convenient.

I made this apparatus in 1900, and carried it about with me, for example, to the British Association meeting at Glasgow the following year, and only once obtained a moderately good view of a few flashes, but the developed plates showed nothing at all! Though I have had this now for twenty-six years, I still have not succeeded in obtaining any photograph. It had been my intention to go on until I did get a result before describing the method, but as I now have no window in London with a good sky view, and in my present house at St. Marybourne in Hampshire, while I have all the sky there is, I have no 'compact' storms such as we so often have in London. For twelve years I have not seen a storm in which the lightning is fairly frequent and in one direction, which is what I mean by 'compact,' and therefore if any results of interest are ever to be obtained in this way they must be by some one else. If Dr. Simpson thinks the method worth following, the apparatus with the 10 × 8 double back, which it is made to take, is freely at his disposal.

In the case of a multiple flash on the same track the different pairs of images would be at altogethe different azimuths, and the wheel of lenses migh well have made more than one turn between each They would therefore in no way clash when examined There might, however, be a marked difference between the first and succeeding flashes if the first showed any sign of progressive character due to the operations discussed by Drs. Dorsey and Simpson The first flash has certainly left the whole track conducting, and succeeding flashes therefore might well fail to show any such progression.

There is one more experiment which I have wished to make with this apparatus. This is to fire a rocket towards or into a thundercloud when it is getting ripe for another flash. The ordinary display rocket would do perhaps, especially if its head were removed and its stick lightened. I should, however, prefer to make suitable rockets on purpose with perhaps an extra calibre of composition over the spindle and no head. Such a rocket would go at an immense speed to twice the usual height if undisturbed by lightning on the way, leaving a conducting trail of potash smoke and ions of every kind. A six-oz rocket (⅞ inch) or a half-pound (1 inch) would be the most convenient to use. The pound rocke (1¼ inch) is more difficult to make, but it would be very persuasive, while a 3 lb. rocket (1¾ inch), the largest within my experience, is too much of an undertaking and too dangerous in its descent to be lightly selected.

If a photograph were obtained with the revolving lenses of a flash striking a rocket a good way up, the rocket itself might be expected to be the place of origin of the flash, and this position would be obvious on the plate, as below this the lightning would no doubt follow the rocket trail.

Rocket-directed lightning also would be good for spectrum examination, as a prismatic camera could be employed with certainty as to time and direction. There might be some indication of potassium in the spectrum below the rocket, and a great splash of potassium at that place if the lightning got inside and fired the remaining charge all at once.

To fire such a rocket, the only safe plan would be to pull a string lying on the ground and leading to a striker at the rocket. No slow match would work at the desired instant, and electric communication by wire would be too dangerous. I am unable to make the rocket experiment as I am in a village of thatched houses.

C. V. BOYS.

The Detection of Icebergs.

THOUGH navigation in iceberg-infested waters has been recognised from early times to be fraught with special dangers, it is only comparatively recently that attempts have been made to apply scientific methods to the detection of these floating dangers to navigation. Early whalers and explorers in Arctic and Antarctic waters met and surmounted these dangers without such assistance, but the present circumstances of sea travel in waters occasionally subject to invasion by icebergs are so different as to render special precautions necessary. Some of these circumstances are the increasing size and speed of passenger vessels, the replacement of wooden hulls by steel, and the need, in the face of competition from rival steamship companies, to complete the voyages within scheduled times. The small ice 'growler,' floating almost submerged, is not only the most difficult to detect, but is also almost as dangerous an obstruction to modern steel ships as the iceberg of large dimensions, which is likely to be more readily perceived even in a fog.

The apprehension of the need for early warning of the approach of the ice has been especially lively since the *Titanic* disaster in 1912. This disaster led directly to the formation of the International Ice Patrol, which now maintains a continuous patrol during the ice season in the dangerous area of the North Atlantic This organisation is maintained by the United States, the countries chiefly concerned contributing to the cost in proportion to their shipping tonnage. At present the chief duties of the Ice Patrol are: The continuous location of ice endangering the shipping lanes, and dissemination of relevant information to vessels approaching the danger area; oceanographical work associated therewith; the investigation of various devices and aids to the location of casual icebergs, and of the waters of polar origin in which they are found.

The early experiments of Profs. Barnes and L. V. King on the detection of icebergs by temperature differences in the neighbouring sea water, which were carried out with the assistance of the Canadian Government, seem to have been unsuccessful, since we find that attention is now being concentrated on underwater echo methods of detection similar to those used for echo sounding. These methods formed the subject of a recent illuminating article in NATURE, May 9, 1925, p. 689. In the 1925 season an echo sounder of U.S. Navy type was tried by the Ice Patrol, and it was established that weak echoes could be obtained from a large iceberg in favourable circumstances at a maximum range of 2500 yards, the echoes being, however, first reflected from the bottom of the sea. 'Growlers' and very small bergs did not reflect well under normal conditions.

In the meantime, it is encouraging to note that the Canadian Government and the Research Council of Canada have afforded Prof. Boyle and his co-workers the financial and material assistance which has enabled them to institute a series of fundamental investigations[1] on the properties of ultrasonic (high-frequency) sound waves in water. Some tests have also been carried out at sea. The investigations included the measurement of the energy in an ultrasonic sound beam in water by means of a torsion pendulum, together with the measurement of the energy reflected from various materials, such as steel, various types of rock, and ice immersed in the water. The lateral distribution of energy in the sound beam has also been determined in this way. One of the most striking experiments has been the production of stationary waves in a small tank, which were made evident by the pattern formed on a tray by the dust of coal cinders which had fallen slowly through the acoustic energy field above. This method of rendering visible the interference pattern due to the combination of direct and reflected beams has been utilised to check the values of the coefficient of reflection from different substances by decreasing the energy output of the transmitter until a definite pattern just failed to form in the case of each reflector.

The experiments showed that ice was, of the materials tried, the worst reflector of sound. This, indeed, was expected from the fact that the products (density × velocity of sound) for ice and water differ little from one another. The circumstance that ice in its natural condition contains a considerable amount of included air in the form of bubbles held under pressure will, however, tend to make the detection of icebergs by echo methods less unpromising than might be judged from calculations on the basis of the data relating to pure ice, while the variations in temperature and salinity in the water surrounding a melting berg must also be taken into consideration.

The final report details the results of some practical trials to determine the range of iceberg detection at sea by the use of a high-frequency sound transmitter fitted on the s.s. *Montcalm*, a vessel maintained by the Department of Marine and Fisheries of Canada. It was anticipated that the small transmitters used would enable echoes to be obtained from rocks at a range of about 1000 yards, and this estimate was found to be justified. Echoes from a medium-sized iceberg were detected at a range of only 250 yards, but echoes due to multiple reflections between the berg and the ship were observed in other cases at a distance of 150 yards. In spite of this statement, it is clear that a very accurate measurement of time interval between echoes must be made before the explanation of the cause of the multiple echoes can be accepted. It is stated that the tests, which were carried out in shallow water, showed that echoes from the bottom and surface of the sea were a source of disturbance up to and beyond the time of arrival of the echoes from the iceberg.

The results obtained by Prof. Boyle are promising in that more powerful transmitting apparatus has already been constructed by him. Whether a reasonable increase in power will permit detection of the smaller icebergs and 'growlers,' which must be considered the most dangerous types of ice, can only be decided by further practical experiments at sea. In view of the attitude already displayed by the Canadian Government and by the Research Council of Canada, there is room for little doubt that Prof. Boyle will be enabled to continue his investigations to a point which will decide whether the directional high-frequency, or the relatively non-directional low-frequency, sound beam is better adapted for the detection of floating ice.

C. S. W.

---

[1] *Trans Roy. Soc. Can.*, Third Series. Vol. 19, 1925, p. 167. "Visualisation and Energy Survey of a High-Frequency Diffraction Beam." By R. W. Boyle, J. F. Lehmann, and C. D. Read. Vol. 20, 1926, p. 245. "Reflecting Powers of Various Materials for Ultrasonic Waves." By R. W. Boyle and . B. Taylor. Vol. 20, 1926, p. 233. "Practical Experiments on the Detection of Icebergs and on Sounding by Means of an Ultrasonic Beam" by R. W. Boyle and C. D. Read.

The Total Solar Eclipse of January 14, 1926.

A JOINT meeting of the Royal Society and Royal Astronomical Society was held at Burlington House, London, on Thursday, November 11, to discuss the results obtained by the British eclipse expedition to Sumatra in January of this year. The Astronomer Royal opened the discussion with an account of the coronal pictures obtained by various eclipse expeditions in the past sent out from the Royal Observatory, Greenwich. In addition to the well-known changes of form with the solar cycle, he pointed out the close connexion of certain prominences with arches in the corona, and also certain changes detected as taking place during an eclipse, as seen from a comparison of plates taken at widely distant stations.

Mr. C. R. Davidson gave an account of the instrumental arrangements made for the Sumatra observations (see NATURE, February 27, p. 306), and of the chief results obtained from it. A study of the objective-prism spectra obtained by Col. J. Waley Cohen with a camera of 38-foot focal length, and by Dr. F W. Aston with a 19-foot camera, gives the heights to which the different elements can be traced, the observed heights being in general accordance with previous results. The coronal rings show evidence of intensification in the neighbourhood of several prominences; the brightening does not quite coincide either in position or in form with the prominences, but some close relation seems to be indicated. The plates taken with the Grove-Hills flint slit-spectroscope do not go beyond the oxygen triplet at λ 7772. The dicyanin stain failed to work satisfactorily under the conditions of heat and damp prevalent in Benkulen. The wave-lengths of the two coronal lines in the green and the red were determined as 5303·4, 6374 1 I Å.U. The flash spectrum obtained by Mr. Davidson with the Grove-Hills quartz slit-spectroscope extends down to λ 3066. The lines have been measured and grouped in series, where the data are available. In the coronal spectrum obtained with the same instrument, the lines from a high prominence, which also appear on the plate, gave an excellent scale for the coronal wave-lengths. These have been determined as 3387·95, 3454·11, 3601·03, 3642·87, 3800·77, 3986·82, and 4086·30 I.A.U. The relative brightness of the lines of the corona differs from the values found in previous eclipses, but it is easily apparent that the lines themselves differ in the distribution of intensity with height above the sun's limb.

Mr. Stratton gave an account of the photometric work which has been done, by the kind permission of Prof. L. S. Ornstein, by Dr. Minnaert and himself on the ultra-violet slit-spectra with the aid of the Moll spectro-micro-photometer at the physical laboratory at Utrecht. The trustworthiness of the actual measures of intensity of the lines have been tested by examining certain multiplets which have been found to have relative intensities in close accordance with their proper values. The intensity of the K line has been measured at eight different heights and a satisfactory accord found over a range 30,000 km. to 100,000 km. of height with the theoretical value calculated by Mr. P. A. Taylor from Prof. E. A. Milne's theory of the chromosphere. The coronal lines also have been measured for intensity at different heights, and curves plotted connecting the intensity with the height. The lines were divided into three well-marked groups; the extreme groups confirmed the results found some years ago by Sir Norman Lockyer through a study of variations in the coronal rings from different sources. Attempts have been made from a study of line intensities to determine the temperature of the sun at different levels. In the Balmer series an application of Schrödinger's formula has given a temperature which decreases as the height above the sun's limb decreases. The temperatures deduced cannot be accepted, but what the observations gave was a measure of the weakening at lower levels in the chromosphere of the lines in the Balmer series corresponding to the atoms with the larger orbits. This weakening was to be expected from the increased ultra-violet radiation from the sun streaming through these lower layers; its extent has now been measured. Balmer lines from $H\delta$ (6) to H 29 have been used in this work. The hydrogen continuous spectrum which extends towards the violet from the head of the Balmer series has also been examined. From this a measure of the temperature (the distribution of the velocities of the electrons) was possible. The value thus found, 1700° K. at 8000 km. height, is too low, as checked by a cross-determination from the relative intensities of certain ionised titanium lines at that same level and in the low level of the flash spectrum. One further result of interest in the photometric work is a study of the continuous spectrum in the low corona or high prominence at a height of 20,000 km. In agreement with the result obtained by Deslandres in 1893, this continuous spectrum when compared with that of a black body gave a lower temperature than the sun's temperature. The result is consistent with Ludendorff's recent work on the distribution of intensity in the continuous spectrum of the corona, which he finds to be unaltered from that of the sun. But Ludendorff's results come from much higher layers and are consistent with the light being scattered by electrons. The suggestion is that at the lower layers concerned the light is, partly at least, affected by Rayleigh scattering from atoms.

Prof. Ornstein raised the point whether a formula due to Miss Bleekers which fits many laboratory spectra need be rejected because when applied to the Balmer series it gives a negative temperature. This is very little different in reality from the extremely low temperatures given by the Schrödinger formula. Both formulæ make it clear that some disturbing factor is affecting the relative intensities of the lines, which clearly do not correspond to thermodynamical equilibrium. He welcomed the co-operation in this work of physicist and astrophysicist.

Dr. Minnaert dealt with the problem of comparing intensities at different wave-lengths and urged the necessity of extending our knowledge of a trustworthy curve of the intensity of the solar radiation for different wave-lengths. Abbot has not used sufficient resolving power to meet present requirements of spectrophotometers, and H. H. Plaskett's work needs to be extended more towards the ultra-violet. It is desirable that astrophysicists living in suitable climates should make further measures by photographic methods, if full value is to be obtained from future eclipse records.

The president of the Royal Society, Sir Ernest Rutherford, expressed his appreciation of Mr. Davidson's beautiful photograph of the Balmer series and of the kind co-operation of the Dutch scientific workers in reaping the fruit of the eclipse expedition, their own expedition having failed through bad weather conditions. It is the first time that intensity measures have been made on eclipse spectra; and the possibility of this has been due to the work of Prof. Ornstein and his colleagues at Utrecht.

Prof. Newall expressed great pleasure at hearing from the Astronomer Royal that Mr. Wesley's drawings of the corona are to be reproduced, and added his view that Mr. Davidson's ultra-violet spectra are the best yet achieved in eclipse work. He, too, welcomed the co-operation with the Dutch physicists and astrophysicists.

Prof. Fowler expressed admiration for the photographs, and pointed out with what refinement the adjustments must have been made The photographs seen that day were remarkable for the large size of the solar image, and they should add consider ably to our knowledge. He was interested to hear about the suggested relation between the corona intensity and the prominences, as there is no evidence for it in earlier eclipses. The increased accuracy o the wave-lengths of the coronal lines should help in the further investigation of their source. What i now required is higher resolution and more powerfu instruments. Longer exposure is necessary, and this could be obtained by working on the edge of the bel of totality or even outside it.

Prof. Milne pointed out that the theories being tested at this eclipse are all of very recent growth Prof. Ornstein must feel gratified that his contribution is bearing fruit so soon It is possible that some of the theories of solar physics will need to be revised He was much interested in Mr. Taylor's results. It is clear that radiation pressure must play its full par in supporting the atoms at high levels if the chromosphere reaches the heights indicated. The low temperatures found at the lower levels of the sun only indicate that the fraction of the more highly excited atoms there is less than it would have been if the atmosphere had been in thermodynamical equilibrium If the distribution of intensity in the continuous spectrum is due to atomic scattering, then i looks as though the prominence must consist of mass of material thrown out with a comparatively high density.

Mr. R. H. Fowler suggested that it is the laws of perfect gas that are failing at lower levels rather than those of thermodynamical equilibrium. He has made a rough numerical estimate of the falling off c intensity of lines of the higher quantum numbers and compared it with Urey's correcting factor. That will account partly for the result expressed in terms of the parameter, T, as indicating a lower temperature.

Prof. Lindemann supported the view that the future of eclipse work lies with photometry rather than with the determination of wave-lengths. In discussing the continuous light, the possibility of light-scattering in the instrument should be borne in mind. He would like to see a negative temperature gradient in the sun, such as might fit the demands of convective equilibrium.

Dopes and Detonation.

WE have received a copy of the Air Ministry Reports and Memoranda, No. 1013, by H. L. Callendar, R. O. King, and C. J. Sims, published by H.M. Stationery Office. The primary object of the investigation which is described was the determination of the physical actions that delay or prevent detonation in the cylinder of an internal combustion engine.

The addition to petrol of non-detonating fuels, such as benzene, has long been familiar as a means of checking the onset of 'pinking' in a high-compression engine. In the case of benzene a large addition is required, alcohol and toluene are more effective than benzene by about 50 per cent, though they still appear to act mainly by dilution of the original fuel.

There are, however, other classes of substances, many times more effective than toluene, the action of which cannot be explained by dilution. Thus, in the case of lead ethide, the addition of 0·25 per cent. by volume is nearly as effective as 100 per cent. of toluene. Nickel carbonyl shows a similar order of effectiveness.

The action of such 'dopes' must evidently depend on some specific property requiring further investigation. It has been shown that the heavier paraffins, on account of their high critical temperatures combined with low critical pressures, are exceptionally liable to persist in the form of nuclear drops, which serve as foci of simultaneous ignition by compression owing to their low ignition temperature. The marked effect of pressure in promoting detonation is explained by the rapid increase of nuclear condensation with increased density of charge. The action of a dope in delaying detonation is to 'infect' the nuclear drops in such a way as to delay their ignition. The fact that these drops form a small percentage of the whole mixture helps to explain the possibility of a relatively small quantity of the dope being effective. It has been shown that lead ethyl and nickel carbonyl, two of the most effective metallic dopes, when mixed with petrol residues, decompose rapidly at temperatures above 200° C, depositing a film of metal on the surface of the liquid. This metallic film would tend to protect the nuclear drops from oxidation, and would help to keep down their temperature by reflecting radiation

Organic dopes, such as methylaniline and xylidine, have the advantage that much higher compression ratios can be employed than in the case of metallic dopes without risk of fouling the engine with deleterious deposits. On the other hand, much larger quantities are required than in the case of lead ethide. Organic dopes probably act mainly by the dilution of the nuclear drops, which results in a rise in the ignition temperature; but the chemical reactions which may occur are very complicated and require further investigation.

University and Educational Intelligence.

CAMBRIDGE.—Honorary degrees are to be offered to the Maharajadhiraja Bahadur of Burdwan, the Right Hon. W. L Mackenzie King (Prime Minister of the Dominion of Canada), the Right Hon J G Coates (Prime Minister of the Dominion of New Zealand), and to Mr. W. T Cosgrave (President of the Executive Council of the Irish Free State).

Amongst those elected to the Council of the Senate are Sir H. K Anderson, Dr T. C. Fitzpatrick, Prof. A. C. Seward, Mr. T. Knox Shaw, and Mr. F. J. M. Stratton. Mr. R. E Priestley, Clare College, assistant registrary, has been elected secretary of the general board of the faculties, a body that is to be elected for the first time on November 30.

Mr. W H Florey, lately John Lucas Walker Student and Rockefeller Research Fellow, has been elected to a fellowship at Gonville and Caius College.

MANCHESTER.—The Council has made the following appointments: Dr. William Susman, to be lecturer in morbid anatomy and histology; Mr C. J. Polson, to be assistant lecturer in chemical pathology, Mr. A. M Downie, to be assistant lecturer in bacteriology, Dr F A. Mason, to be lecturer in tinctorial chemistry and dyestuffs; Mr. Arthur Riley, to be assistant lecturer in textile engineering, Mr. F. W. Bailey, lecturer in papermaking.

Dr. Ivar Waller has been awarded an honorary research fellowship in physics.

Dr. James A. Bowie has been appointed Director of the Department of Industrial Administration in the Manchester College of Technology. After the War, Dr. Bowie was appointed lecturer at the College, where he devoted his attention to industrial relations with special reference to problems of wages, profit-sharing, and copartnership.

THE Universities of South Africa form the subject of an article by Prof. H. Clement Notcutt, of the University of Stellenbosch, in the October number of the *University Bulletin* (issued by the Association of University Teachers). It is pointed out that whereas the Act of Parliament which brought the Union into existence provided that the English and Dutch languages should both be "official," Afrikaans, which differs from the Dutch of Holland both in vocabulary and in syntax and is the home language of a large part of the inhabitants of Dutch descent, has recently been given by Parliament the same status Consequently there are now three official languages In the schools, English and Afrikaans are taught with the intention that all children of European descent growing up in the country shall have an adequate knowledge of both languages, but there is an ever-present danger of their failing to acquire the power of using either with that exactness which is necessary for clear thinking. Prof Notcutt might have added that the prestige won for Afrikaans has reacted unfavourably on the position of Dutch, and a movement inspired largely by enthusiasm for maintaining the Netherlands connexion and cherishing the traditions handed down from the original Dutch settlers is in fact tending to estrangement, for the Dutchmen of Holland cannot, generally speaking, find time to learn Afrikaans, nor can the Afrikanders spare for Dutch so much time as they could before Afrikaans became a literary and official language. It is estimated that a higher proportion of the *white* population is attending college or university than in Great Britain or any of the other British Dominions. A noteworthy characteristic of South African university students is their devotion to sports, in which respect they resemble the students of Oxford and Cambridge rather than those of the other English universities.

Contemporary Birthdays.

November 20, 1851. Prof. John Merle Coulter.
November 21, 1866. Sir John Carruthers Beattie.
November 22, 1868. Sir Thomas H. Holland, K.C.S.I., K.C.I.E., F.R.S.
November 22, 1875. Prof. L. N. G. Filon, F.R.S.
November 23, 1864. Dr. P. Chalmers Mitchell, F.R.S.
November 26, 1851. Prof. J. Cossar Ewart, F.R.S.

Prof. COULTER, botanist, was born at Ningpo, China, and he was educated at Hanover College, U.S.A. Early in his career, when only twenty-one years of age, he was botanist with the United States Geological Survey in expedition work in the Rocky Mountains. Afterwards he returned to his old college, becoming professor of natural sciences; next he accepted the chair of biology in Wabash College. President, and professor of botany in Indiana University from 1891 until 1893, he has been, since 1896, professor and head of the department of botany in the University of Chicago. He is a member of the National Academy of Sciences, Washington and of the National Research Council; and a foreign member of the Linnean Society of London.

Sir J. C. BEATTIE, a graduate of the University of Edinburgh, studied also at Berlin and elsewhere abroad. Professor of physics in the South African College, Cape Town, from 1897 until 1918, he is now vice-chancellor and principal of the University of Cape Town. In 1909 (collaborating with Prof. J. T. Morrison) he brought to successful issue a magnetic survey of South Africa.

Sir THOMAS HOLLAND, Rector of the Imperial College of Science and Technology, received his scientific training at the Royal College of Science, South Kensington. He joined the Geological Survey of India in 1890, and was appointed professor of geology and mineralogy in the Presidency College, Calcutta, in 1893. From 1903 until 1909 he was director of the Geological Survey of India. Returning to England he became professor of geology and mineralogy in the University of Manchester, occupying the post for nine years. The Geological Society of London awarded him its Bigsby medal in 1913 in recognition of eminent services rendered to geology, more especially during his tenure of office in India. Sir Thomas is chairman of council of the Royal Society of Arts.

Prof. FILON has been Goldsmid professor of applied mathematics and mechanics in the University of London since 1912. Born at St. Cloud, France, he was educated at University College, London, and his energies, in the past and present, have centred there.

Dr. CHALMERS MITCHELL was born at Dunfermline. He graduated at the University of Aberdeen and Christ Church, Oxford, studying as well at Berlin and Leipzig. Since 1903 he has been secretary of the Zoological Society of London. Dr. Mitchell has made notable contributions to biological science, and has in addition promoted wide interest in scientific progress generally by numerous articles and other works.

Prof. J. COSSAR EWART was born at Penicuik, Midlothian, and graduated at the University of Edinburgh. Sometime occupant of the chair of natural history in the University of Aberdeen, he returned to Edinburgh in 1882, becoming Regius professor of natural history. Prof. Ewart has specially studied fishery questions; whilst he has written many critical memoirs on the development of the horse and on animal heredity.

Societies and Academies.

LONDON.

The Physical Society, October 22.—Ernest **Wilson**: The corrosion products and mechanical properties of certain light aluminium alloys, as affected by atmospheric exposure. Experiments have been made upon the electrical conductivities, the corrosion products and tensile properties of high purity aluminium, and certain light aluminium alloys, which have been exposed to London atmosphere for a period of twenty-four years. The elements concerned are copper, nickel, manganese, and zinc in varying amounts up to a few per cent. There is also a note on the corrosion products of high conductivity copper.—M. C. **Johnson**: The distribution of intensity in a positive ray spectral line (Part 2). The distribution of velocity among the particles contributing to the 'moving' spectrum is compared with the distribution of velocity in positive rays measured by the electromagnetic method and, with some investigations of Betschinsky and Dopel. The appearance of the many-lined spectrum of hydrogen in the positive rays, and the ratio of intensity of the 'moving' and 'resting' spectra is also considered. The inverse square law of probability of electron capture, and some consequences of the work of Wien and Rüchardt, are the most likely controlling factors in the several phenomena.

Optical Society, October 28.—R. **Kingslake**: The analysis of an interferogram. It has been frequently suggested that it should be possible to analyse mathematically the interferometer pattern produced by a lens, in order to obtain a measure of the aberrations from the coefficients of the terms in the various orders of x and y. x and y are here the co-ordinates of a point on the interferogram, the optical path difference of which relative to the central ray of the lens is known at once by counting the fringes. Results obtained by this method do not agree well with those obtained under identical conditions by the oblique Hartmann test.—T. **Smith**: The stationary value of axially symmetric functions (Part 2). Alternative methods to those described in Part 1 of constructing a series representing the stationary value of a given function are developed and applied to evaluate all the terms not involving powers and products of the coefficients of the function higher than the eleventh. The formula in its optical applications enables the first 451 monorythmic aberrations of a symmetrical optical instrument to be determined.

Mineralogical Society, November 2.—L. J. **Spencer**: (1) Schultenite, a new mineral from South-West Africa. The colourless platy crystals from Tsumeb are monoclinic ($a:b:c = 0\cdot8643:1:0\cdot7181$, $\beta = 84°\ 36'$) and gave on analysis by E. D. Mountain the formula $PbHAsO_4$. They are identical with crystals prepared artificially by the late Baron A. de Schulten in 1904 (see NATURE, Sept. 18, 1926, p. 411). (2) Aramayoite, a new mineral from Bolivia. This was found in 1925 in a silver-tin vein in the Animas mine at Chocaya. It shows a confused aggregate of cleavage plates with iron-black colour and brilliant metallic lustre. In addition to the perfect basal cleavage there are also good cleavages following a steep tetragonal pyramid. The mineral is pseudotetragonal. Analyses by T. B. McGhie and by E. D. Mountain give the formula $Ag(Sb, Bi)S_2$.—K. **Yardley**: (1) X-ray examination of aramayoite. Some photographs taken with the beam perpendicular to the perfect basal cleavage (001) show no symmetry; powder photographs also show that the tetragonal symmetry apparently indicated by the cleavages does not actually exist. Ionisation spectrometer data reveal the triclinic nature of the mineral and give a complete crystallographic description: $a = 5\cdot672$ Å.U., $b = 5\cdot688$, $c = 5\cdot623$; $\alpha = 86° \ 55'$, $\beta = 90° \ 53'$, $\gamma = 93° \ 18'$. The structure is pseudo-tetragonal with two molecules of Ag(Sb, Bi)S_2 in a minimum cell (2) The structure of baddeleyite and of prepared ZrO_2. The natural form of ZrO_2 is monoclinic with four molecules in the unit cell Ionisation spectrometer measurements on a single crystal and powder photographs both indicate a distorted CaF_2 arrangement of the ions. The structures of three specimens of the mineral from entirely different sources are practically identical, except for slight variations of spacing due to the presence of impurity. Powder photographs of prepared zirconia from two distinct sources are almost identical with those of baddeleyite and show that prepared zirconia is also monoclinic and not (as previously stated) tetragonal.—W. **Binks**: The crystalline structure of zircon. X-ray examination of zircon shows the structure of zircon to correspond to the space group D_{4h}^{19}. The unit cell containing eight molecules $ZrSiO_4$ has dimensions $a = 9\cdot30$, $c = 5\cdot93$ Å U. The silicon and zirconium atoms form two interpenetrating face-centred lattices, and the oxygen atoms are arranged tetrahedrally around the silicon atoms. The structure has some resemblances to that of anhydrite ($CaSO_4$).

Society of Public Analysts, November 3.—W. R **Schoeller** and C. **Jahn**: Investigations into the analytical chemistry of tantalum, niobium, and their mineral associates (vi) The precipitation of the earth acids by sodium compounds. When tantalic oxide is fused with potassium carbonate and the solution of the mass treated with sodium chloride, 4 : 3 sodium tantalate is precipitated. Niobic oxide treated in the same manner yields 7 : 6 sodium niobate. The precipitates are dense, crystalline powders. Sodium tantalate and niobate are decomposed by dilute acid. The quantity of the latter is proportional to that of the alkali in the precipitates This reaction was applied to the indirect volumetric determination of the earth acids in the mixed sodium salts, but the end-point could not be ascertained with sufficient sharpness with colour indicators.—A. E. **Parkes**: A simple method of testing for sulphites in foods. The food (if not a liquid) is mixed with water and placed with fragments of marble and dilute (about $2N$) hydrochloric acid in a conical flask, closed with a rubber stopper bearing a small thistle funnel bent twice and having a small bulb on each limb The funnel contains a few drops of dilute ($0\cdot01N$) iodine solution and dilute barium chloride solution. After evolution of carbon dioxide has ceased, the flask is heated, and, in the presence of a sulphite, the colour of the iodine in the funnel is discharged and the liquid becomes opalescent (barium sulphate). The test may be made approximately quantitative.—J W. **Haigh Johnson**: A critical review of the methods of analysing waters, sewages and effluents, with suggestions for their improvement Present methods yield results which are often inconsistent Recent modifications in sewage treatment have greatly increased the amount of nitrogen oxidation products. Comparing the Wanklyn, Kjeldahl, acid chemical, and biological processes, the first is too vague, whilst the acid chemical test yields only a fifth of the result obtained biologically. A method of combining the Wanklyn test and the alkaline oxidation method is described, and suggestions are made for improving the Kjeldahl test and for the biological determination of absorbed oxygen

PARIS.

Academy of Sciences, October 18.—G. **Bigourdan**: The equations of diverse origins, which may affect the pendulum corrections C_p adopted at the Bureau International de l'Heure (B.I H.), year 1925 Marin **Molliard**: The dimorphism determined in the gall of *Mikiola Fagi* by a secondary parasite. Some oak galls from the forest of Fontainebleau were observed to differ in shape and other characteristics from the normal gall, and this has been shown to be due to another parasite, identified by Ch. Ferrière as *Secodes coactus* Similar galls have since been observed in abundance in other parts of France, Normandy, Brittany, Savoy—Charles **Richet** and **Oxner**: The accommodation of salt-water fish to supersaturated waters. A study of the effect on *Sargus Rondeleti* of a gradual increase in the proportion of sodium chloride in the water. This fish could support a salinity 37 per cent. above the normal, but a diminution to 18 per cent. below the normal caused death. J. **Costantin**: The variability of living beings according to prehistoric man—Ch. **Depéret**: The neolithic layer of Glozel (Allier). Some doubt has been thrown on the authenticity of the objects found at Glozel: the author's own excavations and observations confirm the view of Morlet that the find is authentic, and of extreme importance—Léon **Guillet** and Albert **Portevin**: The influence of the chemical composition of alloys on the possibility of making castings.—E. **Bataillon** and Tchou Su · Activation and rectification in the parthogenesis of the echinides by hypertonic solutions alone.—Paul **Alexandroff**: The dimension of closed *ensembles*.—Léon **Pomey**: Partial differential equations and linear integro-differential equations with an infinity of variables—Leonida **Tonelli**: The double series of Fourier.—G **Cerf**. The characteristics of partial differential equations of the first order—André **Roussel**: Certain isoperimetric problems.—H. **Galbrun**: The propagation of a sound wave in the atmosphere.—A. **Toussaint** and E. **Carafoli**: The theory of supporting wings.—A. **Dauvillier**: The discovery of the characteristic O and N series of low frequency. Spectrographic joining of the X-rays and the extreme ultra-violet. Utilising a thorium filament prepared by M. de Boer, good spectra have been obtained with 25 milliamperes at 2800 volts. These show the pure low frequency spectrum of thorium, consisting of the characteristic N and O radiations. The line 121 Å U. approaches the optical spectra obtained by Millikan in the extreme ultra-violet (limit of aluminium, 136 Å.U.).—H. **Pilon** and A. **Laborde**. The immersion of metals in homogeneous media opaque to the X-rays. Improvement of radiographic methods. The method suggested consists in immersing the metallic body in a homogeneous saline solution the absorption co-efficient of which, for the X-rays used, is nearly that of the metal. Some suitable solutions are given · for aluminium a 35 per cent. solution of barium chloride, for iron, barium iodide (159 gm. in 100 c.c. of solution), for copper, the same barium iodide solution Under these conditions discontinuity in the metal is very clearly shown—Jean **Bouldoires**. The transformations undergone by aluminium bronzes. Results are given of a thermal analysis, measurements of resistance and micrographic study of aluminium bronzes submitted to varying heat treatment—Georges **Delbart**: The magnetic permeability of cold-drawn steels.—Emile **André** and Mlle. Th. **François**. The saturated fatty alcohols of the oil of the sperm whale and of *blanc de baleine*.—Guy **Emschwiller**: The action of magnesium on methylene iodide. The reaction (in ether) is vigorous and takes place in two directions, one giving ethylene, the other the magnesium compound $CH_2(MgI)_2$. The latter gives methane on treatment with water.—Alfred Carpentier: The extension of the Weald in the north of France.—A. Maige: Observations on the amylogenesis in the cotyledons of the pea.—F Henrijean: The signification of the electrocardiogram.—René Hazard and Raymond Hamet: The circulatory action of pseudo-pelletierine.—H. Barthélemy: Comparative influence of the *p*H and the saline concentration on the duration of survival of the spermatozoids of *Rana fusca*.—Mme. Anna Drzewina and Georges Bohn: The activation by light of the effects of silver on Convoluta. The destruction of Convoluta by metallic silver in water is partially dependent upon light. In a strong light the poisonous action is much more rapid.—René Fabre: Cholesterol allophanate and its use in biological chemistry. The preparation and properties of cholesterol allophanate is described: it may prove useful in various problems in biological chemistry.—Constantino Gorini: The action of *B typhosus* on milk.

Diary of Societies.

SATURDAY, November 20.

British Mycological Society (at University College), at 11 A.M.—W. R. Ivimey Cook: The Genus Ligniera.—Prof. O. V. Darbishire: Isidia and Soredia of the Lichen Peltigera.—W J Dowson: An Extraordinary Botrytis causing a Disease of Narcissus Leaves.—W. A. Roach: On the Nature of Disease Resistance in Plants, with Special Reference to Wart Disease of Potatoes.—Miss A. Lorrain Smith: A New Family of Lichens.

Royal Sanitary Institute (at Town Hall, Colchester), at 11 A.M.—Discussions on Rheumatism in School Children and The Plan and Design of a Public Elementary School.

North of England Institute of Mining and Mechanical Engineers (Associates and Students Section) (at Neville Hall, Newcastle-upon-Tyne), at 3.—L. F. H. Booth: Screening and Washing Plant at Deaf Hill Colliery.

Royal Institution of Great Britain, at 3.—Rev. E. M. Walker: The Study of History (II).

Institute of British Foundrymen (Lancashire Branch, Junior Section) (at College of Technology, Manchester), at 7.—A. H. Goodger. The Foundry Cupola.

Hull Association of Engineers (at Technical College, Hull), at 7.15.—C. C. Dinsmann: Starters for Alternating-current Motors.

MONDAY, November 22.

Cambridge Philosophical Society (in Cavendish Laboratory, Cambridge), at 4 30.—Dr H. W B. Skinner: On the Polarisation of Mercury Lines Emitted from a Discharge Tube in a Magnetic Field.—C. F. Sharman: The Application of the Method of the Magnetic Spectrum to the Study of Secondary Electronic Emission.—L. H Thomas: The Calculation of Atomic Fields.—L Wertenstein: A Contribution to the Theory of Diffusion Pumps.—*To be communicated by title only:*—W. Burnside: On a Group of Order 25920 and the Projective Transformations of a Cubic Surface.—Dr. P. A. M. Dirac: The Compton Effect in Wave Mechanics.—J. B. S. Haldane: A Mathematical Theory of Natural and Artificial Selection. Part IV.—R. Hargreaves: Geodetic and Dynamical Principles, a Comparison and Connexion.—G. C. Steward: On the Addition of the Primary Aberrations.

Institution of Electrical Engineers (Informal Meeting), at 7.—J. F. Shipley and others: Discussion on Comparative Electrical Progress in European Countries.

Institution of Electrical Engineers (North-Eastern Centre) (Informal Meeting) (at Sopwith's Lounge, Newcastle-upon-Tyne), at 7.

Institution of Electrical Engineers (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—J. R. Beard and T. G. N. Haldane: The Design of City Distribution Systems and the Problem of Standardisation.

Institution of Mechanical Engineers (Graduates' Section, London), at 7.—Lt.-Col. R. Kitson Clark: Archæological Engineering (Lecture).

Royal Society of Arts, at 8.—Prof. H. L. Callendar: Recent Experiments on the Properties of Steam at High Pressure (II.)

Chemical Industry Club, at 8.—C. S. Garland: The Incandescent Gas-Mantle Industry.

Royal Society of Medicine (Odontology Section), at 8.—Dr. E. W. Fish: Further Notes on the Lymph Supply of Enamel and Dentine.

Royal Geographical Society (at Æolian Hall), at 8.30.—C. Gillman: South-West Tanganyika Territory.

Medical Society of London, at 8.30.—Dr. C. Riviere and J. E. Roberts: The Treatment and Diagnosis of Bronchiectasis.

TUESDAY, November 23.

Royal Institution of Great Britain, at 5.15.—Sir William Bragg: The Imperfect Crystallisation of Common Things (I).

Institution of Automobile Engineers (Informal Meeting) (at 83 Pall Mall, S.W.1), at 7.—Inventors' Evening Discussion of Motor Car Devices not yet on the Market.

Royal Photographic Society of Great Britain (Kinematograph Group), at 7.—Lecture.

Society of Chemical Industry (South Wales Section) (jointly with South Wales and Bristol Sections of Institution of Civil Engineers and South Wales Section of Society of Chemical Industry) (at Technical College, Cardiff), at 7.30.—T. M. McKenzie: Asphaltic Roads.

Royal Anthropological Institute (jointly with English Folk-Dance Society and Folk-Lore Society) (at Royal College of Music, South Kensington), at 8.30.—Miss Violet Alford: The Ritual Dance.

British Psychological Society (Medical Section) (at Royal Society of Medicine), at 8.30.—Dr. B. Gluck: Current Tendencies in American Criminology.

WEDNESDAY, November 24.

Royal Institute of Public Health, at 4.—Dr. C. W. Saleeby: From Heliotherapy to Heliohygiene.

Institution of Automobile Engineers (Manchester Centre) (at Engineers' Club, Manchester), at 7.—J. H. Southcombe: Recent Research on Friction and Lubrication.

Institution of Electrical Engineers (North-Eastern Centre) (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7.—Prof. W. M. Thornton: What is Electricity? (Faraday Lecture).

Royal Society of Arts, at 8.—W. S. Bradley: Industrial Welfare in Practice.

Eugenics Society (at Royal Society), at 8.30.—Mrs. S. Gretton: Oxford Village Pedigrees.

THURSDAY, November 25.

Royal Institution of Great Britain, at 5.15.—Dr. R. R. Marett: The Archæology of the Channel Islands—Neolithic and Bronze Ages.

Royal Society of Medicine (Balneology and Climatology Section), at 5.30.—Dr. R. Ackerley: Presidential Address.

Institution of Automobile Engineers (Luton Graduates' Meeting) (at Luton), at 7.30.—T. T. Brown: Lubrication.

Royal Society of Medicine (Urology Section), at 8.30.—Clinical Pathological Meeting.

Institution of Mechanical Engineers (at Bristol).—Prof. E. G. Coker: Elasticity and Plasticity (Thomas Hawksley Lecture).

FRIDAY, November 26.

Society of Chemical Industry (Manchester and Fuel Sections) (at Municipal College of Technology, Manchester), at 10 A.M.—Tar Symposium.

Diesel Engine Users' Association (at Caxton Hall), at 3 30.—R. L. Quertier: Modern Air Compressor Practice in Oil Engine Installations.

Physical Society of London (at Imperial College of Science and Technology), at 5.—H. C. Hepburn: Electro-endosmosis and Electrolytic Water Transportation.—L. Hartshorn: The Input Impedance of Thermionic Valves at Low Frequencies.

North-East Coast Institution of Engineers and Shipbuilders (at Newcastle-upon-Tyne), at 6.—Dr H. V. Telfer: The Practical Analysis of Merchant Ship Trials and Service Performance.

Institution of Electrical Engineers (London Students' Section), at 6.15.—H. J. D. Palfrey: The Measurement of Light.

Junior Institution of Engineers, at 7.30.—Col. the Master of Sempill: Petrol and its Substitutes for use in Internal Combustion Engines.

Manchester Literary and Philosophical Society (Chemical Section).

SATURDAY, November 27.

Royal Institution of Great Britain, at 3.—Dr. G. C. Simpson: Atmospheric Electricity (I).

PUBLIC LECTURES.

SATURDAY, November 20.

Horniman Museum (Forest Hill), at 3.30.—H. MacLeod: Eclipses of the Sun.

SUNDAY, November 21.

Guildhouse (Eccleston Square), at 3 30.—Dr. G. C. Simpson: Meteorology in the Service of Man.

MONDAY, November 22.

Sheffield University, at 7.30.—H. H. Stilgoe: Water Supply and its relation to Public Health (Chadwick Lecture).

TUESDAY, November 23.

Goldsmiths' Hall, at 4.—Prof. J. S. Huxley: Biology and Human Life (Norman Lockyer Lecture).

King's College, at 5.30.—Miss Hilda D. Oakeley: Modern Theories of the Nature of Value in Psychology and Philosophy. (Succeeding Lecture on November 30.)

WEDNESDAY, November 24.

University College, at 5.30.—Dr. W. D. Johnston: The Library of Congress, its Functions as a National Library.

London School of Economics and Political Science, at 6.—G. W. Mayne: The Monroe Calculating Machine.

THURSDAY, November 25.

College of Nursing (Henrietta Street, W.), at 5.30.—Dr. Mary Buchan Douie: The Adolescent and Social Hygiene from the Standpoint of the Home.

Imperial College of Science and Technology, at 5.30.—Brig.-Gen. H. Hartley: Chemical Warfare.

Fulham Central Public Library, at 8.—A. D. Allen: Home-Grown Food.

SATURDAY, November 27

Horniman Museum (Forest Hill), at 3.30.—J. E. S. Dallas: Nature in Southern England.

SUNDAY, November 28.

Guildhouse (Eccleston Square), at 3.30.—Viscount Haldane: The Wider Meaning of Relativity.

CONFERENCE.

Friday, November 26.

Tar Conference (at the College of Technology, Manchester), at 10.30 A.M.—F. S. Sinnatt and Dr J. G. King: A Study of Tars and Oils obtained from Coal.—W G. Adam: A Plea for Standardisation of Analytical Methods in Coal Tar Products Specifications.—H. M. Spiers: (*a*) The Viscosity of Tar; (*b*) The Consistency of Bitumen Mixtures.—At 2.—Dr. A. Parker: Tar from Steamed Vertical Retorts.—J. McLeod: Notes on Vertical Retort Tar.—M. Barash: The Production of Road Tar from Vertical Retorts.—H. Hollings: The Influence of Carbonising Conditions on the Free Carbon Content of Tar.—At 5.—H. G. Adam and H. W. Robinson: Tar from the Point of View of the Highway Authority.—A. C. Tait: Coal Tar Disinfectants.—H. F. Taylor: Pitch.

SATURDAY, NOVEMBER 27, 1926.

CONTENTS.

PAGE

Science and the Press 757
The Electricity Bill. 759
The Mystery of Money. By W. H. Coates . . 760
Venereal Disease 762
The Biology of the Protozoa. By D. Ward Cutler 763
Our Bookshelf 765
Letters to the Editor:
The Continuous Spectrum of Mercury.—The Right Hon. Lord Rayleigh, F.R.S. 767
The Golgi Origin of Fatty Yolk in the Light of Parat's Work.—Prof. Vishwa Nath. . . 767
Anthropology and Administration. —Dr. B. Malinowski 768
The Recurrence of Magnetic Storms.—Dr. C. Chree, F.R.S.; Albert Alfred Buss . . 769
Post-Cretaceous Igneous Activity in Western India.—Prof. K. K. Mathur and V. S. Dubey . 769
The State and Industrial Research Associations.—Dr. W. Lawrence Balls, F.R.S. 770
Modern Photometry.—A. P. Trotter; L. C. M. . 770
Broadcasting Birth-control. — Prof. Julian S. Huxley 771
Spectrographic Junction between the X-ray Region and the Extreme Ultra-violet.—Robert Thoraeus 771
Quantum Theory and Intensity Distribution in Continuous Spectra.—Dr J. R. Oppenheimer . 771
University Laboratories and Research. By Sir. J. J. Thomson, O.M., F.R.S. 772
Richard of Wallingford and his Rectangulus. By Dr. R. T. Gunther 773
A Remarkable Suborder of Fishes 774
The Reform of the Calendar. By F. W. D. . . 776
Obituary:
Prof. J. D. F. Gilchrist 776
News and Views 777
Our Astronomical Column 782
Research Items 783
Recent Industrial Research in Cotton. By Prof. F. P. Slater. 786
The Function of Chlorophyll 786
Tide-predicting Machines. By Dr. A. T. Doodson. 787
University and Educational Intelligence . . . 788
Contemporary Birthdays 789
Societies and Academies 790
Official Publications Received 791
Diary of Societies and Public Lectures . . . 792
Recent Scientific and Technical Books . . Supp. v.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Science and the Press.

JUDGING from the Press reports of the Oxford meeting of the British Association, it is obvious that there is a considerable variety of opinion among editors regarding the appreciation of science among their readers. Some pander to the kinema mind and attempt to make the news which they have obtained from a news agency attractive by giving it captious titles such as "Why Mosquitoes Prefer Blondes," "Are Bald Men Brainiest?" "Bobbing Eases the Mind," or seize upon a chance illustration regarding the frayed edge of a collar as a pretext for the assertion that science is rediscovering what every woman knows. Others evidently care for little except the sensational or ultra-controversial subjects, giving the greatest prominence to speculative fields of inquiry and ignoring the substantial advances which have been made in knowledge during the past few years.

It is most gratifying, however, that there are now many editors who have become aware of the increasing demand for accurate presentation of facts as stated by the masters of science, and tend to leave their readers to draw their own deductions from the facts presented. As might be expected, these editors show a nice sense of differentiation between the 'givers' and the 'takers': between those who take every advantage of the facilities afforded at the meeting of the Association to make a wider public acquainted with the recent advances in knowledge, and those who abuse their position by indulging in self-advertisement or putting forth theories which are based upon nothing more substantial than their prejudices and predilections.

Whatever the form in which it is presented, science is now considered good 'copy.' Moreover, it is good copy for all types of journals, from the great national newspapers down to the parish-pump periodical. It may distress some scientific workers that an enterprising reporter of an obscure suburban journal should canvas the local barbers on their views on "What Time hath scanted men in hair, he hath given them in wit," the Shakespearian quotation which Dr. Gunther considered apposite to his thesis on "The Hairlessness of Man." Some may feel that most sections of the Press attached exaggerated importance to the views of Sir Oliver Lodge on the imperishability of the individual spirit of man: others may deplore the reporter's partiality for the easily assimilated contributions to knowledge which are characteristic of such sections as agriculture, education, and geography, or that a broad survey of the recent applications of science to the solution of the pressing problems of industry, public health, and the nation's food supplies and defence, should prove more attractive to editors than a brilliant analysis of the phenomena of line spectra. Many of those who read papers before the sections of the British Association may feel aggrieved that the substance of their contributions is neglected, while considerable importance is attached to their incidental analogies. Then again, there is the large class of contributors whose papers are ignored altogether in the newspapers, and this is frequently attributed to the reporter's preference for the contributions of scientific workers of well-established reputation, or for those of distinguished laymen.

It is obvious there must be selection. A modest estimate of the average daily output during the Oxford meeting would be sixty papers. To do bare justice to them all, the newspapers would need to devote at least thirty columns daily to science news, and this would involve the employment of a staff of scientific experts for each newspaper, unless all editors were prepared to present to their readers exactly the same copy. But if the public demand for science news were sufficiently great to warrant such wholesale circulation, it is clear that it would also be sufficient to justify the publication of a science daily newspaper.

In existing circumstances, editors will select those items of news which they think will appeal to their particular public. But any author of a paper can help them materially in this process of selection if he will take the trouble to prepare for the official programme of the Association, a summary which is not only written in language intelligible to the average well-educated member of the community, but also calculated to awaken interest either from the newness of its facts or the novelty of their presentation. It is useful if, in addition, one or two copies of his complete paper are available in advance to the reporters in the Press Bureau, as this widens the scope of selection of individual reporters. Attention to such matters as these will usually safeguard an author against misrepresentation of his facts, theories, and opinions. The title given to a paper is also important in this connexion. "The Hygroscopic Relations of Colloidal Fibres" conveys all that is necessary to members of Section A, but is not likely to interest a reporter with limited space and time at his command, who sees, moreover, that there are a dozen other papers with far more attractive titles to be delivered the same day. He is only human in preferring to look to papers on "Intelligence in Rats," the "Psychology of Patriotism," or "The Public Schools and National Life" for his copy.

It is not suggested that scientific workers should aim at providing reporters with 'stunts,' or that the importance of scientific investigations be judged by their immediate value as copy for newspapers or topics of conversation. But it is clearly worth while to present the results of investigation in any one branch of science and theorie based upon them, in a form which will enable ever scientific worker, as well as the specialist, to appreciat them. Since the general public is also interested i science, there seems every reason why it should b provided with the best of science, and every assistanc given to reporters—the channels of communicatio between science and the public—in the difficult tas of selection and presentation. Serious scientific worker are themselves partly to blame for having the patien work of years dismissed in three or four unintelligibl lines. They have put a new weapon in the hands o humanity; they have insensibly imposed upon it new mental outlook; upon them devolves the responsibility of enabling all members of the community t understand the functions, aims, and methods of science and the essence of the scientific spirit, its fearlessnes in facing facts, its determination to resist prejudice and its constant researches to test the validity o theories or the universality of laws.

If scientific workers will not seriously apply themselves to the task of securing greater and bette publicity for their work, other than that which the obtain in the scientific and technical press, and report of proceedings of learned societies and institution they must not complain of the manner of the publicity They must be prepared for valuable utterances an suggestive discussions to be neglected in favour of th trivial and fantastic contributions made to the proceedings by our scientific entertainers—the terms in whic the *Saturday Review* described the press reports of th Oxford meeting of the British Association. Yet ther is now less justification for this criticism than formerl since recently the Press, taken as a whole, has progressively improved its performance in separating th grain from the chaff. Many of the principal newspape now have at their disposal the services of journalist who are also scientific writers of distinction. Th daily reports of the Oxford meeting in the princip London and provincial journals were fuller than eve before, and considering the circumstances in whic they were compiled, remarkably fair and accurat Naturally, newspapers like the *Times* can devote mor columns to the proceedings than those in the clas typified by the *Daily Express* and the *Daily New* but little exception could be taken to the reports as whole. They flattered the intelligence of their reader Moreover, many of these journals maintained a runnin fire of comment in leading articles on the more importan papers delivered, a striking commentary on the interes in science which the meeting provokes.

There is little doubt that this interest could b sustained. The *Daily Express* published recently series of articles by eminent scientific workers. Mo f the serious weekly periodicals devote some space to cientific subjects. The day cannot be far distant vhen the editors of the *Observer* and the *Sunday Times* vill make a science page as regular a feature of their apers as their literature, music, and dramatic art pages. t is not improbable that the demand for scientific nformation is great enough to justify the publication f a science daily newspaper, or at least a sound and opular science weekly, written in a form calculated o appeal to a wider public than NATURE. There are laily and weekly journals devoted to finance, and these re not read solely by professional financiers.

The steps which might be taken by scientific workers o satisfy the public demand for knowledge of their vork have already been the subject of comment in hese columns. Reference has also been made to what as been done in the United States, by scientific workers themselves, to deal with a like situation. It is obvious that where there is a demand it will be satisfied by somebody. If the scientific community in Great Britain wishes to safeguard itself against the kind of misrepresentation of its endeavours which masquerades in the guise of 'popular science,' if it wishes to safeguard those members of the public interested in science progress against exploitation by enterprising advertisement agencies, there is no time to be lost. The opportunity to give the best of science to the nation exists. Do scientific workers possess the will and energy to take advantage of the present favourable situation?

The Electricity Bill.

THE Electricity Bill, after passing its third reading in the House of Commons, is now being considered in the Upper House. As there were twenty-six pages of amendments to be discussed and the bill is of a highly technical nature, the task was no easy one, but it started auspiciously. In the committee stage the bill was discussed from almost every point of view, and so it is unlikely that any serious flaw has been overlooked. Many politicians think that this bill makes a long step in the direction of nationalisation. In the opinion of the Government, however, it will stop nationalisation. It is pointed out that the electric supply industry is on a quite different footing from other industries. In every district of Great Britain electric supply is a monopoly. It is urged, therefore, that the industry should not be deprived of the great benefit that would ensue when co-operation and centralisation replace individual effort. The need for passing the bill at once is imperative, as several schemes for developing electrical supply are being held up pending the new legislation.

The amendment adopted by the Government making it obligatory instead of permissible for the Electricity Board to advance free of interest such sums as might be necessary to enable authorised undertakers or owners to alter their frequency, will probably meet the chief objection of many opponents of the bill.

It will be remembered that the origin of the bill was the desire expressed by many engineers to increase the interconnexion of networks of electricity supply in Great Britain The primary object of the bill was to increase the efficiency of the supply. It will probably follow that an increase in the retail supply and a lowering in the price of electricity will take place concurrently. In Canada and the United States there are huge supply networks covering many thousands of square miles. The Pacific Gas and South Californian Edison Companies network covers 120,000 square miles and links up 130 stations, which is more than double the area covered by the Government scheme.

The Electricity Commissioners have pointed out that 56 per cent. of the capital of electricity undertakings is locked up in spare plant. If complete interconnexion were established, this could be reduced very considerably. This is one of the principal gains which the promoters of the bill hope to secure. In due time considerable savings will doubtless be effected, and care has been taken to ensure that the consumer will benefit largely by them.

In our opinion this scheme will be a boon to both the country and the industry, provided that no undue delay ensues before it is put into operation. A really forward policy need not involve large expenditure. The Electricity Commissioners' Reports prove conclusively that many of the electricity networks in Great Britain are inadequate and were very expensive to construct. In some cases the cost per unit of maximum demand is about twenty times as great as that of the most efficient stations. The multiplicity and variety of the systems of supply in London, although largely due to early electrical legislation which established two competing companies in each local area, is not creditable to electrical engineers. Figures have proved the great economies that could be effected without even the necessity of scrapping plant the efficiency of which is only fair. A first step in the direction of improvement has been the standardisation of the pressure of supply. Whenever new schemes have been sanctioned or systems changed from direct current to alternating current, or even in those cases where direct current is being retained, the pressure of supply is now 230 volts.

We are glad to see that progress is being made by electrical manufacturers in the direction of cheaper systems of distribution in rural districts. Every one who has travelled on the continent knows the extensive use that has been made of overhead electrical distribution, particularly in connexion with railways. Whether they spoil the view of the landscape or not, there can be no question but that the use of poles, whether of wood or iron lattice work, is a great boon to the various countries concerned. We hope that the collieries and iron and steel works in Great Britain which do not generate their own electricity will be able to secure a bulk supply at low rates when this bill is passed. We also hope that those firms which can generate from waste heat more than sufficient power to meet their own needs will benefit by being able to sell their excess power to the Electricity Board.

The Mystery of Money.

Wealth, Virtual Wealth, and Debt: the Solution of the Economic Paradox. By Prof. Frederick Soddy. Pp. 320. (London: G. Allen and Unwin, Ltd., 1926.) 10*s.* 6*d.* net

IN childhood many things are hidden from us, but we use money to buy our first sweets at an age which is rarely within the recollection of mature thought. So we take money for granted. We learn by experience that it procures the things we want, and that usually seems to be all we want to know about it. Its origin, its functions, the explanation of the ebb and flow of its command over goods, with an accompanying maldistribution of unearned gain and undeserved loss, are, if not entirely unknown phenomena, at least recondite subjects which are best left alone.

Prof. Soddy is, however, a more adventurous spirit. After achieving a position of distinction in his own sphere which would satisfy the ambition of most men, he has become intrigued with the elusive problem of money. So we have "an attempt, rarely made nowadays, by a specialist in one field of knowledge to solve the problems in another."

Prof. Soddy has produced a volume which contains at one and the same time a penetrating analysis of the ultimate realities of modern banking science and a new theory of money which, despite his assertion that the solution which he brings is "the most ordinary incontrovertible commonsense requiring nothing more than that to prove it," will be rejected by every student of economics.

In the preface the reader is encouraged to read the conclusions in the last chapter before he commences on the arguments in the book. He could economise his time still further by skipping the very interesting but irrelevant matter in the first 100 pages, because it is not until Chapter vi. that the author comes to grips with his first concept of wealth. In this chapter which bears the heading of "The Two Categories of Wealth," the first section has the sub-title of "The Nature and Definition of Absolute Wealth," and we have to assume, in the absence of any clear indication, that his definition lies in the concluding words, which read: "Wealth as a form, product, or result of a draft upon the flow of available energy consists of the special forms, products, or results which empower and enable human life." After careful study we doubt whether this definition will jump readily to the minds of "all serious readers sincerely anxious to understand the causes of modern unrest." The theme, however, is further developed and two main categories of wealth distinguished. The first includes commodities "which retain part of the energy expended in their production as an internal store, which, in the consumption of these commodities, is released to serve the purposes of life." The second category includes commodities of which "the energy is expended in overcoming dead resistance, in changing the form or nature of the materials worked upon, and does not remain in the materials as an essential to their use." As examples in the first category we are given food, fuel, explosives, etc., and in the second, clothes, houses, furniture, tools, plant, roads vehicles, and ships. The difference lies in the relative perishability of those in the first category contrasted with the relative permanence of those in the second. So we reach the distinction, familiar to the economist, between consumers' goods and producers' goods—a distinction which Marshall characterises as "vague and perhaps not of much practical use" ("Principles," II., III., 1).

The meaning of the new term "Virtual Wealth" is not made easy. Prof. Soddy tells us that "the important thing is that this Virtual Wealth does not exist." 'Money,' although nowhere defined, apparently includes gold and silver coins, bank notes and cheques; we assume the latter term to mean all bank balances. Gold in the form of bullion is part of the national wealth; in the form of coins in circulation it is condemned as representing a waste of the community's labour. The system of bank balances is described as a power conferred upon the owners of those balances "not to possess but to be owed wealth." From this it is deduced that money is not wealth, but evidence that the owner of the money has not received the wealth to which he is entitled—wealth which he can demand at his convenience. It follows that "in a community, of necessity, the aggregate money, irrespective of its amount, represents the aggregate value of the wealth which the community prefers to be owed on these terms rather than to own. This negative quantity of wealth I term the *Virtual Wealth* of the community, because the community is obliged . . . to act as though it possessed this much more wealth than it actually does possess."

The trained student, to say nothing of the ordinary reader, will not find the argument very lucid, especially when he reads, on a later page, that "Virtual Wealth has, in fact, very little to do with the quantity of money." The author does not seem to realise that both in their private and business lives people retain floating balances of money (in the house, office, or bank) because it is a convenience to do so. The custom rests upon an economic basis; balances so kept perform a useful service. But the real object of Prof. Soddy's attack is the creation of bank money, which proceeds from the mechanism of banking operating through the extension of credit resting upon a gold basis. With an increase in 'cash balances' of 100*l.* and a cash ratio of 15 per cent., it is possible, he notes, to create deposits to the extent of 666*l.* 13*s.* 4*d.*, this liability being balanced on the assets side by the 100*l.* of original cash plus 566*l.* 13*s.* 4*d.* of advances. In this manner additional purchasing power is created, and Prof. Soddy says that if the total advances tend steadily to increase, people are undoubtedly "empowered by the banks to acquire wealth temporarily from the community to which they were not entitled and for which the whole community paid."

The author asserts that the financial device of the cheque for economising the use of currency means that a complete and unsuspected alteration has come over the nature of money. It may be complete, but it is surely going too far to imply that it is unsuspected by any one familiar with monetary science. In the ordinary course the growth of credit is small and gradual. It is controlled in all communities using the gold standard by that standard. Viewed impartially, the cheque system joined with the expansion of credit has been a blessing and not a curse. On the other hand, the multiplication of credit by the banking system during the War years, and immediately afterwards through the increase in the cash basis provided by the withdrawal of gold from circulation and the substitution therefor of Treasury notes, did bring into being a mass of purchasing power which was acquired from the community as a whole through the depreciation in sterling. In one word, we had inflation, and undoubtedly inflation was profitable not only to manufacturers, merchants, and traders, but also to the bankers. Views may differ as to the necessity of this operation, but few will now be found to hope that it is possible, as Prof. Soddy would wish, to put the clock back.

Prof. Soddy contends that "something of the order of two thousand million pounds have been created by the banks," which at 5 per cent. brings them in a revenue of a hundred million. His remedy is that the State should "buy back in the open market £M2000 of War Loan with genuine new money to replace that created by the banks." It is not clear how this money is to be issued. In one place we are told it is unnecessary to issue this quantity of Treasury notes and put them in circulation; three pages later we learn that this new money has in future to be held by the banks. Debtors to the banks in respect of present advances must, under this scheme, either sell their securities or find some one who has fresh money to lend them in order that they may repay the banks, which in future are to be required to lend only genuine deposits and are to be forbidden to extend credit upon the principle of keeping only in their tills a safe proportion of deposits.

The precise manner in which these proposals are to be executed is not specified. If contact and trust can be established between repaid National Debt holders and debtors to the banks so that the former lend to the latter sufficient to repay the banks, this part of the scheme might work in theory. The hypothesis, unfortunately, rests upon unexpounded assumptions which will not bear a moment's examination. The new money would unquestionably be paid into the banks, to the credit of the repaid National Debt holders as depositors. Now the banks are in future to keep pound for pound against deposits. We are at a loss to understand how they can do so and still "lend money at interest as before." If they keep cash pound for pound against deposits, they can earn no interest, and the whole credit structure, with all the assistance it renders to industry, will be brought to the ground. Further, how are the debt holders who are to be penalised by the redemption of their stock in new currency to be selected? If impartially, then the innumerable changes that have taken place in the ownership of debt holdings necessitate nothing less than a capital levy. In truth, Prof. Soddy's real plea is for the nationalisation of banking. But just as he shirks the issue of a capital levy, so he omits to carry his other proposals to their logical conclusion.

In the latter half of his book the author concentrates on the problems of the monetary factor in relation to production, and argues in favour of a stable price level controlled through the medium of a national statistical office. Control of currency is, however, to be in the hands of the State. As production increases, new money is to be printed and issued to the consuming public, by meeting Government expenditure therewith instead of by taxation. We are told that the correct quantity of money is that which is sufficient at the stable level of prices to purchase the total stocks of finished wealth in and outside the industrial system. No attention is given to the special circumstances of

Great Britain as an exporting country We are left wondering how we are to have a stable price level—presumably upon a gold basis—kept in proper relation to the price levels of other countries upon a like basis, if the export trades optimistically expand their output despite the absence of foreign buyers at the prices current, and if floods of new currency are issued by the State *pari passu* with the optimism of the producer.

While we have every sympathy with the difficulties that Prof. Soddy has found in the full comprehension of our present monetary system, we fear that his remedies would involve evils and difficulties far worse than those from which we at present suffer.

W. H. COATES.

Venereal Disease.

Proceedings of the Imperial Social Hygiene Congress, Wembly, Oct. 1925. Pp. iv+301. (British Social Hygiene Council, Carteret St., London, S.W.1.) 4*s*.

THE report of the Imperial Hygiene Congress deals exclusively with venereal diseases. Formerly all diseases were regarded as 'trials,' or as 'punishments for sin.' To-day only venereal diseases are so regarded, and only by the least civilised. It is known that they are caused by microbes, and that microbes do not discriminate between the just and the unjust. Nevertheless, even in England, and even so lately as during the War, after lectures compulsorily attended by soldiers, the jest that "It cannot, then, be sinful to have intercourse with virgins and respectable married women" was not uncommon. The silliness of these lectures is realised when it is borne in mind that among the sufferers are millions of infants.

Diseases may be prevented, or they may be cured. Cure is not an hygienic measure of importance. At any rate, the prevalence of no disease has been reduced appreciably by mere cure. Hygiene *is* prevention, which implies some effective form of cleanliness. Thus, diseases of the alimentary tract (*e.g.* cholera, typhoid, and dysentery) are prevented by attention to the food and water supplies. Insect-borne diseases (*e.g.* malaria, typhus, yellow fever, and bubonic plague) are prevented by destroying the insect carriers. Contagious diseases, such as most skin complaints, can be prevented only by personal hygiene.

The venereal diseases are strictly contagious. They have certain peculiarities. In the vast majority of infections, man is the carrier for woman and woman for man; that is, if they be prevented for one sex, they are automatically prevented for the other. As a very general rule, infection occurs only on particular occasions and on particular parts of the body. The microbes are very delicate, and therefore destructible by ordinary disinfectants if the latter be employed soon after the danger has been incurred, while the microbes are yet on the surface of the body. The male is much more easily disinfected than the female—so easily that a child might perform the operation which consists in no more than the swabbing of a few inches of very accessible skin. Lastly, the venereal diseases are the only maladies with which morality is now concerned.

Two methods of prevention are in vogue: exhortations to morality, and the use of chemical disinfectants. No one has objected to the exhortations; but the use of disinfectants has been much opposed. It has been forgotten that cleanliness is next to godliness. Exhortations to sexual morality, though used for many centuries, have not been very effective at any time. A point of psychology is involved. The sexual inclination is an instinct—a mental impulse to action which is awakened by experience, but not created by it. Thus no one *learns* to be hungry, or thirsty, or to suck. All human instincts are the same for all races of men. On the other hand, morals differ with time and place. They are learned. They constitute the rules by which men restrain their instincts and play the game of society. Almost invariably they are acquired at a particular age and in a particular way—during childhood and by imitation. A little child is 'plastic' (*i.e.* imitative), and therefore tends to copy the emotional convictions of its associates.

Consequently, a child can learn with sincere and unquestioning belief the tenets of any religion and its associated system of morals. In later life this power of learning through imitation becomes greatly enfeebled. The adult learns more through evidence; or what he supposes is evidence, for his judgment is often warped by preconceptions acquired during youth. Thus, while the child of ardent Mohammedans or Hindoos may be brought up in any religion and system of morality, it is usually impossible to change the opinions of the parents. In Christendom, and especially among English-speaking peoples, it is remarkable that exhortations to sexual morality are usually delivered by adults only to adults. Consequently, children learn their sentiments from other children among whom a knowledge of sex is traditional. It follows that exhortations to sexual morality delivered to adults are usually very ineffective—as any reader of NATURE may judge from his own feelings. Would any amount of preaching alter his present sentiments?

Prevention by means of chemical disinfectants has been practised for many years, and on a large scale during, and since, the War. During the War, precise statistics, every item of which could be checked from official records, were available. It was demonstrated that in many instances, under many and diverse conditions, in many parts of the world, high venereal rates had been reduced almost to the vanishing point by means of immediate disinfection practised by the endangered persons themselves. These facts were unpalatable to people whose principal concern was sexual morality. They could not bring themselves to believe, and sought to create unbelief. But the evidence has been examined by several committees of inquiry, and found unassailable—for example, Lord Trevethin's committee. To-day the only people who insist that personal disinfection is valueless are those who, on moral grounds, have refused to advise it, and therefore have no experience of it.

During the proceedings of the Imperial Hygiene Congress there seems to have been general agreement on two points: public sexual immorality had increased, and the prevalence of venereal disease had diminished during recent years. The conclusion to which we are driven is very obvious. Exhortation has had little influence and disinfection much.

The opening address of the Congress was delivered by Mr Amery, Secretary of State for the Dominions and Colonies, who stated:

> "Now we are dealing in this Congress more particularly with a certain aspect of health, and with certain types of diseases. We are dealing here with a problem that is at once one of the most serious and one of the most hopeful to which any body of public workers or reformers can devote themselves. Most serious, because I think it is becoming increasingly realised how wide-spread, how appalling in the misery, suffering, waste of human life, strength and ability they cause, are the consequences, direct and indirect, of venereal diseases On the other hand, hopeful, because from the medical point of view there can be no doubt that under the conditions of modern science there is no range of diseases which is more obviously and definitely capable of being dealt with, of being cured, and, indeed, if public opinion was strong enough, capable of being extirpated."

In effect, the only reference to chemical disinfection was made by Surgeon-Commander Thomas Shaw, professor of hygiene in the Royal Naval Medical School, Greenwich, who declared:

> "As stated by Trotter one hundred years ago, the best means of preventing venereal disease, if promiscuous sexual intercourse is indulged in, is immediate disinfection of the parts The part played by suitable and immediate prophylaxis is no longer disputed by any responsible person, and as promiscuous sexual intercourse will still continue to be practised by certain people in spite of all efforts to the contrary, our only hope of eventually exterminating venereal disease altogether is by a wider application of this measure. Whilst we all recognise the great importance of social measures in combating venereal diseases, we shall never exterminate them by these means alone."

The remainder of the volume recording the proceedings is occupied with accounts of the prevalence of venereal diseases in the British Empire, with descriptions of measures taken to cure people already infected, and of narrations of attempts to preserve sailors and other plastic types from the sirens of the streets.

The word hygiene does not accurately describe the Congress.

The Biology of the Protozoa.

The Biology of the Protozoa. By Prof. Gary N. Calkins. Pp. 623. (London: Baillière, Tindall and Cox, 1926.) 35*s*. net.

ALTHOUGH during the last quarter of a century the study of protozoa has been vigorously pursued by many students in many lands, yet the bringing together of the results so obtained, and the critical analysis of often discrepant results, is long overdue. The well-known text-books by Minchin and Doflein to a certain extent fill this need, but one is largely concerned with parasitic forms of protozoa, while the other is not available to those not conversant with the German language

Moreover, as Prof. Calkins says in his introduction, "protozoology as a branch of the biological sciences has meant little more than the application of biological or zoological methods to a definite but limited group of organisms, the Protozoa." The author has therefore tried to weave the many aspects of protozoological research into a common whole, with the hope of so founding a science of protozoology. The underlying principle of the work is the irritability of protoplasm, combined with protoplasmic organisation. Keeping this fundamental fact in view, the various characteristics of these unicellular animals, namely, metabolic activities, asexual and sexual reproduction, reorganisation and restoration of organisation, etc., are considered.

The word 'unicellular,' as applied to these animals, reminds one of the much-debated point as to whether 'non-cellular' is not a better designation. Prof. Calkins points out that, whereas a single protozoon is to be compared structurally with a single isolated tissue cell of a metazoon, it is a different unit physiologically, and as such should be compared with a complete organism, as was pointed out by Whitman, and later by Gurwitsch, and Dobell

The book is divided into twelve chapters, covering a wide range of the subject; the first five chapters treat of the general organisation of the protozoan body, nuclei and kinetic elements, structural differentiations, general physiology, and reproduction. This is followed by chapters dealing with each of the big subphyla of the protozoa: Mastigophora, Sarcodina, Infusoria, and Sporozoa. The classes of each of these groups are described and useful keys to the common genera are given. The concluding three chapters are perhaps the most interesting, for the author discusses such questions as vitality, fertilisation, and the origin of variations.

In a book of only about six hundred pages it is obviously impossible to treat exhaustively this subject matter, and the author has been wise in concentrating more upon free-living protozoa, to the exclusion of the parasitic types, as for example in the chapter on structural differentiations. Here little or no mention is made of the many curious adaptations incident upon the adoption of parasitism; since, however, these have already been well described, the account given by Prof. Calkins of the modifications found in free-living protozoa is particularly welcome.

Under the heading nuclei and kinetic elements, the author has grouped together, in a clear and interesting way, the various organs and cellular elements associated with movements, together with a description of the different configurations grouped together under the term nucleus. To the general biologist the section devoted to kinetic elements will probably appeal most strongly, for it is comparatively few who realise how complex is such a seemingly simple structure as a flagellum or cilium; added to this the reader is introduced to the numerous cytoplasmic granules known as endobasal bodies, centrioles, blepharoplasts, parabasal bodies, etc., all of which appear to play some part in the physiology of movement.

Particular attention may also be directed to the advances recently made towards elucidating the question of co-ordination in protozoa. Sharp, Yocom, McDonald, and others have been able to show that a definite conducting system of fibrils exists in many species of ciliates and that this system emanates from a common mass of protoplasm—the motorium—constituting with the fibrils a 'neuromotor' apparatus. Fig. 57 of Calkins' book illustrates this apparatus in *Euplotes patella* and goes far to substantiate the view that a single protozoon must be regarded as physiologically comparable with a whole metazoon individual.

The chapter on general physiology does not attain the high character of the rest of the book. This is unfortunate, since the title of the volume would suggest that physiology was particularly stressed; and, moreover, there is no modern book dealing with this branch of protozoology which can be recommended to the student. Prof. Calkins' book does help to fill this need, but not completely. In a future edition he would probably be well advised to expand this section to two or three times its present dimensions, even at the expense of some of the other material The author has evidently been at pains to keep his book within reasonable limits, with the result that sometimes his treatment is a little sketchy; thus little space is given to the questions concerning the response to various stimuli, and little or no mention is made of the reactions brought about by changed environmental conditions or adaptation to new conditions. Again, the important phenomena of encystation and excystation are not adequately discussed. The author has committed himself to the view that external conditions do not play a predominant part in causing the former reaction—a view to which most students of protozoa will subscribe—but the results of the many modern experiments are not given.

A similar criticism may be made against the treatment of nutrition, for, while certain aspects of it are well described, it is a surprise to find such a fascinating subject as choice of food dismissed quite summarily, without even mention being made of the work of such men as Oehler, to give only one example.

Probably the chapters to which all biologists will at once turn are those dealing with vitality; the author means by this term "the sum total of actions, reactions, and interactions between and amongst the substances making up the organisation of protoplasm, and between these and the environment." As is well known, Prof. Calkins, as a result of many years' research, has arrived at conclusions regarding the significance of conjugation and the part it plays in the life cycle of ciliates different from those of other distinguished observers.

The experiments on which these views are founded are well recounted; and to-day Prof. Calkins maintains the following conclusion: "To my mind the phenomena in these forms lead to the conclusion that Protozoa and Metazoa are fundamentally alike in respect to protoplasmic continuity and protoplasmic death, the difference between them is bound up with our definitions of the individual. So far as immortality of Protozoa is concerned, Hertwig's (1914) conclusions appear to sum up the situation: 'However these investigations may turn out, one may say this now, that the doctrine of the immortality of the Protozoa in the form established by Weismann, at a time when we did not know anything of the fertilisation processes of the Protozoa, cannot be retained.'"

The author must be congratulated upon the production of an exceedingly useful and interesting book; and in conclusion the hope may be expressed that at a future date he will furnish us with a more extended account of the general biology and physiology of that group of animals to which he has given thirty years' research.

D. WARD CUTLER.

Our Bookshelf.

Cotton and its Production. By W. H. Johnson. Pp. xxvii + 536 + 16 plates. (London: Macmillan and Co., Ltd., 1926.) 30*s.* net.

THE author has evidently utilised his very extensive experience of cotton-growing in most parts of the world to guide him in compiling this substantial volume from documentary sources. The result is a useful addition to the books about cotton, for besides being well up-to-date it is well balanced and exceptionally free from errors of fact. The author's first-hand knowledge puts his treatment on a higher level than mere compilation, but it is in no sense a critical treatment, and only attempts to present the known or reputed state of affairs. He deals with cotton production throughout the world, taking the information available with discretion.

The general level of the agricultural chapters which deal with the different countries is very fairly maintained in the others. Such subjects as the history and botany of the crop, its manufacture and by-products, its pests and diseases, all receive a chapter each, and these chapters are not likely to mislead the student, but will serve as useful introductions to further study.

Seeing that the scope of the book is such as will serve for reference purposes as well as for general information, it is regrettable that the system of references is very irregular. The "bibliography of cotton" which figures in the table of contents only contains some fifty items, apart from lists of journals and reports; some of these few are merely of casual interest, while others have not been used in the text. Conversely, there is internal evidence for the use of many publications which are not cited, as in the chapter on manufacture. Having regard to the skill with which the author has built up these citations into readable matter, and the great number of sources from which he has drawn them, it is to be hoped that the next edition will be lavishly provided with footnotes. An alternative course would be to issue a thin supplement volume of such references.

The details open to criticism are unimportant, and in most cases are due to the authority cited, for which the author has become responsible; thus the paragraph concerning the reputed depreciation in length of Sakel is very misleading, and the possibilities of rain-grown cotton in the Sudan, as regards quantity, are neglected more than the descriptive treatment warrants. W. L. B.

Dairy Cattle: Selection, Feeding and Management. By Prof. William Wodin Yapp and Prof. William Barbour Nevens. (Wiley Farm Series.) Pp. xvii + 378. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 11*s.* net.

THIS book deals with the selection, feeding and management of dairy cattle on the lines which the authors consider suitable for vocational-school students and dairy farmers in the United States. The subject matter of the different chapters is generally well known to the writers and workers in dairy husbandry in Great Britain and does not require special mention, but the method of study recommended in each chapter is novel and characteristic of the organisation and attention to detail which is possible in agricultural educational work when there is a staff sufficiently large to permit of the division of each subject into numerous sections.

The method adopted by the authors is that of stating clearly at the commencement of each chapter the practical operations involved; thus in the chapter on "Improving the Dairy Herd" the operations specified are: (1) Eliminating the low-producing cows; (2) choosing the proper sire; (3) practising rigid selection.

Each operation is then considered and the procedure to be followed is set out concisely in appropriately headed paragraphs. This method appears excellent, and has the merit of at once attracting the attention of the reader to the main points which the writers wish to emphasise. At the end of each chapter is given a list of American text-books and bulletins to which the reader may refer for further information; also a series of questions is set out, and the student is advised to obtain answers for himself by visiting a number of dairy farms. The advice given throughout is excellent, but amid so much attention to detail it is strange that the fundamental dairy farm operation of milking is passed over in a few words, and that in taking composite samples of milk for fat testing no mention is made of the need for the amount of the sample to be proportionate to the quantity of milk from which it is taken.

The book will be interesting and helpful to the lecturer in dairy husbandry in Great Britain who does not already possess an American text-book, but its value to the British student and farmer is limited because the numerous breeds of dairy cattle and kinds of feeding stuffs common in England but little known in the United States are not referred to by the authors.

Les mollusques d'eau douce. Par Prof. E. Chemin. (Encyclopédie pratique du naturaliste, Tome 24.) Pp. viii + 186 + 15 planches. (Paris: Paul Lechevalier, 1926.) 25 francs.

THIS little manual is one of a kind common in France, but only too rare in England, in which a circumscribed portion of some branch of natural history is treated by itself, be it from an elementary or from an advanced point of view. As a matter of fact, this one is more restricted than usual, for while its title would lead one to expect a complete account of the freshwater molluscs, at all events of France, the author announces in his preface that such is far from his intention. He writes, he says, merely for those who are interested in the natural sciences and the marvels of Nature, and his method is to select a common, characteristic form from each genus and describe its salient features, external and anatomical, so far as they can be explored without serious dissection. Comparisons are drawn between these genera, and their relationships to the bigger groups which they represent are outlined.

All this is admirably done, and the explanations are thoroughly clear and as good as any we have seen. On the other hand, in common with many who rest in the biological stage and are incapable of developing into the higher one of zoologists, the author gives vent to his contempt for the systematic side of his subject, and his sole contribution is to append to each generic description brief remarks on, or sometimes only the names of, the species he includes under it. He has evidently no first-hand knowledge of this branch of the subject, and his statements are antiquated and sometimes erroneous, as for example when the names of *Unio pictorum* and *U. tumidus* are interchanged. Fifteen plates depicting these species are appended to complete the book. Four are in gaudy, unnatural colours, the remainder in bistre half-tone, based principally, it would seem, on photographs, and for the most part devoid of their characteristic surface-markings or sculpturing.

Animal Husbandry. By H. J. Waters and F. G. King. Pp. viii + 546. (Boston, New York and London: Ginn and Co., 1925.) 7*s.* 6*d.* net.

No phase of agriculture has made more distinct advance within the last century than that which relates to the care and management of domestic animals. Certainly no other makes quite so attractive an appeal to human nature. This may explain the numerous text-books on this subject which appear from time to time. In one of the latest of these, by means of a judicious interweaving of theoretical principles and sound practical instruction, Messrs. Waters and King have succeeded in promoting that degree of co-ordination which should exist between the science and practice of stock farming.

A well-marked feature of the book is the attention devoted to the improvement in live-stock production, emphasis being laid on the attainment of the breeder's ideal through years of judicious selection and the vigorous culling of the scrub animal. It is pleasing to see that a few chapters are devoted to the encouragement of boys' and girls' clubs. This movement originated in the United States and has now assumed very large dimensions; doubtless it has been a factor of considerable importance in the general advancement in live-stock production. Useful hints are given regarding the formation of such clubs and what should be the ideals of club members.

We are of the opinion that the sections relating to the nutrition of the farm animal might have contained somewhat more detail. However, considering the size of the volume, the authors appear to have covered the ground with remarkable thoroughness.

The whole work is well produced (there are many beautifully reproduced photographs to illustrate the text), and should serve as an introductory or intermediate text-book for rural economy classes in schools and colleges.

Bibliographia Genetica. Onder redactie van Dr. J. P. Lotsy en Dr. H. N. Kooiman. Deel 1. Pp. v + 462. ('s-Gravenhage: Martinus Nijhoff, 1925.) 25 guilders.

Dr. Lotsy and Dr. Kooiman have undertaken the task of editing this work, the first volume of which appeared last year. In a series of volumes, contributed to by geneticists from all over the world, it is intended to summarise the whole field of modern genetics. The enormous and rapid development of genetics, which began in 1900 and is still going on at an increasing pace, makes such a series of summaries very valuable to workers in this field and to those who wish to know the present state of the subject without looking up the original papers. Each author covers the field in which his own contributions figure most prominently.

Thus in the present volume of 460 pages we find Fritz von Wettstein summarising—in 38 pages—the genetical work on mosses, including his own important work on polyploidy in these forms. Similarly, Punnett takes up the genetics of the sweet pea, giving a chromosome map of the various linkage groups. Castle deals with rabbits and guinea-pigs, with illustrations of the more important types; Fruwirth sets forth in 48 pages the genetic results on the potato, and Lehmann in 56 pages those with Epilobium.

Of somewhat different character is Haecker's "Aufgaben und Ergebnisse der Phänogenetik," which occupies 222 pages and is divided into eight chapters, dealing with such topics as size and its inheritance, asymmetry, pigmentation, skull shape, etc., in a comparative way.

Each contribution ends with a list of literature and an index which places all the information in the most available form. The volumes are well bound and should find a place in every productive biological library.

R. R. G.

A Course of Geometrical Analysis. By Dr. Haridas Bagchi. Pp. xi + 562. (Calcutta: Chuckervertty, Chatterji and Co., Ltd., 1926.) 20 rupees.

It is evident from this book, which is concerned with differential geometry, that Dr. Bagchi knows a great deal of mathematics and that he is a charming man, but it is equally clear that he would have been well advised not to publish this work in its present form. It consists of a kind of commentary or gloss on Forsyth's "Differential Geometry," to which the author makes handsome acknowledgments—see in particular on p. 228 the disarming way in which he ventures to point out a misprint. He deals at great length with rather elementary and trivial points, referring to Forsyth for the serious algebra and for the explanation of his terms, so that the book is unintelligible by itself. There are long digressions on such matters as homogeneous functions and Jacobians, in which the author has really nothing to say which should not be well known to any one beginning the subject. In fact, the book would be intolerably prolix and quite unreadable were it not for the delightfully quaint turns of speech which are to be found on every other page, but from which, in spite of the temptation, we refrain from quoting. Twenty rupees is a large sum to pay for this kind of amusement; after all, Mr. Anstey has done it quite as well long ago. It is a great pity, because Dr. Bagchi is undoubtedly capable of doing good work in mathematics, if he would not spread himself so much.

Kleines Praktikum der Vegetationskunde. Von Dr. Friedrich Markgraf. (Biologische Studienbücher, 4.) Pp. v + 64. (Berlin: Julius Springer, 1926.) 4·20 gold marks.

Dr. Markgraf's introduction to the practical study of vegetation is chiefly of interest because of a somewhat detailed consideration of the use of the quadrat method in the field, illustrated especially by reference to bogs and woodlands. This occupies nearly half the volume and, by comparison, the second section dealing with methods of investigating the features of the habitat appears all too brief, even for a beginner.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Continuous Spectrum of Mercury.

IN recent papers I have discussed the continuous spectrum of mercury and its association with the resonance line λ 2537 Prof R. W. Wood showed in 1909 that the green visual fluorescence of mercury vapour with continuous spectrum was destroyed by a red heat. I have recently studied the effect of heat on a stream of mercury vapour, showing the continuous spectrum as it distilled away from the electric discharge in which it originated. The visual glow disappeared, as might be anticipated from Wood's result. I thought it very probable that this was to be explained by the dissociation of mercury molecules which give rise to the (apparently) continuous spectrum. It was of interest to see whether the resonance line due to the atom would survive.

Photographs of the ultra-violet spectrum taken with these ideas in view gave a very surprising result The resonance line *did* survive, but with it was the strong part of the continuous spectrum in the region λ 3300, little if at all affected by the heat. This surviving part of the continuous spectrum is separated by an intervening minimum from the visual region which *is* extinguished by the heat.

There is much more to do I limit myself for the moment to announcing the above, which has been thoroughly confirmed.

RAYLEIGH.

Terling Place, Chelmsford,
November 14.

The Golgi Origin of Fatty Yolk in the Light of Parat's Work.

DURING the last few years evidence has been steadily accumulating that the Golgi rings or crescents of certain eggs give rise to fatty yolk. As this conclusion has been challenged by certain authors (for example, Harvey, *Quart. Journ. Micr. Sci*, 1925), it seems to me desirable to set forth briefly the evidence in favour of the above view in the light of Parat's work, which lends strong support to it.

To the best of my knowledge, Hirschler (*Zeit. f Wiss mikr u. tech.*, 1915) was the first worker to describe, in the eggs of ascidians, a swelling of the Golgi elements and their fusion with the swollen mitochondria to give rise to compound yolk bodies. This conclusion has been recently supported by Parat and Bhattacharya (*Comptes rendus*, 1926), who have studied the eggs of Ciona by means of Vital dyes. The greater bulk of evidence in support of the Golgi origin of fatty yolk, however, has been furnished by Gatenby and his pupils, and more recently by myself. In the egg of Saccocirrus (Gatenby, *Quart Journ. Micr. Sci*, 1922) the juxta-nuclear Golgi apparatus spreads out and proliferates with the growth of the egg, and probably gives rise to granules which are fatty in nature. A similar process has been described by me (*Proc Camb. Phil Soc*, Biol. Sci., 1924) in the eggs of Lithobius, in which the granules that arise from the proliferation of the Golgi apparatus grow to a considerable size and form fatty yolk which comes up in the centrifuged eggs exactly like the fatty yolk of Saccocirrus. In Helix (Brambell, *Brit. Jour. Exp. Biol.*, 1924) some of the Golgi elements are directly metamorphosed into fatty yolk which occupies the upper pole in centrifuged eggs In Patella, Ludford (*Jour. Roy. Micr. Soc*, 1921) and Gatenby and Woodger (*Jour Roy Micr Soc*, 1920) give a very circumstantial and convincing account of the origin of fatty yolk from the Golgi elements which has more recently been confirmed by Brambell (*Brit Jour Exp. Biol*, 1924), who shows that the fatty yolk occupies the upper pole in centrifuged eggs as is the case in Saccocirrus, Lithobius, and Helix.

During 1924 and 1925 Parat and his collaborators (*Comptes rendus des Séances de l'Académie des Sciences* and *Comptes rendus des Séances de la Société de Biologie*) have published a large number of small papers giving the results of their study of the Golgi apparatus in the genital and somatic cells of both invertebrates and vertebrates This is not the place for a full discussion of Parat's view. According to Parat, the Golgi elements exist in the form of vacuoles in all vertebrate and invertebrate cells. This he has proved by the use of the Vital stain, neutral red, the crystals of which precipitate in the vacuoles while the mitochondria remain quite colourless These latter, however, can be stained by the application of Janus green. Vacuole-like or ring-like Golgi elements are of course very common even in fixed preparations of all the cells of invertebrates and the genital cells of vertebrates. The important contribution, however, that Parat has made is that even the network-like Golgi apparatus of the somatic cells of vertebrates really consists of vacuoles. The reticular appearance of the Golgi apparatus is, according to Parat, an artefact produced by the precipitation of metallic silver or osmium in the interior, or at the periphery, or between these vacuoles.

As the somatic cells arise by differentiation from the germ cells, and as undoubtedly the Golgi elements of a particular cell are roughly distributed to the two daughter cells during mitosis, it has been so far difficult to explain how the Golgi crescents or rings of the germ cells could give rise to a network found in the somatic cells of vertebrates. As to the contents of the vacuoles, Parat insists that they are not lipoidal, because osmic acid is the test for fats and not for lipoids The content is mostly a liquid and its reaction is acidic; hence the affinity of vacuoles for the basic neutral red The absence of coagulum leads us to think that we have to deal in the majority of cases with the solution of crystalloids But it is a fact that certain colloids not miscible with protoplasm can accumulate in the vacuoles, like aleurone grains in the vegetable cells Final judgment on the chemical nature of the Golgi apparatus, however, can be delivered only when we are able to analyse it chemically, as has been done in the case of nucleo-proteins, but the view that the Golgi apparatus really consists of vacuoles in all animal cells lends strong support to the view of Guilliermond, Mangenot, Bensley, and others, that the plant cell vacuole is the homologue of the animal Golgi apparatus.

The above view of Parat also lends very strong support to the opinion that fatty yolk may arise from the Golgi elements In spiders (Nath, unpublished), in Scolopendra (Nath and Hussain, unpublished), and in the firefly Luciola (Nath and Metha, unpublished), the juxta-nuclear Golgi apparatus consists, in Mann-Kopsch preparations, of rings which may also be appropriately described as vacuoles with a sharp chromophilic rim and a central chromophobic area With the growth of the eggs, the Golgi rings proliferate and swell up and give rise to fatty yolk spheres by the deposition inside them of free unsaturated fat which is stained black even by the osmic acid in Flemming-without-acetic. The most interesting point, however, is that when these osmicated fatty yolk spheres which appear solid are treated with turpentine, they show a chromophilic rim and a chromophobic central substance, exactly like the Golgi elements. On further decolorisation the yolk spheres appear like clear vacuoles, which give a frothy appearance to the whole egg.

Recently Miss S. D. King (*Proc. Roy. Soc.*, June 1926) has given convincing arguments in favour of the Golgi origin of fatty yolk in the eggs of Oniscus exactly as in the eggs of Lithobius. It seems to me that there is no justification for the attacks that have been made on the above view of Gatenby and his pupils. My line of argument is perfectly simple. Golgi rings look like vacuoles, and fat spheres are certainly vacuolar in nature. It seems clear that the vacuole-like Golgi elements give rise to vacuole-like fatty yolk spheres, by a process of deposition in their interior of free fat not miscible with the general cytoplasm.

VISHWA NATH.

Bhupendra Research Laboratory,
Mohindra College,
Patiala, India,
October 7.

Anthropology and Administration.

ALL anthropologists will feel grateful to Mr. Ormsby-Gore, as well as to NATURE, for the vigorous pleading on behalf of the Imperial importance of our science by the Under Secretary of State for the Colonies, and for the interesting leading articles in the issues of October 30 and November 6. The passage from the Under Secretary's report quoted in NATURE is of special value for the right appreciation of anthropological methods. Mr. Ormsby-Gore sees clearly that "personal contact" is not enough. A "scientific study of their [the natives'] mental and moral characteristics, of native law and customs, of native history, language, and tradition" is indispensable. As is pointed out in the leading article, "There is now a wealth of accumulated experience and knowledge at our command in our schools of anthropology." I should like to add a few concrete suggestions as to how anthropology should be studied in order to be of direct use to the administrator.

The official in a Crown Colony has to legislate and to administer justice to his subjects; he has to regulate relations between white settler and native—relations which are predominantly of an economic or judicial nature—and he has to deal in various ways with local custom and belief. Three lines of anthropological approach are therefore of extreme importance to the future Colonial administrator: early economics, the psychology of native races, and, above all, the theory of primitive jurisprudence. Remarkably enough, two of these branches of learning, economics and jurisprudence, have been almost entirely neglected until recently. Text-books of anthropology, and even of social organisation, as well as most records of field-work, ignore them or deal with them inadequately or one-sidedly. Yet both primitive production and consumption of wealth, as well as the principles of justice and its administration, are fruitful subjects of observation in the field, as I have proved from my own experience and have shown in my published work. When trying to co-operate with the Colonial authorities in the utilisation of native labour, and the preservation of native culture, it seems of paramount importance to insist from the onset that our science can and will assist directly the authorities in what they need most.

There is, moreover, no practical difficulty in the way of such teaching in Great Britain, for it has been provided for by two or three universities, including that of London, where anthropology is taught in several of its colleges. At the London School of Economics a chair of ethnology has been in existence since 1913—and afterwards a readership in social anthropology—while later on the teaching of this subject was also established at University College and Bedford College. In the Department of Ethnology of the London School of Economics, under the direction of Prof. Seligman, the study of the early economic systems, the principle of native law and of savage mentality has been carried on for the last fifteen years. With field-workers of the measure of Prof. Seligman and Prof. Westermarck, with sociologists such as Prof. Hobhouse and Prof. Graham Wallas, with jurisprudents specially interested in anthropology such as Prof. Jenks, the teaching of our science has gone hand in hand with that of comparative law, comparative sociology, and economic history.

Recently also chairs of international relations and international history have been set up at the London School of Economics, and are held by Prof. Baker and Prof. Arnold Toynbee respectively. A wide scope is given to the study of the subject, and problems of inter-racial relations; the mutual influences of western and oriental culture; and the diffusion of European civilisation among simpler peoples fall within the sphere of these two chairs.

To such studies the background of appropriate anthropological theory is indispensable. The anthropologist is able first to supply the dispassionate attitude of mind so necessary to the discussion of inter-racial problems. His methods, especially if he is trained in field-work, tend to develop that sympathy with each specific culture based on understanding, which is perhaps the best antidote to political bias or false sentimentalism.

At the University of London we have also perhaps the biggest school of comparative linguistics extant, the School of Oriental Studies. I believe that any serious attempt to train future settlers and officials in the anthropological outlook must include linguistic teaching both of a theoretical and practical nature. It is to be hoped that the already existing co-operation between the London School of Economics and University College will soon be extended, also the School of Oriental Studies, and that with the assistance and advice of the Colonial Office, some such scheme of training will be devised as that already in force in the universities of Holland, above all at Leyden. This scheme has proved invaluable to the Dutch Colonial authorities.

There is, then, a definite field for anthropological research which can be made practically useful to the Colonial authorities. By cultivating it more intensively than is done at present, anthropology can also be brought in touch with realities and be able empirically to verify some of its theories.

Nothing is so salutary to a new science as a pragmatic contact with facts. Without in any way swerving from the pursuit of purely theoretical ends, anthropology needs at present to be deflected from the curio-hunting sensation-mongering interest which had been its curse in the past. There is a useful as well as a useless anthropology.

B. MALINOWSKI.

Department of Ethnology,
London School of Economics,
University of London.

The Recurrence of Magnetic Storms.

A FEW remarks seem expedient on Dr. Deslandres' letter in NATURE of October 30. Various recurrence phenomena, including pulsations with periods of a few seconds or minutes, have attracted the attention of magneticians, but my original letter referred only to the recurrence of magnetic storms, that is, large disturbances of considerable duration experienced simultaneously all over the earth. The various members of a recurring series of storms do not seem to bear any special family resemblance to one another. The methods I have employed have demonstrated recurrence after intervals of 27 days or multiples thereof, but not in shorter intervals. I am uncertain whether Dr. Deslandres agrees that these large prolonged disturbances show only the 27-day interval T, or whether he believes that they also tend to recur to a lesser extent in intervals $iT/6$, where i is integral, and that the failure to show these shorter intervals is the fault either of my data or of my methods. He refers to doubts entertained respecting the international character figures. So far as I am aware, the only criticism passed on these is that any particular character figure, for example, 1·5, is not an absolute measure of disturbance, but may signify different amounts of disturbance in quiet and disturbed years. This criticism is one I have made myself, but the defect does not prejudice the use of the figures for discriminating between disturbance on consecutive days, the only purpose for which the figures have been used in the present connexion.

Dr. Deslandres also seems to suggest that the use of mean data from a number of years may obscure real recurrence intervals prominent in individual years. If, however, mean data from a number of years reduce to insignificance a period prominent in one or two years, it implies a remarkable deficiency of recurrences with this period in the other years, a phenomenon difficult to explain unless the prominence during the one or two years was a matter of pure chance.

As a matter of fact, the results which I gave from the international character figures did not represent an 11-year period, as Dr. Deslandres seems to suppose. Two separate periods, one of six years, 1906 to 1911, and one of five years, 1920 to 1924, were dealt with separately, and neither showed the intervals $iT/6$. The 11-year period 1890 to 1900 which I dealt with preceded the existence of international figures. The results for it were based on Kew data alone, the criterion of disturbance being the absolute daily range of the horizontal force No trace of a period a submultiple of T appeared in that case either.

As regards the suggestions which Dr Deslandres has made for the better utilisation of the international character figures, the employment of 14 instead of 5 selected days a month has two rather obvious drawbacks. It entails nearly three times as much arithmetic, and it largely waters down the amplitude of the primary pulse. There is admittedly no special virtue in the number 5; it merely happens to be the number of quiet or disturbed days internationally selected for each month. But long experience has shown that in disturbed months it is difficult to secure more than 5 reasonably quiet days, while in quiet months it is sometimes difficult to get so many as 5 reasonably disturbed days. The suggestion to consider individual cases individually embodies the procedure which I originally followed after Mr. Maunder's investigations directed my attention to the subject. When following this procedure I did not succeed in arriving at any conclusions from which I felt assured that the influence of personal bias had been excluded. For ascertaining definitely the cause of the phenomenon the consideration of individual cases may be essential. It has of course special attractions for astronomers like Dr. Deslandres or the late Rev. A. L. Cortie, S.J., who have corresponding solar data immediately available.

C. CHREE.

75 Church Road, Richmond, Surrey.

THE letter on the above subject by Dr. Deslandres in NATURE of October 30, contains a reference to some preliminary investigations made by me some fourteen years ago.

From Dr. Deslandres' remarks I gather that he regrets that I should have confined myself in these investigations to 10 spots, and I wish to correct this impression, inasmuch as I have subjected all spots which appeared during the years 1912–14, that is, three years, to the identical examination, but the space available permitted only of the publication of one specimen table. The result in all the many other tabulations was the same, but when the material I worked upon gave out, I certainly came to a standstill. However, by an odd coincidence, on the very day I read Dr. Deslandres' communication, I received a letter from Stonyhurst offering to provide me with all the required data on similar lines as those the *Observatory* used to provide so very suitably. Therefore I intend to take the matter up again, and desire at this juncture already to express my thanks to both Dr. Deslandres and the Stonyhurst Observatory officials for their kind encouragement.

I wish to add that I am equally delighted to read that Dr. Deslandres has also found the presence of the D_3 helium-line over merely facular areas, an observational fact of many years' standing with me, and to which I have often referred in lectures and papers.

ALBERT ALFRED BUSS.

22 Egerton Road, Chorlton-cum-Hardy,
near Manchester,
November 8.

Post-Cretaceous Igneous Activity in Western India.

THE discovery of nepheline-syenite and monchiquite in Girnar, Kathiawar, announced by Dr. J. W. Evans in 1901 has, after a lapse of a quarter of a century, been followed by detailed petrographical and field investigations published in recent issues of the *Records of the Geological Survey of India* and the *Journal of Geology* respectively. The central mountain forms a dome of plutonic rocks intruded into the overlying Trap. Further investigations in Gujrat and Kathiawar have revealed a fascinating chapter in the history of post-Cretaceous igneous activity in India which is not dissimilar from the Tertiary igneous activity of Scotland. They acquire a special interest in view of the recent theory of magmatic cycles and its application by Dr. G. W. Tyrrell to the British Isles.

The plateau basalt which was presumably erupted from long fissures is, as a rule, free from evidence of explosive activity and the mode of its extravasation needs no description. This was followed in India by laccolithic intrusions, of which the Girnar and Barda hills are better known than others. A large circular dyke, corresponding to the ring-dykes of the Scottish intrusions, occurs round the central intrusion of Girnar (*Journal of Geology*, Vol. 34, No. 4). The long dykes which follow an approximately elliptical course east of Girnar and are so conspicuous in the Gir Range and near Gondal are, likewise, to be explained as a result of the stresses set up by a concealed intrusion which denudation has not yet exposed to the surface.

In addition to these, a number of other laccolithic intrusions appear to lie on a line which runs from Baroda *via* Bhavangar and Girnar to the Barda hills. An assumed northerly shift of this line makes it continuous along the intrusions of Cutch, Baluchistan, and Persia. It indicates a zone of weakness which keeps its parallellism to the coast and along which the basaltic magma was still able to intrude itself when the ascensive force was unable to bring it any longer to the surface. Slow crystallisation at some depth in the local magma reservoirs brought about differentiation and resulted in the production of acid types which took a plutonic, hypabyssal, or volcanic phase according to the mechanical strength of the intruded beds and the movement of the magma. The acid igneous rocks of the Deccan Trap, therefore, appear to represent the end product of differentiation in a basaltic magma.

This period of laccolithic and dyke intrusions was followed by the manifestation of local volcanic activity of the explosive type at various centres probably on the top of cooling reservoirs. Detailed investigations have been carried out by us on the Pawagadh hill, near Baroda, the rhyolites of which were first described, after a hurried visit to this locality, by Dr. L. L. Fermor, who had suspected an interbedding of rhyolite with basalt. The results of our examination of the hill show that Pawagadh became a centre of volcanic activity of an explosive type long after the cessation of the eruption of plateau basalt, during which interval valleys had been carved out in the existing lava flows. Doleritic olivine-basalt was extravasated in contrast to the olivine-free compact plateau basalt, followed by andesitic lavas and tuffs. Rhyolite flowed at the end from a central neck at the top of the hill (2811 feet) and from a few other subsidiary vents at a lower level. The Osham hill, where the rhyolite occurs again as the end product, appears to have had a similar history. A number of other volcanic vents are known on the line of laccoliths indicated above. This association confirms the explanation of volcanic activity of the explosive type put forward by Dr. A. L. Day and supported by Prof. A. Holmes (NATURE, vol. 117, p. 66).

The above outline serves to indicate the fact that in Gujrat, Kathiawar and Cutch we have an interesting record of events of an igneous cycle initiated by a fissure eruption. Field and laboratory work is in progress which will throw light on the detailed history of this period.

K. K. MATHUR.
V. S. DUBEY.

Department of Geology,
Hindu University, Benares,
September 23.

The State and Industrial Research Associations.

THE arguments adduced by Mr. J. W. Williamson in his paper on "The State and Industrial Research Associations," published in NATURE of Nov. 6, have made out several good reasons for the permanent subvention of such bodies by the State. No doubt his arguments might be met by the counter-argument that each industry should and could take out its own policy of insurance against ignorance.

Between these two alternatives there is a middle course which suggested itself to me in the course of past experience connected with the actual founding of one such association. This course would, I think, meet Mr. Williamson's views, and yet would still leave the responsibility for profitable development to be carried by the industry itself.

The suggestion I would make is cognate with my analysis of research into eight classes, defined by the restriction or freedom of their methods, aims, and subjects respectively (NATURE, Aug. 28, 1926) In the second of these classes the research is restricted to a subject which may be of industrial importance, such as cotton, but it is otherwise free; not bound to any particular technique or science, not constrained to any aim, but working simply to increase the total of scientific knowledge concerning its subject, whether such knowledge be 'useless' or otherwise. Such research is a fit and proper subject for State endowment to a limited extent; indeed, it could probably make out a more forcible claim on social grounds than could pure science, my unrestricted first class

In the organisation of such a research association as already exists, the endowment would support a nucleus organisation within it, whereto some three members of the staff would be allocated in such a way that even if an industry decided to abandon its association, the nucleus thereof would still continue to exist and function, upon a laboratory footing. Laboratories are not costly if they have not to concern themselves with the application of results; the administrative charges of such a nucleus would be trivial; the staff would, by definition, be picked men who could co-operate as colleagues without other formal direction than that of the accidental senior amongst them. They could be housed in some existing institution until such time as their industry saw fit to re-crystallise its research around this nucleus, in order to make their results usable by further studies made under restrictions of aim or method.

A State endowment of less than 4000*l.* a year would ensure such a nucleus of permanent appointments—not permanent staff—for each industry, and this nucleus would cost the same amount for every industry, large or small. The staff of an existing association would then be assured that, even if their association dissolved, still the roots of their work would continue to grow forward Issues too big to be profitable could be taken up by this nucleus staff; issues too profitable to be interesting would be willingly met by temporary expansion of the industry's direct contribution, and the subsequent contraction would not involve a risk of disintegrating the whole structure.

A certain insecurity which is inherent in any organisation built entirely on voluntary levies has an unfavourable influence on research, and while I do not quite agree with Mr. Williamson's cogent plea for a permanent State support of research associations as at present constructed, I believe that the insertion therein of such permanent nuclei would sufficiently ensure all the aims he has expressed, and more.

W. LAWRENCE BALLS.

Meldreth, Royston,
Herts, November 10.

Modern Photometry.

ALTHOUGH, as the reviewer of Mr. J. W. T. Walsh's "Photometry" in NATURE of October 23 says, "The reader must not object to change" and "Thi is not the place to discuss fully the vexed question o nomenclature," and that "of course" Mr. Walsh uses the terminology adopted by the Internationa Commission, I join in regretting the exchange o 'candle-power' for the words 'luminous intensity. The official language of the Commission is French Of course, 'candle-power' cannot be literally trans lated into French. I pointed out, at the meeting o the Commission in 1921, that M. Blondel at the Geneva Congress in 1896 had used the expression '*puissanc lumineuse*,' but it was objected that the word *puissanc* cannot now be employed in that sense. In English usage, 'candle-power' is strictly a form of power, and might, if we had the data, be defined in ergs per second. In French, an electric current cannot be strictly expressed in amperes, but the *intensité* of a current can be so stated. In English, the notion of *intensité* is here redundant, and, as the reviewer observes, "In scientific English the word 'intensity' always connotes something analogous to 'energy per unit area.'"

A good deal might be said about the proper use of the term 'flux,' when 'luminous flux' is to be substituted for 'light.' Flux is generally employed in English to connote a flow, not a rate. 'Luminous radiation' is all that is wanted, without introducing the conception of a rate. Need we stop to consider, or wait to know what light is before using the word in scientific English? Heat is not easy to define, temperature is less easy, but no new terms are wanted here. A. P. TROTTER.

Teffont, Salisbury,
October 30.

I AM very glad to find Mr. Trotter in agreement with me regarding some points in photometric nomenclature, but in reply to his concluding remarks I have only to suggest that the scientific use of the term 'light' should be at least as exact and simple as its ordinary use in English Terms like 'ultra-violet light' are simply ridiculous. That is why I suggested a greater care in the use of the word. Why manufacture new terms because a very small proportion of the population misuses the good old words?

L. C. M.

Broadcasting Birth-control.

SIR JAMES MARCHANT, in a letter published in the *Times* of November 17, refers to my "extreme and one-sided views" on the subject of birth-control As there appears to be much misconception in regard to what I actually did say on this subject during the broadcast debate on "Is Science Bad for the World?" on November 16, I should like to have the opportunity of putting my words on record They were as follows:

"Birth-control is capable of great harm, if it is not regulated; but its absence would lead to greater harm. It therefore must be regulated and supervised by the State" (or, I would now add, by the medical profession), "and the nation should allow no interference on the part of prudery or of religious intolerance. . . ." Here I was interrupted

I claim that this statement was neither extreme nor one-sided. Whether subjects like 'birth-control' should ever be mentioned on the wireless is another issue altogether. To me personally, letters such as that of Sir James Marchant appear to add point to the fear which has been expressed that State control of broadcasting might well tend to dulness and sterility through a banning of all controversial matters. Had broadcasting been possible in 1859, doubtless no expression of opinion would have been allowed over the wireless on the shocking question of whether man had not been specially created, but had evolved from animals.

However, I am here only concerned to defend myself from the imputation of having abused my privileged position at the microphone. I should also add that a year ago I was invited to give a series of wireless talks on biology and human life, and that no objection was then raised by the B.B.C. to the brief references to birth-control which I there made. I therefore conclude (and earnestly hope that I am correct) that though the policy of the B B.C. may be against the raising of the question in a controversial way in debate, this does not preclude the topic from ever being mentioned over the wireless

JULIAN S. HUXLEY.

King's College,
Strand, London, W C.2.

Spectrographic Junction between the X-ray Region and the Extreme Ultra-violet.

IN a letter published in NATURE of October 16, p. 551, Dr. A. Dauvillier has announced some preliminary results of attempts to get spectroscopic evidence of the unknown region between the X-rays and the extreme ultra-violet He has followed the same general methods and technique as have been used by me in measuring the *K*- and *L*-series of the formerly unknown domain of wave-lengths 12 Å.U.-25 Å U. (*Phil. Mag.*, February 1926).

My experience from this work is that a thorough critical scrutiny of the obtained spectrograms is necessary to exclude erroneous interpretations. To show that the lines found were not ordinary short wave-lengths reflected in higher orders or in other atomic planes than those supposed, Dr. Dauvillier has used goldbeater's foil. Our experience is that such foils, even of the thinnest obtainable sort, absorb completely all wave-lengths greater than 13 Å.U.-15 Å U, and therefore it is scarcely possible by this means to identify the longer wave-lengths.

It is also surprising that a foil of magnesium thick enough to prevent the photographic plate from fogging by the rather intense ordinary light would transmit this very soft radiation in any considerable amount, especially when the relatively small intensity of the *N*- and *O*-series, as also theoretically suggested by Kramers, is taken into account.

It will, however, be of great interest to get a detailed report of these experiments, which, if they prove to be correctly interpreted, are of high scientific value. ROBERT THORÆUS.

Physical Laboratory of the University,
Upsala, Sweden, October 29.

Quantum Theory and Intensity Distribution in Continuous Spectra.

THE undulatory mechanics makes it possible to give a quantum theory of aperiodic phenomena, and, in particular, to compute the intensity distribution for continuous spectra. The theory has recently been applied to the hyperbolic orbits of the hydrogen atom (*Proc. Camb. Phil. Soc.*, Oct. 1926). The results are too complicated to be given here in detail; but they yield an estimate of the intensity distribution in the continuous X-ray absorption spectra. This is, I believe, the first experimental verification of this part of the theory.

According to the theory, absorption sets in discontinuously at the series limit with a finite value, which, for a given n_k electron, is proportional to the wave-length of the limit. For very short waves the absorption coefficient is of the form $f(n, k)Z^{2k+2}\lambda^{2k+1}$, where Z is the effective nuclear charge and λ the wave-length of the radiation, and where $k = \frac{1}{2}, \frac{3}{2}$ . . . . The values of $f(n, k)$ give atomic absorption coefficients $Z^{\alpha}\lambda^{\beta}$, where α ranges from 3 to 4·5, and where β, for the shortest waves, is 2·5, and for the customary range varies between 2·5 and 3. This is in agreement with the empirical formulæ.

J. R. OPPENHEIMER.

Institut für Theoretische Physik,
Göttingen, October 30.

University Laboratories and Research.[1]

By Sir J. J. THOMSON, O.M., F.R.S.

PHYSICAL laboratories at the present day are very different from those existing when I began to study physics now, alas, more than fifty years ago. In those days they could be counted on the fingers of one hand. They were not palatial buildings, but for the most part consisted of a few odd rooms, wrung from a reluctant governing body by the importunity of the professor. The physical laboratory of Owens College, now the University of Manchester, where I began my study of physics, was a few rooms which nobody else wanted in Cobden's house in Quay Street, and I believe that one of the rooms in Lord Kelvin's laboratory at Glasgow was an old coal-cellar. The whole equipment of apparatus could in many cases not have cost more than a few hundred pounds. Now almost every university and technical school has a separate building equipped with expensive apparatus.

The provision of these laboratories, and the funds required for their maintenance, has become a very serious question for those responsible for the finances of our universities. I am afraid that physical laboratories are especially expensive. I am afraid, too, that the sums required for their equipment and maintenance are much more likely to increase than to diminish. They have indeed increased very rapidly of late years. Let me give an example of my own experience. At the beginning of this century there were about thirty persons doing original work at the Cavendish Laboratory. Their researches cost the laboratory between 300*l.* and 400*l.* a year. The cost now would be at least six times that amount. As science progresses the instruments required become more and more elaborate and expensive. The old endowments of the universities and the fees from students are quite inadequate to meet the expenses on the new scale. New studies require new endowments; there is still need, nay, there is increasing need, for the 'pious founder.'

It would be ungrateful, however, not to acknowledge the liberal help which is now given to physical science by the Government of the country, partly by grants to the universities, partly by grants for research administered by the Royal Society, and partly by the formation of the Advisory Council for Scientific and Industrial Research, which, among other things, finances the National Physical Laboratory. The Government, indeed, is now giving to physical science far more than any Government gave before. To the liberality of some of the city companies we owe some fine laboratories, and there are many private benefactors to whom our gratitude is due, but there is still room, nay, need, for many more.

It is not necessary for me to dwell on the educational value of the study of science in our universities and schools. Indeed, there are those who maintain that it is the literary studies that are in danger of neglect. I believe, however, that the vast majority of scientific men recognise the great, nay, the vital importance of literary subjects in education, and would view with horror a system from which they were absent. Both are necessary, but in my opinion science without literature would be worse than the old system of literature without science.

The educational value of the training in science depends to a great extent upon work in the laboratory. What are the educational values of science? Are they not that science arouses and does something to satisfy the wonder and curiosity we feel about the marvellous processes going on in the world around us; that it cultivates and develops the powers of observation; that, and this is a most important point, it teaches us to reason about facts that come under our own notice? It gives the student confidence in the powers of reason. I think every teacher of science knows that when a student calculates from the principles he has been taught what will happen, say, when light passes through a system of lenses, and on proceeding to try the experiment finds that the result agrees with his predictions, it comes to him as a great surprise. It comes almost as a shock that human reason can lead to accurate results. Nothing helps a student to use his reason more than the belief that it can be trusted. But to get these educational values from science the laboratory is essential; it is there that the facts on which he has to exert his reason are to be found, where the contact between the facts and the intellectual effort takes place. Again, by his experiments the properties of light, electricity, and so on are impressed upon his mind with a vividness possible in no other way. It is in the laboratory that we realise that close touch with Nature which is essential to the progress of science.

It is the duty of the universities to enlarge the bounds of knowledge, as well as to instruct the community in the knowledge already won. Such research is of great value to the community. The discoveries made in the universities by people working simply to increase human knowledge, without any idea whatever of any industrial application, are the very discoveries which create new industries and revolutionise the old. Take the case of the electrical industry. How did that come into existence? It was not because somebody set to work to develop a method for the transmission of power. It arose because Faraday wanted to try, in the laboratory at the Royal Institution in London, what would happen if he moved a magnet about near a coil of wire. That industry would never have been created if he had simply worked with the idea of discovering something to transmit power. I want to emphasise this point because there are many who say that the only legitimate object of research to which public funds should be applied is research with definite industrial intention. I am the last to decry *ad hoc* research, but it is not enough.

When bows and arrows were the most formidable weapons, it would have been a very good thing to establish a Bow-and-Arrow Research Association to make sure that one had got the best bow and arrow possible. But some man, working to get knowledge for its own sake, discovered gunpowder, and made the best bow and arrow obsolete. The truth is that Nature is so full of wonderful things that there is probably a much better solution of any problem than any we possess. We shall not find it by working directly on the problem, but if we work away, faithfully recording what we see in our experiments, we shall probably get a hint and arrive at results which may be of importance. It is difficult to say that any discovery which is made is devoid of commercial value. Our experience in the War showed us that the most recondite phenomena, known only to a few, could be applied for the service of the country

---

[1] From an address delivered at the opening of the new science laboratories at the University College of North Wales, Bangor, on November 2

I have heard the fear expressed that the multiplication of laboratories may lead to something like over-production—that there may not be enough discoveries to go round. Such a fear seems ludicrous to a physicist who knows that a discovery is not a terminus but an avenue opening up new and wider fields for work. We are surrounded on all sides by physical and chemical phenomena of which our knowledge is not even in its infancy, scarcely in embryo Consider for example the chemical and physical properties of living matter. A tiny seed is put into the ground and becomes with nothing but the soil, water, air, and light a workshop weaving for leaf, flower, and fruit fabrics of exquisite texture, moulding these with unerring accuracy into shapes of the greatest variety and complexity, dyeing them all the colours of rainbow, often spreading the colours in patterns full of minute and elaborate detail, laying up stores of substances, most of which are beyond the power of the chemist to produce, and finally producing other seeds able to produce the same effects. Compared with results like this our workshops, our looms, our dye-works seem clumsy and inefficient. What is the mechanism by which these wonderful results are produced? We have no idea.

To find out the mechanism of this tiny seed we shall have to develop methods of investigating the changes that go on, almost molecule by molecule. Of late years methods have been devised which are continually diminishing the distance between us and the solution of these problems, and in the not too indefinite future we may hope to get to know something of the way in which those marvels are accomplished. This requires the co-operation of many sciences, and it seems to me that the new buildings at Bangor are admirably fitted to take part in this great work.

Richard of Wallingford and his Rectangulus.

By Dr. R. T. GUNTHER.

THE celebration of the sixth centenary of the elevation of Richard of Wallingford to the Abbacy of St. Albans in 1326 is an occasion of far more than local interest, for it is also the celebration of the sixth centenary of the beginning of trigonometry in England.

Richard's father was a blacksmith in the village of Wallingford, who died when the son was only ten years of age, but Richard was fortunate enough to be adopted by the Prior of Wallingford, who sent him to Oxford at the age of seventeen. Six years later he was admitted to the monastery of St. Albans, perhaps, as Sir Edgar Wigram has suggested, because he instinctively recognised that in those days a monastery was the only refuge where a man of science could find license and leisure to prosecute his studies undisturbed. But after three years training, Abbot Hugh sent him back to Oxford as one of the students whom every Benedictine house was bound by statute to maintain at the University, in order to ensure that its learning should be kept up to standard Apparently to the deep concern of the chronicler, Richard then proceeded to spend valuable time on mathematics and astronomy, which he was expected to devote to theology. But in 1326 he had his reward by being elected Abbot of St. Albans, and, as after events proved, turned his scientific training to good purpose by reducing the debt and by rebuilding the Cloister of his Abbey.

We have two miniature portraits of Richard of Wallingford in the illuminated chronicle of Matthew Paris. In the first he is engaged at his bench making or measuring a circular instrument with a pair of compasses. His simple tools are lying by his side and his Abbot's mitre is on the floor. In the second portrait he is pointing to the famous clock which he made for the Abbey. A point of singular interest is the fact that in both portraits he is represented with a spotty face, indicating the ravages of the incurable disease of leprosy which he had contracted at Avignon. Indeed, of this we have confirmatory evidence in a prayer composed by him in later life after his promotion as Abbot. The words are worth quoting, if only as an example of the devotions of an English man of science of the fourteenth century.

> Though I be a man of lowly state, and smitten by Thy providence with an evil plague, so that I am not worthy to walk among men, but should by law be cast without the camp; yet Thou, O Lord my God, by what secret judgement I know not, dost yet hold me in honour, such honour as I have known none of my parents or kindred to attain to, in all health of body, and as I oft-times remember with wonder at Thy great bounty, dost so incline the hearts of the great towards me, that ever when present, they d not abhor my speech and the deformity of my face and hands, but rejoice to converse with me . .

We may, therefore, claim that the miniatures are truthful representations of "The Father of Trigonometry" in England.

Wallingford's trigonometrical methods are indicated in two works, *De sinubus demonstratis* and *De sinubus et arcubus in circulo inveniendis*, and their practical application is further described in his treatise on the Art of working with a Rectangulus.

Two scientific treatises on the 'Albion' and the Rectangulus are dated about the time of his election as Abbot. Fortunately, illustrated copies of the manuscript are still extant and they include many working drawings which reveal the construction of the instruments so clearly that a reconstruction is possible.

The 'Albion' has often been stated to have been the Abbey clock for which he is famous; but the evidence of the original manuscript points to its having been an elaborate Aequatorium or Volvelle composed of a number of circular dials for showing the position of the planets: the name 'Albion,' or all-by-one, having reference to the various operations which could be performed by the one instrument. There is no mention of cogwheels, pulleys, and weights, or of any driving or regulating apparatus in connexion with the Albion. Doubtless it was intended to be used with his other invention, the Rectangulus, with which the relative positions of stars could be measured.

In the prefatory sentences to his treatise on this instrument, Richard tells us that he invented the Rectangulus in order to obviate the laborious and difficult use of the Armillary Sphere in determining the course and place of fixed stars and planets, and for other problems which were usually solved by the astrolabe and the torquetum. The fundamental principle of the instrument is based on the theorem of Euclid on the equality of the angles and lengths of equidistant lines between parallels.

The instrument consists of three superposed limbs or rules connected by hinges in such a manner that each limb may not only be opened out at varying angles like the blade of a pocket knife, but may also be rotated round a peg-pivot below its hinge. Above all is an alidade, or rule with perforated sight-vanes, which is so hinged to the third limb that it can be either elevated above it or be moved parallel with it. The hinges may all be clamped more or less tightly by wedges driven through slots in the pegs, like those used in astrolabes.

To complete the instrument six scales of bronze were prepared and graduated. Three of these are fixed to the sides of the three limbs; the other three are movable, being pivoted on the pegs under the limbs. The lowest scale was divided along the edges into 60 equal divisions called degrees or parts of chords, *gradus seu partes cordarum*, each of which might, in the case of a large instrument, be further subdivided into 60 parts, while the middle or intervening band was divided by a table of right and versed chords, *corde recte et verse*. This middle divided band is omitted in the five other scales. The division of the upper scale of chords, which are called right chords, are numbered from the peg to the end of the scale; the lower scale, called versed chord, is numbered from the end of the rule to the peg. The ends of the alidade and upper limbs are provided with plumb-lines.

In his second treatise on the use of the Rectangulus, Wallingford explains in ten chapters how various observations and calculations are to be made. In the first place the whole instrument must be adjusted for level by a plumb-line fixed near the surface of the base pillar. The instrument is then ready for the first exercise, "To find the right and versed chord of a given arc less than a quarter of a circle and to find any arc from a given chord." The method in his own words, as translated by Sir John Findlay, is to

> let the perpendicular of the second limb hang over the first limb at the given arc, the length between the peg and the string reckoned from the peg to the end of the limb is the right chord of the arc. The distance beyond the string, reckoning from the point of the limb, gives the versed chord of the same arc. The reverse process enables an arc to be found from its chord. Note that the plumb-line hangs at right angles when it falls on equal divisions of the scales on both sides of the limb, and this is chiefly why the scales of chords are double on all the scales. The right and versed sine of an arc greater than a quarter of a circle may be easily found from what has been said, for the right sine of an arc less than a quarter of a circle is the right sine of the arc of the rest of the circle. Further, the versed sine of an arc greater than the quarter of a circle but less than a semicircle is greater than the semidiameter by the amount of the right chord of the angle by which the given arc is greater than a quarter of a circle, as is shown elsewhere.

Then follow chapters upon how "To find the meridian," "To find the altitude of a star above the horizon and its azimuth," "To find the latitude of a place by a star which does not set," "To find the latitude and longitude of a star from the equinoctial circle," "The declination of a star and its latitude in the ecliptic," "To find the true place of the sun from its aspect," "To find the true place of the moon in longitude and latitude," "The true place of fixed stars in latitude and longitude."

The treatise concludes with the sentence, "The Rectangulus was invented for the purposes which have been explained, and therefore, because what has been explained is sufficient for an apt pupil, the way is clear to everything that can be done by other instruments. Here I finish."

Wallingford died in 1335 at the age of forty-three. It is reported that the Abbot's house where he was sleeping was struck by lightning, and, weakened as he was by his disease, he did not survive the shock. His tomb is in the Abbey Sanctuary just east of the altar rails.

A Remarkable Suborder of Fishes.

DURING the Danish *Dana* Expeditions of 1920–1922 in the North Atlantic and the Gulf of Panama, under the leadership of Prof. Johs. Schmidt, a magnificent collection of ceratioid fishes was made, which forms the subject of a monograph by Mr. C. Tate Regan,[1] Keeper of Zoology in the British Museum (Natural History), from which the accompanying illustrations have been reproduced. Prior to the *Dana* Expeditions, and excluding the *Michael Sars* collection, as yet undescribed, only about sixty examples of this amazing suborder of fishes were known, so that the *Dana* addition of 220 specimens representing 39 species, many of which were new to science, was of great biological value.

The Ceratioidea form part of the order Pediculata, that group of highly specialised fishes in which the first ray (illicium) of the spinous dorsal fin is placed on the head and modified into a 'line and bait.' Their characteristic features are evidently related to their conditions of life. They are inhabitants of the deeper parts of the ocean, the majority living in mid-water, probably from 500 to 1500 metres below the surface, where there is little or no light. Related to the absence of light is the structure of the 'bait,' or terminal expansion of the illicium, which is a luminous bulb; the outer skin of the bulb is generally transparent, and within is a glandular sac that opens to the exterior by a pore and has a luminous secretion; the lower, or sometimes the posterior part of the sac is pigmented, and this pigmented area, according to Brauer, is covered inside by a layer of cells which acts as a reflector. Externally the bulb may be furnished with papillæ, flaps or tentacle-like filaments. There are great differences in the length of the 'line' or first dorsal ray; from fishes in which the luminous bulb is sessile on the head, to those in which it is borne on a line several times as long as the fish itself. The line is articulated to the anterior end of a movable basal bone which as a rule lies in a trough on the upper side of the head. Those more highly specialised forms, in which the basal bone is slender and flexible and completely exserted, may be considered true anglers, for they have both rod and line, and Lasiognathus (Fig. 1), which is in addition provided with hooks, may well be termed a complete angler.

---

[1] "The Pediculate Fishes of the Suborder Ceratioidea." By C. Tate Regan. The Danish *Dana* Expeditions 1920–1922 in the North Atlantic and the Gulf of Panama. Oceanographical Reports edited by the *Dana* Committee, No. 2. (Copenhagen; Gyldendalske Boghandel. London: Wheldon and Wesley, Ltd., 1926.) 15s.

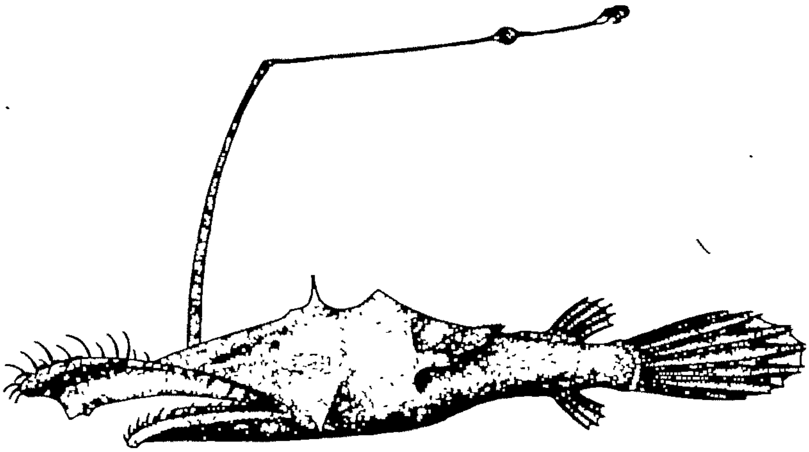


FIG. 1.—Lateral view of *Lasiognathus saccostoma*, Regan. Length 75 mm.

The majority of the ceratioids appear to be piscivorous, and have a large mouth and jaws furnished with slender acute teeth which are generally arranged in about three series. The teeth are depressible inwards, an arrangement which would make it very difficult for a ceratioid to release a fish it had seized, even if it wanted to. Neoceratias (Fig. 2), with teeth on top of the head that recall the spines of an echinoid, is perhaps the strangest of all. In some genera the stomach is extraordinarily distensible; thus a Melanocetus has been known to swallow a Lampanyctus three times its own length and many times its weight. Equally remarkable are the pincer-like jaws of Rhynchoceratias, and the forwardly directed telescopic eyes of Aceratias, indicating that the fishes of this genus have binocular vision.

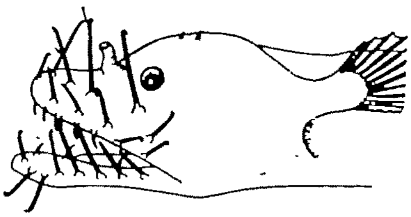


FIG. 2.—Head of *Neoceratias spinifer*, Pappenheim. Length to base of caudal fin, 25 mm. After Pappenheim, 1914.

Probably the chief interest in the ceratioids lies in the fact that they are unique among vertebrates in having the males dwarfed and parasitic on the females. The species in which males are known are *Photocorynus spiniceps* (male 10 mm. long attached to a female of 62 mm.), *Edriolychnus schmidti* (male 14 mm. long attached to a female of 62 mm.), and *Ceratias holboelli* (males of 80 and 85 mm. on a female of 1030 mm., and a male of 105 mm. on a female of 1000 mm.) (Fig. 3). The males resemble the females in general form, but differ from them in the development of structures for attachment, in the absence of the illicium, the reduction or absence of spines on the head, the absence of teeth, and the vestigial condition of the gut; the only organ of importance in the abdominal cavity is the large testis. The method of attachment to the female is of especial interest. In Photocorynus and Ceratias, upper and lower outgrowths of the anterior end of the head of the male unite in front of the mouth and fuse with a papilla-like projection from the skin of the female.

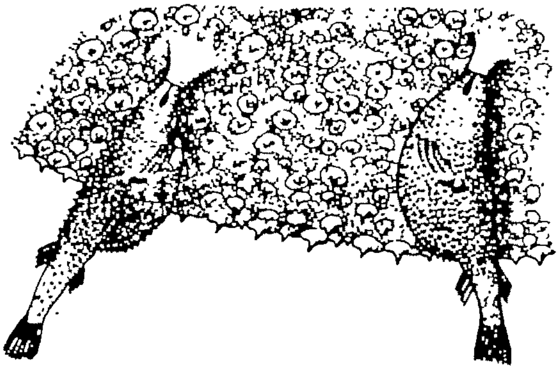


FIG. 3.—Two males of *Ceratias holboelli*. Half natural size. After Sæmundsson.

From his microscopic examination of sections of a strip of the tissue connecting the male and female Ceratias, Mr. Tate Regan is of the opinion that the male and female are completely blended, the highly vascular fibrous tissue of the outgrowths of the male being continuous with that of the papilla of the female, and he regards it as almost certain that the blood-systems of the two fishes are continuous. He does not favour the view that the attachment may be of the nature of a placenta, which implies that the two animals separate later on, but suggests that the males, soon after they are hatched, attach themselves to the females, if they are fortunate enough to meet them, and remain attached throughout life. In all probability the males are incapable of free development, and it is likely that the majority fail to find a female and perish, although another possibility has been suggested, namely, that the post-larval fishes that find and become attached to females develop into males, and those that do not, into females.

The Reform of the Calendar.

SINCE the War a number of ingenious schemes have been put forward for the reform of the calendar. Such an important step should not be taken unadvisedly, lightly, or wantonly, but the advantages claimed should be considered, the extent of the demand for it assessed, and the possibility of finding a scheme which would meet general approval carefully weighed. The League of Nations, being in a position to consult the various bodies which could give authoritative expression to opinion on the subject and the aid of which would be required in carrying out any changes proposed, undertook a full inquiry. It appointed a committee, with Prof. van Eysinga of Leyden as chairman, and with representatives of the Holy See, the Orthodox Church, the Church of England, the International Chamber of Commerce, and the International Astronomical Union upon it. This committee has recently issued a short and valuable report.[1]

The principal defect in the Gregorian Calendar arises from the unequal lengths of months, quarters, and half-years, which introduce a certain amount of irregularity in statistics, accounts, commercial and transport figures. This is increased somewhat because different days of the week are of unequal value as regards volume of trade, and thus one year or one quarter is not strictly comparable with another.

Minor defects are that special tables are required by banks in their calculations of interest, and that dates of periodical events, for example, the opening of Parliament, cannot be fixed without reference to a calendar. As many as 185 schemes of reform were received by the committee, including 33 from France, 27 from the United States, 24 from Germany, and 5 from Great Britain. The minimum change proposed was to take a day from August and give it to February. A second suggestion made the months of three of the quarters of the year consist of 30, 30, and 31 days respectively, and the last quarter of 30, 31, and 31 days. The question may well be asked whether the advantages are sufficient to justify the change.

A more radical reform is obtained by the use of one day without name in ordinary years and two such days in leap-years. The remaining days of the year may then be divided into 52 weeks, which may be arranged as four quarters of thirteen weeks, the months consisting of 30, 30, and 31 days, or as 13 months of 4 weeks each. The advantages and disadvantages of these two schemes are compared, and preference on the whole given to the former. The committee is satisfied, and most people will agree with it, that there is no genera demand for these changes, which would be strongl opposed by many religious bodies. Without genera assent, confusion would result, and it may be remembered that the Gregorian Calendar was introduce in 1582, adopted in Scotland in 1600, but not i England until 1751, and in eastern Europe only si years ago.

The committee next considers the question of fixin or 'stabilising' Easter. At present Easter Sunda varies between March 22 and April 25. This wid range makes difficulties in the arrangement of schoo and university terms and of public holidays. Man commercial transactions and transport services ar prejudiced, in particular, business dealing with textiles articles of fashion, and the hotel-keeping industry There appears to be a consensus of opinion in thes circles that the second Sunday in April would be th most convenient date. The committee favours slightly different date, namely, the day following th second Saturday, in order to avoid the contingenc of the festival of the Annunciation and Passion Sunda both falling on the same date

The committee has made general inquiries of th attitude of the heads of different Christian Churche on the stabilisation of Easter. It is agreed that ther is no dogmatic reason against a fixed date. It appear that the Church of England and the Greek Church ar ready to accept the change if the Church of Rom also accepts it. The Holy See does not consider tha there is sufficient reason for changing a date hande down by immemorial tradition and sanctioned b councils from early times, and would not be prepare to consider the question except on the advice of a Œcumenical Council. The Protestant Churches o Europe and America and the Jewish Community rais no objections to the proposal.

The report of the committee of the League of Nation shows that there is a general belief, certainly in England that the stabilisation of Easter would bring substantia advantages and a wish to see the change made. A there are no difficulties of dogma involved, it may b hoped that ecclesiastical concurrence is not impossible Incidentally, uniformity in keeping Easter will b secured between the different Churches. At th present time the Greek Church uses the position o the moon to determine Easter, while the tables o Clavius are still retained by the Roman and Anglica Churches. Sometimes the two methods give the sam date; frequently they differ a week, and occasionall a month.

F. W. D.

---

[1] Publication of the League of Nations, viii Transit, 1926, viii 6. (London Constable and Co.) 3s 6d

Obituary.

PROF. J. D. F. GILCHRIST.

PROF. J. D. F. GILCHRIST, who died recently in Capetown at the age of sixty years, had been in South Africa for thirty-one years. Gilchrist's early university days were spent at St. Andrews and Edinburgh. At one time he had thought of entering the Presbyterian ministry, but after coming under the influence of inspiring leaders in natural science at St. Andrews and Edinburgh, he definitely resolved to pursue a biological career. After a period at Münic and Zürich, and at biological stations, more especiall that of St. Andrews, he was appointed, on the recommendation of the late Sir John Murray, of the *Challenger* and of Prof. M'Intosh, St. Andrews, to the position o Government Marine Biologist at the Cape of Good Hope

Gilchrist was probably the first to hold the title o Government Biologist in any country, and in his late days he was wont to tell his friends about the weary ohill task he had during his first year, in a government fice in Parliament Street, Cape Town, without either boratory or practical equipment of any kind. He as, however, able to persuade the Ministry of Agrilture that a vessel for dredging and trawling, a useum for storing the specimens, and a marine boratory and aquarium were necessary.

Gilchrist was particularly fortunate in securing as e first captain of the government trawler, Alexander urbyne, a keen fisherman naturalist, who had been ained under the late Sir John Murray. An important ractical result of the preliminary surveys of the S.S. *ieter Faure* was the discovery in 1898 of a rich fishround on the Agulhas Bank, within easy reach of the arkets of Cape Town. This discovery appealed alike o the public and to the Government, and led to greater nancial support

While recognising the necessity of developing the conomic aspect of marine biology, Gilchrist always ept the more purely scientific point of view in his ind. The Cape waters had only been explored in a ursory manner by such expeditions as the *Challenger* nd the *Gazelle*, and thus there was open ground for ore thorough investigations. The dredging and rawling expeditions of the *Pieter Faure* resulted in the apture of more than twenty thousand specimens, the ajority of which, with the exception of the fishes, ere despatched home to be studied by specialists. rom the papers published by these workers, and from is own contributions, Gilchrist edited the volumes Marine Investigations in South Africa" (1902–1907). n 1907, however, during a period of severe financial depression in the colony, the office of Government Biologist was abolished, but the publications were revived in 1913, under a new board, as "Marine Biological Reports of the Cape Province."

From 1905 to 1917, Gilchrist was professor of zoology in the South African College, and when, in 1918, the latter developed into the University of Cape Town, he held the chair of zoology until in 1925 ill-health compelled his retirement. After his resignation he still carried on some work at his favourite haunt, the St. James Marine Station, on the shores of Kalk Bay.

Gilchrist was the author of numerous papers, dealing more especially with the description of new or rare species of fish, and of their larval development; but he also contributed publications of more general interest, such as those on the early stages of *Cephalodiscus gilchristi*, on the enteropneust, *Xenopleura vivipara*, on the remarkable crawling medusa (*Cnidonema capensis*, g. et sp. n.), and on the temperature and currents of South African seas.

Sometimes Gilchrist may have conveyed the impression of a man who lived in a little world of his own, wrapped up in thoughts of his fishes and other denizens of the sea, but that he could free himself from these deliberations is proved by his work for science in the colony, as president of the Philosophical and later of the Royal Society of South Africa, and as one of the main organisers of the South African Association for the Advancement of Science.

Gilchrist married Elfreda Ruth, daughter of S. H. Raubenheimer, of George, C.C., and is survived by his widow, a son, and a daughter.

News and Views.

ONE of the problems to which the Imperial Conerence has been devoting attention is the present osition of forestry within the British Empire A ub-committee was set up, which dealt with this atter on broad lines. It is a hopeful augury for the uture that the question of a forest policy common to he Empire as a whole, with especial reference to the orld's timber supplies, should have been examined n some detail. It is an accepted fact that the availble virgin supplies of the soft woods (pines and firs) re giving out, Canada and north Russia and Siberia ontaining the chief remaining stocks. About eighty er cent of the wood used for industrial purposes onsists of the soft woods. As regards the hard woods, he available supplies of these from temperate climates re not regarded as satisfactory, and their replacement y tropical hard woods offers difficulties which are ery far from solution. Apart from the question of the availability of the existing supplies to meet lemands, there exist social and economic problems hich make it necessary that each country, and perhaps more especially the British Empire, should formulate a policy which shall maintain a sufficient forest area under a conservative forest management. At the present day a large proportion of the Empire forests have little that can be termed a scientific conservative management in being; the Imperial Conference will have made a long step forward if, as a result of the deliberations and recommendations of the sub-committee, a consistent forest policy is formulated and adhered to. Other matters given consideration were Empire settlement and its connexion with forestry, the meeting of the Empire Forestry Conference in Australia and New Zealand in 1928, forest products research work, and the proposed inauguration of an Imperial Forestry Bureau.

THE silver medal of the Zoological Society of London has been awarded to Capt. H. C Brocklehurst, the Game Warden of the Sudan, in recognition of his services to the Society, and for the active part which he has taken in the preservation of the wild fauna of that part of Africa. The medal, which was designed by Landseer, has been awarded on forty-eight previous occasions, the first recipient being Sir Roderick Murchison, in 1847, "for assisting in the introduction of the Aurochs." Capt. Brocklehurst has been instrumental in obtaining several valuable collections of animals for the London Zoo. The last of these included two giraffes, two Sudanese oryx, and three shoebills, or whaleheaded storks, now one of the rarest birds in the world. The white rhinoceros, which a little time ago was threatened with extinction, comes directly under Capt. Brocklehurst's care, and it is reassuring to hear from him that, owing to the proper administration of suitable game laws, this wonderful animal, which sometimes exceeds 6 ft. at the shoulder, not only is out of danger of becoming extinct, but is even increasing so rapidly that a certain number are now allowed to be shot each year, and he has every hope of obtaining a young one for the Society's collection. From other parts of Africa the reports on game preservation are equally reassuring, especially from the Transvaal, where, after twenty-six years of political struggle, the Great Sabi Game Reserve has been established on a permanent basis, and has been given the name of the Kruger National Park. In relation to this it is highly satisfactory to note that Col. J. Stevenson Hamilton, who was chiefly responsible for getting this measure approved by the Union Government, has accepted the post of secretary to the Society for the Preservation of the Fauna of the Empire.

THE Nobel prize for medicine has been awarded to Dr. Johannes Fibiger, professor of pathological anatomy in the University of Copenhagen, who has spent many years in the study of cancer and is best known for his work on the nematode *Gongylonema neoplasticum*. This worm lives in cochroaches, and, when these are eaten by rats, passes into their stomachs, where by the irritation it produces it initiates the growth of malignant tumours. Prof. Fibiger has worked out the whole process in great detail, and thus made notable additions to our knowledge of the relationship of irritation to cancer. Other examples where the irritant is a worm are the cancers of the bladder in man in Egypt caused by Schistosomum and the sarcoma of the liver in rats often associated with the hydatid phase of *Taenia crassicollis*.

CANON J. M. WILSON, who at Rugby and Clifton did much to introduce practical science teaching into schools, and is now in his ninety-first year, must be known to a wide public as having been a consistent champion of evolutionary ideas in religion long before such ideas had become at all popular in theological circles. The earnestness, moderation, and candour of his writings commended evolution to many minds which otherwise would have continued to regard it with dislike and misgiving. A recent pamphlet by Canon Wilson, "Christianity in the Light of the Idea of Evolution" (London: *Guardian* Office), shows that the powers of this veteran apologist have not declined. Indeed, with remarkable acumen, he lays his finger on what certainly are the critical points to-day. The principle of evolution has now been extended beyond the biological sphere to anthropology and psychology, and it is these applications which are causing trouble to many thoughtful people. Religious beliefs are no longer refuted, but explained, as one writer has put it. Yet, as Canon Wilson sees it, the idea of a gradual evolution of belief is a very valuable one, even from the specifically religious point of view. "The evolution of theology," he writes, "may be welcomed; or it may be ignored and hushed up; or it may be disliked and denounced. But it cannot be denied. It is a fact, and a fact of the greatest significance." This evolution of ideas may be regarded as "progressive discovery," which fro another point of view can still be called revelatio This conception is especially fruitful in the study the Old Testament, which is "the story of man' progressive discovery in theology."

IN England this would nowadays be accepted b even conservative scholars; but it is not alway realised, as it is by Canon Wilson, that the sam principle applies to the New Testament and to th development of the Creeds. In the New Testamen there are several quite distinct strata of theologica development, and the need for 'restatement' wa felt so early as the first century. It is only by dis regarding history that the idea of a fixed and fina theology becomes possible. The problem now is, a Canon Wilson points out, "to enshrine in a trans formed and more elastic framework the old and dee religious experiences expressed in the Bible and th Creeds and other formularies." This is scarcely th place to expand these ideas, but it is gratifying an encouraging for students of science when they see a eminent theologian taking up an attitude of this kind for even men of science have their religious instinct which they would be better able to satisfy if th spirit animating Canon Wilson were more widespread His position is that "religious faith is henceforth to b based on experience and observation; it has becom scientific." From this point of view theology mus always be secondary, being the interpretation of a experience. In science there are no such things a final interpretations or unchangeable hypotheses and if the same principle were recognised in religion religion would share some of the vitality of natura science, and be a great deal more useful to humanity

WE have received the abstract of a lecture entitle "Life and Mind" which was delivered by Dr. Bernar Hollander before the Ethological Society on Octobe 25. Dr. Hollander is to be congratulated on hi courage, for life and mind may be said to be the tw ultimate problems of the universe, since only throug the senses and minds of living beings do we kno anything at all about the universe. He asserts tha life and mind are 'forms' of energy—a statemen which we think erroneous. Dr. Hollander, indeed, i not comfortable about it himself, for he goes on to say "If the brain were purely a mechanical apparatu producing mind, we could not be at the same tim spectators. Those who think so always look at others No one considers his own self a piece of mechanism, part of the universal clockwork." We think that th confusion arises from overlooking the fact that lif and mind are presuppositions of all knowledge. Wha we call 'mind' is a name for our own personality an its activities through which we learn about everythin else, energy included. All else is a series of presenta tions to our mind, presentations which are coloure by its activities. We can no more get outside ourselve and view ourselves from outside than we could lif ourselves out of a marsh by our own waistbands. Th first and soundest conclusion which we come to abou phenomena, a conclusion arrived at before we reac the mature age of one year, is that many of thes phenomena are the result of the activities of personalities like our own. Other phenomena we gradually perceive are the expression of simpler activities, and our conceptions of matter and energy are all in the last resort pale abstractions from our primary conception of 'selves.' For the sake of convenience in classifying phenomena, we neglect this consideration, and affect to regard animals and plants as mere collections of matter and their activities as 'a kind of energy.' Life, as Tyndall pointed out long ago, is not energy at all but the control of energy, the constant composition and moulding of energy. If in attempting to solve an algebraic problem we should designedly leave out one factor in order to arrive at a simpler solution, we should fully realise that this solution could only be partially true. When mechanistic biologists ignore the subjective element in knowledge, their solutions must necessarily be profoundly untrue.

IN a lecture to the Royal Geographical Society on November 15, Mr J. A. Steers discussed some of the changes that are taking place in the coastline between Hunstanton and the Orwell-Stour estuary. This is a submerged low coast modified by marine erosion and the action of longshore currents which have dammed several of the streams and elsewhere have led to the growth of spits Mr Steers mentioned an effect of tides which is sometimes overlooked. The direction of tidal drift is known to change with ebb and flow, but owing to the difference in level of the water the material worked on at high water is distinct from that worked on at low water, so that there often are two opposed movements of beach material on the same foreshore This is noticeable at Blakeney, where the shingle has pushed westward, and the sand, at a lower level, eastward Among other interesting points raised in the lecture was the origin of the shingle on the north coast of Norfolk Analysis shows 99 per cent. of it to be flint, and the remainder to be igneous rock of Scottish and, to a less extent, Scandinavian origin, with a few fragments of sedimentary rock. The prevalence of flint points to an origin not far distant, but the exact source is not yet known. Mr. Steers discussed at some length the origin of Blakeney Point, Lowestoft Ness, Orford Ness, and other recent growths of the coast.

To hold an exhibition of coal products during the present stressful period in the coal industry might be considered somewhat hazardous, for exhibitions involve considerable expenditure on the part of exhibitors, but publicity, and especially co-operative publicity, has been found to pay, and nothing seems to daunt the spirits of our industrial firms in good times or in bad. The National Coal Products, Chemical, and Engineering Exhibition, which is being held on November 16–27 in Manchester, is a co-operative venture sponsored by the Manchester Section of the Society of Chemical Industry, and organised by Provincial Exhibitions, Ltd. When planned last May, it was hoped that the coal strike would be ended long before November, but as events proved contrary, the original scheme of confining the exhibition to tar and tar-products was abandoned, and the subject of methods of utilising coal was substituted. As the strike still continued, it was decided also to display many exhibits relating to the value of research upon coal and its products. The list of exhibitors in the City Hall contains the names of the principal organisations that are investigating coal, those of a few chemical firms and a large number of plant manufacturers. Everything possible has been done to attract and instruct the public, and if we are not sure that (as the official catalogue states) all the visitors will feel that in Manchester they are in the actual workshop of the country, and not merely looking into the Empire's shop-window as in London, we are certain that the promoters of the exhibition deserve the thanks of the scientific community for their initiative and enterprise. In connexion with the exhibition, a conference on tar is being held on November 26, at which important papers are being read by members of the Society of Chemical Industry, the Institution of Gas Engineers, and the Coke Oven Managers' Association.

THE Lloyd Roberts Memorial Lecture was delivered at the Manchester Royal Infirmary on November 9 by Dr. W. E. Gye, who chose as his subject "The Cancer Problem." He reviewed his former work and described further experiments, all of which tend to confirm the conclusions he then reached. His work has been largely prosecuted with the Rous chicken sarcoma, which, unlike most malignant tumours, possesses a 'filterable' virus. If a Rous tumour be triturated and filtered through a porcelain filter, the filtrate injected into a fowl induces tumour-formation, the causative agent is therefore a filterable or ultra-microscopic one. If the filtrate be heated to 55° C. for 15 minutes, or treated with an antiseptic such as acriflavine before injection, it loses its potency, the causative agent becoming inactivated. But if a portion of heated filtrate be mixed with a portion of filtrate treated with acriflavine and the mixture injected into a fowl, tumour formation results Dr. Gye concludes, therefore, that the causative agent of the Rous tumour consists of two parts, one of which may be destroyed by heat, the other by an antiseptic such as acriflavine, and that both are necessary for tumour formation. To the former heat-labile substance the name of 'specific factor' is given; the other factor is regarded as being a living virus or micro-organism. A tumour of one species of animal cannot be transplanted into another, but a mixture of inactive Rous tumour extract (inactivated by acriflavine) with extract of human cancer produces in the fowl a tumour microscopically like the Rous tumour. Many substitution experiments of this kind have been performed with similar results, with one or two curious and inexplicable exceptions only. Dr. Gye believes that the specificity or essential characters of a malignant tumour are carried by the heat-labile agent called the 'specific factor,' and that the other factor is a living virus (or viruses) which becomes operative only when the specific factor is present as well. The fact that cultures in serum broth of tumours (up to the seventh remove) may be substituted for direct extracts in these experiments supports this view. At the same time, other possible, though unlikely, hypothesis are being explored.

THE Factories and Workshops Report for 1925, which was recently issued by H.M. Stationery Office, is instructive and interesting. The work done by the inspectors is very thorough, and the recommendations they have made in previous years have been of great value to the many industries concerned. It seems fairly certain that explosions in works employing benzene and other inflammable products are sometimes caused by electrostatic sparks. This can be prevented in some cases by the use of suitable brush collectors to discharge the electricity on driving-belts. The total number of accidents directly attributable to electricity is 414, and includes 24 fatal cases. This is less than last year; and considering the great increase in the work done in the electrical industry last year it is satisfactory. Twelve of the fatal cases were due to shocks from pressures not exceeding 250 volts. In all these cases alternating current was employed. In one case when a man was inspecting the machinery of a motor car, using a lamp connected with the supply, the lamp broke and the metal car, being insulated from earth by the tyres, became 'alive,' owing to touching a terminal. Although the man was able to call out for the switch to be turned off he was unable to let go and was killed. Another fatal accident was due to a practical joke, the bell handle being connected with one of the supply mains. The worst accidents are caused by a hand to foot shock, the hand, for example, touching the cover of a defective switch, the cover of which has become alive, and the foot making a good contact with the earth through a damp boot. If a person is well insulated from earth he only gets a trifling shock when a spark takes place between him and a high-tension terminal. The present regulations seem quite satisfactory, but they need to be enforced. The senior electric inspector, Mr. G. S. Ram, urges that contractors and others should take special precautions when installing an alternating current supply.

THE increasing facilities rendered available in recent years for the publication of geophysical papers have amply justified themselves, and appear to have greatly stimulated interest and investigation in the subject. In Great Britain the only distinctively geophysical periodical is the *Geophysical Supplement to the Monthly Notices of the Royal Astronomical Society*, and the Society has rendered great service by giving the subject of geophysics this valuable support. The supplement is paged separately from the *Monthly Notices* proper, and forms a distinct journal; it is now nearing the end of its first volume, and No. 7, recently issued, deals in its eight papers with an interesting variety of subjects: seismic waves, the elastic yielding of the earth, the rigidity of its central core, magnetic storms, tidal motion, and the relation between barometric pressure and gas pressure in mines. All these papers have been presented to the Society in the early part of this year. Another thriving journal, also published mainly in English, which deals largely but not entirely with geophysics, is the *Japanese Journal of Astronomy and Geophysics*, published by the National Research Council for Japan; beside published papers in full, it gives short abstracts of other cognate papers published in Japan. The recently issued part, vol. 3, No. 3, contains an article on the possibility of gravitational waves in soil, together with no less than 86 abstracts (occupying 33 pages of small print) of other astronomical and geophysical papers.

AN Egyptian wing has been added to the Museum of the University of Pennsylvania, Philadelphia, in memory of the late Mr. Eckley Brinton Coxe, junior. Mr. Coxe was president of the Museum from 1910 until 1916, and was not only a generous benefactor during his lifetime, but also left a sum of half a million dollars at his death for the promotion of Egyptian studies. It will be remembered that extensive investigations at Memphis, including the excavation of the Palace of Merenptah, were carried out by the Eckley B. Coxe Expedition, and many of the objects now installed in the wing and shown for the first time were obtained by this expedition or others on this foundation. A description of the new wing, which was opened in May last, and of some of the principal exhibits, appears in the *Museum Journal* (Philadelphia) for June. It contains twelve rooms appropriate in design and harmonising in colour and proportion with the exhibits. Eight rooms are devoted to Egypt, while Ur, Beisan, Persian art, and Arabic art each have a room, those of Ur and Beisan being used for exhibition of the objects obtained by the expeditions of the Museum now in progress.

THE Sterling fellowships were established by a gift of one million dollars from the trustees of the estate of the late John W. Sterling to stimulate scholarship and advanced research in all fields of knowledge. They are open to graduates who desire to carry on studies under the direction of the Graduate Faculty of Yale University. The fellowships are divided into two general classes: Research or Senior Fellowships for candidates of the standing of the Ph.D. degree, of the annual value of 200*l*.-500*l*.; and Junior Fellowships for candidates who are well advanced in their work towards the Ph.D. degree, of the annual value of 200*l*.-300*l*. All fellows are appointed for a single year in the first instance and are required to submit reports on their work, either at stated intervals or at the expiration of their fellowships. Application forms, to be returned by March 1, can be obtained from the Dean of the Graduate School of Yale University, New Haven, Connecticut.

THE British Museum (Natural History) has issued four additional natural history booklets in the attractive series commenced last year. The new subjects include the pine marten, the harvest mouse, the fallow deer and the barn owl (Price 6*d*. each). As before, each booklet contains a short account of the history and habits of the animal, and is accompanied by a charming coloured illustration. Among the latest sets of postcards to be published by the Museum is the second series of portraits of famous naturalists (Price 1s.) This set includes Sloane, Banks, Leeuwenhoek, Mendel, Seba and Shaw, among others, and a pamphlet enclosed with the set gives concise details of their lives, with special reference to their contributions to natural history. The series of British Museum postcards now covers a wide range of subject and interest, and there can be little doubt that their publication has contributed considerably to the popularity of the institution and to public interest in its collections.

MR. F. G. LLOYD, 1 Sinclair Road, Kensington, W. 14, writes to ask if it is very uncommon now to find the Camberwell Beauty butterfly near London, as a patient had given him a perfect specimen caught near Honor Oak Park Station in the summer of 1911 or 1912. Dr. James Waterston, of the Natural History Museum, South Kensington, has been good enough to send us the following answer to this inquiry: "The Camberwell Beauty is, in Great Britain, a somewhat rare visitor, occurring not in the late spring or early summer (as is commonly the case with other immigrants), but more frequently in August or later. While the species has been proved to hibernate occasionally in Britain, no authentic occurrence of the larva or pupa is on record. 1911 appears to have been a Camberwell Beauty year, and, according to information supplied by my friend Capt. N. D. Riley, the species was then recorded (August) from, amongst other places, Berkhampstead; Bradwell-on-Sea, Essex; Brading, Isle of Wight; Chelsfield, Kent. With all this, the occurrence of the Honor Oak Park Station specimen falls into line. The interest of Mr. Lloyd's record is rather a sentimental one, the species on this occasion having been taken, after a long interval, in the locality from which it received its popular name."

THE *Scientific American* for October contains a very discursive but interesting article on "Hunting Fossil Insects," written in the well-known free-lance style of that entomological genius Prof. T. D. A. Cockerell. The insects dealt with are two collections of Tertiary fossils, one from some new beds on the banks of the Kudia river in the Amagu region of Siberia, opposite the southern shores of Sachalin, the other from the Santa Barbara district, Province of Jujuy, Northern Argentina. In each case, Prof. and Mrs Cockerell underwent an adventurous journey to obtain the specimens, and the chief interest of the article lies perhaps in the illuminating remarks about the conditions of the countries through which they passed. Prof Cockerell has, we believe, dealt with both collections scientifically elsewhere. We think it important to point out that he is in error in assuming that his Argentine Tertiary insects were the first fossil insects to be discovered in the whole of South America. Prof. Wieland, of Yale University, discovered two very fine Rhaetic specimens near Mendoza a good many years ago; one of these was a Homopteron and the other a caddis-fly. It was a pity that Prof. Cockerell did not know of this bed, as he might have found further specimens. From the article before us we learn some interesting points about the sect of the "Old Believers," whom, it appears, the Bolsheviks have left somewhat severely alone, so that they still keep their old religion and customs. "Our guide explained that even the Old Believers had had their revolution"; but apparently it was a mild one, as they are still allowed to drink whisky, though tea and coffee are taboo!

SIR ARTHUR KEITH and Mr. C R Peers have been elected honorary members of the Yorkshire Philosophical Society.

REPLYING to a question in the House of Commons on November 21, Mr. Amery, Secretary of State for the Colonies, said that the appointment of director of the Amani Institute has been accepted by Mr W. Nowell, Director of Science and Agriculture, British Guiana. On his arrival in England from British Guiana the new director will be invited to submit recommendations as to the staffing of the Institute

A PORTRAIT of Michael Faraday, and a reproduction of the portrait of Lord Kelvin painted by Herkomer for the Institution of Civil Engineers, both by Mr George Harcourt, R.A., will be shown in the lecture theatre of the Institution of Electrical Engineers in the positions allotted to them at the ordinary meeting on December 2. After introductory remarks by the president, Mr. Harcourt's portrait of Faraday will be presented to the Institution by Mr. Sydney Evershed.

AT the annual general meeting of the London Mathematical Society, held on November 11, the following officers were elected: *President*, Prof. G. H. Hardy; *Vice-Presidents*, Prof. S. Chapman, Prof. A. L. Dixon, Mr. J. E. Littlewood; *Treasurer*, Dr. A. E. Western; *Librarian*, Prof. H. Hilton; *Secretaries*, Prof. G. N. Watson, Mr. F. P. White; *New Members of Council*, Prof H. F. Baker, Prof. A. S. Eddington, Prof. E. H. Neville.

IT is announced in *Science* that the Perkin medal for 1927 has been awarded to Dr. John Teeple, treasurer of the American Chemical Society, for "significant scientific, technical, and administrative achievements, particularly the economic development of an American potassium industry at Searles Lake, Calif." The committee of award consists of representatives of the American Section of the Society of Chemical Industry, the American Chemical Society, the American Electrochemical Society, the American Institute of Chemical Engineers, and the American Section of the Société de Chimie Industrielle.

AT the annual general meeting of the Philosophical Society of the University of Durham, the following officers were elected: *President*, The Earl of Durham (Chancellor of the University of Durham); *Secretary*, Dr. Grace Leitch; *Treasurer*, Mr. J. W Bullerwell; *Editor*, Dr. Todd, *Librarian*, Dr Bradshaw; *Assistant Librarian*, Mr. E. Patterson; Sectional Officers, the chairman and secretary of each section being given in brackets: Chemical and Physical (Dr. P L. Robinson and Mr. O. Darbyshire), Geological and Biological (Dr. Kathleen Blackburn and Dr. Allan), Mathematical (Mr. Colborne and Mr. Miles), Applied Science (Dr. Morrow and Dr. Baker), Philosophy (Dr. A. Robinson and Mrs. Alderson), Archæological and Historical (Dr. J. Wight Duff).

WE are informed by Messrs. Ernest Benn, Ltd., that Lady Bell is editing the letters of Gertrude Bell, which will be published, probably in two volumes, during the course of 1927.

THE latest catalogue (No. 146) of Messrs Dulau and Co., Ltd, 34 Margaret Street, W.1, gives particulars of nearly 1300 volumes on zoology, botany and gardening, agriculture, geology, palæontology and mineralogy. Copies can be had free from the publishers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant in the Engineering School, Trinity College, Dublin—The Registrar (November 29). An assistant master, with qualifications in mathematics, at the Government High School, Nassau, Bahamas—C.A. (T.), Board of Education, Whitehall, S.W.1. For Scottish candidates (T.), Scottish Education Department, Whitehall, S.W.1 (December 6). An officer for research work and a professor of pathology at the Punjab Veterinary College, Lahore—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S W 1 (December 10). Chief designer, designer, chief testing engineer, and first assistant testing engineer at Admiralty Engineering Laboratory, West Drayton—Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (December 13). An instructress in fruit and vegetable preservation, and housemistress of one of the hostels of the Swanley Horticultural College for Women—The Principal of the College, Swanley, Kent (December 15). A bacteriologist in the Department of Agriculture of the Irish Free State—The Secretary, Civil Service Commission, 33 St. Stephen's Green, Dublin (December 16). A principal of the University College of Wales, Aberystwyth, in succession to the late Principal J. H. Davies—The President of the College (D. Davies, Esq., M.P.), Plas Dinam, Llandinam, or The General Secretary, University College, Aberystwyth (January 31). A pathologist at the Cancer Hospital to conduct investigations in the effects of radiation on malignant and normal tissues and body fluids—The Secretary, Cancer Hospital, Fulham Road, S.W.3. A government analyst for the Public Health Department, Southern Rhodesia—The Secretary, High Commissioner for Southern Rhodesia, Crown House, Aldwych, W.C.2. A keeper of the laboratories of the Royal Horticultural Society at Wisley—The Secretary, Royal Horticultural Society, Vincent Square, S.W.1 A temporary assistant in the Research Department, Woolwich, under the Directorate of Explosives Research—The Chief Superintendent, Research Department, Woolwich, S.E.18. An agricultural chemist at the Kirton Agricultural Institute—The Principal, Kirton Agricultural Institute, near Boston, Lincs

Our Astronomical Column.

COMET COMAS SOLA.—It appears fairly certain from the first ten days' observations of this comet that it is a periodic one, of Jupiter's family. The following orbits are by Mr. G. Merton and Dr. A C D. Crommelin respectively:

T =	1927, March 2·316 U.T.	1927, March 24·940 U.T.
ω =	24° 58′ 20″	37° 0′ 18″
Ω =	68 8 14	65 24 50
i =	11 50 54	14 0 4
e =	0 41065	0 55380
log q =	0·26526	0 26290
Period =	5·525	7·789
Equinox =	1926·0	1926 0

The elements bear some resemblance to those of Spitaler's Comet, 1890, VII. ω for that comet was 13° 20′; Ω 45° 6′, i 12° 51′; log q 0·2596; period 6·4 years It has not been seen since that apparition. Observations of the present comet are expected to continue for several months, which should decide the question of identity.

BRITISH TELESCOPES.—We have pleasure in directing attention to a recent publication entitled "Astronomical and Optical Instruments" which has been issued by Sir Howard Grubb, Parsons and Company, largely for the purpose of describing and illustrating the resources and equipment of the Company's new optical works at Newcastle-on-Tyne. The contents of the publication consist of a series of four short articles on (1) the development of optical instruments for astronomy and astrophysics; (2) the British optical industry; (3) the history of Sir Howard Grubb, Parsons and Company, (4) the new optical works of the Company at Walker Gate, Newcastle-on-Tyne. The articles are very attractively written, and are well illustrated with a number of clear reproductions. Of special interest are the plans of sectional elevation of the 45-ft. dome and the 41-inch refractor, and two photographs showing the framework of the dome and its rising floor now under construction at the works. Reference to this large telescope and to the optical works in general was made in NATURE of September 4, p 340 The list on pages 44-45 of some of the principal large astronomical instruments made by the firm since it was founded by Thomas Grubb is eloquent testimony to the debt which astronomy, in particular, owes to these noted makers of telescope objectives and instruments.

EARLY ARABIAN ASTROPHYSICS.—More than 90 pages of volume 56/57 of the *Sitzungsberichte der Phys.-Med. Soz. Erlangen* are devoted to a presentation of the contents of an early Arabic treatise on the Light of the Moon by Al Hazen, with comments by the translator, Dr. Karl Kohl, of the University of Erlangen. Al Hazen, or al Hasen Ibn al Haitham, was born at Basra but spent most of his life in Egypt. He incurred the displeasure of the Calif al Hakim by the failure of his scheme for preventing the flooding of the Nile and had to conceal himself until the death of the Calif in 1020. He then returned to Cairo, where he died in 1038. His book begins with a short account of contemporaneous knowledge as to the light of the moon; he then shows that phases and eclipses necessitate a spherical moon, goes on to describe his own apparatus and observations, shows that neither transmission nor reflection (according to the laws of ordinary reflection) can explain the light, and concludes, therefore, that the moon is self-luminous, the sun imparting by means of its rays the power of self-luminosity. The original treatise appears to be in the India Office, but we have been unable to find any statement as to how it became available for translation.

Research Items.

Promiscuity and Primitive Marriage.—A discussion on promiscuity and group marriage by Lieut.-Col. E. F. Gordon Tucker and Mr. Leslie H. Gilbert appears in the *Sociological Review*, vol. 18, No. 4. Col. Tucker holds that the investigation of marriage must start with the physiological facts of the intensity of the sexual inclination. He argues that while no very helpful lesson can be derived from the varied conduct of the Quadrumana as to the sexual relations of human precursors among savage men, we get on one hand a widespread 'incest horror,' and, on the other, compulsory marriage among close relatives, but not the closest. Yet among Polynesians brother and sister marriage is a source of honour. Postulating a primitive group, the extent of continuity in gregariousness would be dependent on food supply. If the group were constant and sedentary, promiscuity would arise owing to the strength of the sex instinct and the hypothetical absence of the restraining forces of education, law, and religion. It is a question whether sexual jealousy would be strong enough to overcome these forces. Where the group was not constant owing to scarcity of food supply, either permanent or seasonal, individual men going off to find food would each take a woman to perform woman's work—root and beetle grubbing—and this custom would tend to give rise to individual marriage. In these conditions it is unnecessary to postulate promiscuity as a precedent condition of the classificatory system of relationships as Morgan did. The position of the mother's brother follows as a natural result. In his reply Mr. Gilbert argues from the universality of the individual marriage, while the terms of the classificatory system might be deduced from the Levirate and Sororate, which functions actively to-day, and further, that in the marriage groups, eligibility for marriage does not necessarily connote actual sexual relation. The so-called vestigial customs are magico-religious, though no one explanation can account for the diverse sexual orgies. The promiscuity theory demands the abrogation of the parental instinct, both of woman and man, which are essential to the survival of society in view of the conditions of human birth and infancy.

Physical Anthropology of the Pamirs and Amu-Daria Basin.—Physical measurements collected by Sir M. Aurel Stein on his third archæological expedition to Central Asia in 1915, are analysed by Mr. T. A. Joyce in the *Journal of the Royal Anthropological Institute*, Vol. 56, Pt. 1. The measurements are of fourteen different groups covering Mongolo-Turki, Tajik, and Iranian and Persian stock, for the most part nomad pastorals, but including primitive hunters and fishers from the Helmand River and military levies from Baluchistan. The examination of these measurements points to a double grouping into (1) those of the north and north-west—the Yazghulami, Vanji, Darwazi, and Karateghin, relatively dolichocephalic, narrow-nosed, euryprosopic and short-statured; and (2) those of the south and south-east—the Shighnani, Ishkashmi, and Wakhi, relatively brachycephalic, long-nosed, leptoprosopic, and tall-statured. Intermediate to these groups are the Roshani, dwellers in a secluded valley, who may be taken as the main element of the bulk of these peoples in its purest form, the pure *Homo Alpinus* type. North and east this type has been modified in various degrees by contact with a broad-nosed Mongolo-Turki type. A Karateghin-Vanji group has been modified by contact with a narrow-nosed branch of Mongoloid peoples, while a Seistani-Sayad group are basically Indo-Persian or Indo-Afghan, but contain a leaven of the old Pamir strain.

Inheritance of Fleece Characters.—Fraser Roberts (*Jour. of Genetics*, 17 1, 1926) has an interesting paper dealing with the genetics of the piebald sheep, described variously as Spanish, or Barbary, or Jacob's sheep. He is of opinion that the characterisation of these sheep in Great Britain has not altered since 1760, and in his experience they invariably breed true, whole black or self-white lambs never appearing. In crosses with English breeds, the F_1 offspring were uniformly self-blacks, and it is concluded from further experimentation that the piebald sheep possesses a dominant black factor and also a recessive factor which restricts the black to certain areas.

Haddock Biology.—Mr. Harold Thompson has recently published the third of an important series of studies on haddock biology (*Fisheries, Scotland, Sci. Invest.* 1926, No. 2. Edinburgh and London. H.M.S.O. 2*s.* 6*d.* net.) In preceding papers it was shown that the acceptance of the "scale theory" for haddock is substantially vindicated by the test of experience, and that few, if any, unsurmountable difficulties occur in its general application to the study of the stock in the sea from year to year. The present paper deals with the growth of sea-born baby haddock reared under artificial conditions in aquaria. Two or three weeks were necessary before the fish accommodated themselves to the new conditions, and this check in growth was marked by an apparent ('false') winter mark on the scale in all cases in which transference of the fish from the sea was carried out during the season of greatest growth, namely, from May to October. Abundant proof was obtained of the unfailing formation of normal winter markings on each occasion that a fish passed through one or two winters in captivity. The experiments also demonstrated the important fact that, for the first three years at least, the size of the haddock scale increases on the average in proportion to that of the fish. The growth under artificial conditions was surprising, for all the captive fish showed an increase of nearly 100 per cent in their growth-rate as compared with controls at sea—a result probably due in large measure to the fact that the food-supply was continuous and plentiful.

Sex Differentiation in Bonellia.—Prof. R. Goldschmidt (*Biol. Zentralbl.*, Bd. 46, Heft 8, 1926) holds that the male Bonellia cannot be regarded simply as a case of neoteny and of suppressed development. Regarded from the point of view of the morphogenesis of the female, the male is by comparison suppressed in development, but from the point of view of sex differentiation the male is an early ripening larva; it is not neotenic like axolotl, but precocious like the larva of Miastor. Prof. Goldschmidt regards the quickening of the sexual differentiation of the male as evidence of the activating function of the secretion on the proboscis of the female, while Baltzer, who places the retardation of metamorphosis in the foreground, takes the opposite view of the action of the proboscis secretion. Prof. Goldschmidt, reviewing Baltzer's results, concludes that in Bonellia sex is genetic; those larvæ with the female determinant develop always into females; those with the male determinant which develop as parasites become as a rule males, but after only short parasitism become intersexes; and those developing without parasitism pass through transitory intersexuality into females.

He also examines Baltzer's work from the point of view of developmental physiology and concludes that, before this and the genetical side of the problem can be elucidated, more observations are required.

Host-parasite Specificity.—Prof. R. W. Hegner (*Science Progress*, Oct. 1926) discusses host-parasite specificity—the association of a particular species of host with a particular species of parasite—with special reference to human protozoa. In many cases a parasitic species appears to be rigidly adjusted to one species of host and unable to live in any other species, *e.g.* the organism of human malaria must often be transferred to horses, cattle, and pigs, but infections do not result. The habits of the host often determine the transmission of human protozoa, *e.g.* insanitary conditions determine largely the spread of intestinal protozoa. The factors within a host which enable natural parasites to bring about an infection but prevent 'foreign' parasites from doing so are briefly considered. Prof. Hegner points out that the conditions within the bodies of anopheline and culicine mosquitoes, and especially of closely allied anophelines, must be very similar, and that therefore the adjustments of the malarial parasites to their insect hosts must be very delicate. The actual factors responsible for the minute differences are unknown but are open to experimental study. In discussing the conditions responsible for differences in susceptibility between young and old, he suggests that some type of resistance develops with age, but the mechanism of this resistance is not known. The termination of an infection with protozoa also probably depends largely on the building up of resistance by the host; failure of the food supply appears to play a minor part. A more extensive account of the biology of host-parasite relationships, with special reference to the protozoa living in man, is given by Prof. Hegner in *Quart. Review of Biol.*, 1, 3, 1926.

Problems of Vegetative Propagation.—Dr. R. C. Knight makes an interesting contribution to our knowledge of conditions under which hard-wood cuttings can be successfully propagated as a result of his experiments, mainly with plum stocks, reported in the *Journal of Pomology*, vol. 5, pp. 248-266, October 1926. He concludes that the amount of callus formation is not necessarily indicative of the amount of root production, these two processes bearing no consequential relation to one another. They are not similarly affected by external conditions: thus callus formation is favoured by a high water content in the soil, while root production, on the other hand, may be better with a lower water content, because the lower water content permits more efficient aeration. Treatment of the tissue of the cuttings with various reagents was attempted, but on the whole the results of such treatments were irregular and never so favourable as to give a hint of a method of practical importance.

The Fall of Floral Organs.—Isawo Namikawa has investigated fully the details of the abscission or exfoliation of floral organs, and publishes many details of interest in the *Journal of the College of Agriculture*, Hokkaido Imperial University, 27, pp. 63-131, July 1926. Catkins particularly have formed the subject of study, and in every case a more or less differentiated separation zone is present. Except in the fertilised female cone of Alnus, abscission takes place in all catkins examined. By abscission is understood a separation brought about by living tissue; exfoliation is the term given to the falling of floral organs as the result of drying and death, with separation following mechanical rupture. In Narcissus, Lycoris, Menyanthes, and Ribes, the floral organs are thus exfoliated as the result of ligno-suberisation of a more or less differentiated cell-layer at the base of the floral organ. The female cone of Alnus falls with a part of the vegetative shoot when this is cut off by abscission.

Earthquakes in France.—The earthquakes of France, studied in past times by Perrey (1872) and Montessus de Ballore (1892), have lately attracted closer attention. For a valuable summary of recent investigations we are indebted to M. Edmond Rothé, director of the French Seismological Bureau (*Matériaux pour l'étude des calamités*, No. 9, 1926, pp. 3-47). During the seven years 1919–25, the number of earthquakes felt in the whole of France was 79, the yearly average being thus about the same as in Great Britain. Of the six seismic regions which M. Rothé defines, the more prominent are those of the Alpes Maritimes and the valley of the Rhône, and of the Pyrenees, in the former of which were felt the Riviera earthquake of 1887 (of Italian origin) and the Provence earthquake of 1909, an earthquake of special interest, as the ground in the central region seems to have been elevated by about 1½ inches.

Oil and Coal Resources of the Oregon Basin, Wyoming.—The area covered by this geological survey (the work of D. F. Hewett, *U.S. Geol. Sur. Prof. Paper* 145) lies along the west side of the well-known Big Horn Basin in north-western Wyoming. Stratigraphically, the Carboniferous, Jurassic, Cretaceous, and Tertiary systems are represented; coal deposits, mainly of a lenticular character, occur in the Montana members of the Upper Cretaceous, also in the Fort Union formation of middle Tertiary age; petroleum is mainly derived from the Frontier member of the Upper Cretaceous, and is exploited particularly at the Grass Creek field. Apart from detailed studies of these natural resources, this monograph is of interest for the attention which is given therein to the analysis of the sediments involved. In particular 'bentonite,' a peculiar clay with some unusual properties and of widespread occurrence in the Rocky Mountain region, receives discussion; from mineralogical and mechanical analyses the author concludes that this substance is the alteration product of a volcanic glass, or at least partially derived from some mineral which was crystallised in the glass. It would seem that the alteration ensued soon after explosive phases of vulcanicity had taken place, vapours being condensed and gathering particles into drops, thus producing mud-showers, ultimately forming the clay; the volcanoes responsible for the mother-substance of bentonite were probably situated in the region west of Wyoming, possibly in central Idaho. The mineralogical analyses of other sediments are clearly not exhaustive, most of the 'heavy' mineral constituents being disregarded, except biotite, apatite, and zircon, where these species occur; it is quite certain that further investigation of such accessories would have served the author's purpose still better, "in the hope that . . . additional light on the character, source, and manner of deposition of the sediments" would be forthcoming. This monograph is rich in diagrams, photographs, and maps, but the mass of detail, the absence of any introductory abstract of essential geology and economics, and the omission of any summary make it difficult reading.

Spectra of Heavy Metals.—Vol. 2, No. 6, of the *Proceedings of the Imperial Academy of Japan* contains preliminary notes of some spectroscopic investigations. The fine structure of several bismuth lines has been examined by Nagaoka and Mishima by means of crossed Lummer-Gehrcke plates, and tables of wave-length intervals are given. By exciting the spectra of thallium and gold by means of high tension and heavy current (20 kv. and 1 ka.) Nagaoka and Futagami find that new lines are produced in almost coincident positions for the two metals. They give also a considerable list of almost coincident lines for these substances taken from existing measures, and point out that gold and thallium respectively could be produced from mercury if a proton could be expelled from or introduced into the mercury nucleus. The same experimenters record also the spectra of mercury produced by two different types of explosion.

IMPROVED SPECTROGRAPHS AND SPECTROMETERS.—Messrs. Hilger's supplementary catalogue describes a considerable number of improvements to existing forms of instrument and includes also particulars of apparatus of new type. Among the latter is a new range of spectrograph with interchangeable optical systems containing plane or concave grating, or prism (glass or quartz). Each model is made in three sizes, for focal lengths of 100, 150, and 300 cm. respectively A large aperture glass spectrograph, giving small dispersion, for use with faint sources, should commend itself to many investigators. A special spectroscope is made also for the rapid detection of foreign metals in steel, and is in use in important steel works in Great Britain and America. Visual observation of ultra-violet radiation can be made by an instrument similar in form to the well-known Hilger small quartz spectrograph, but provided with a fluorescent screen above which is fixed a wave-length scale. The instrument is in constant adjustment. Numerous improvements in the constant deviation wave-length spectrometer have been embodied in the "1926 Model" The older form of the instrument ("Standard Model") is, however, still available at a slightly lower price.

ELECTRONIC STRUCTURE OF THE ATOM.—The lecture recently delivered by Prof. A. Sommerfeld at Manchester has been reprinted, under the title of "Electronic Structure of the Atom and the Quantum Theory," from vol. 70 of the *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*. After outlining the main features of the present view of electronic orbits in the atom, Prof. Sommerfeld goes on to consider the relation of atomic structure, as revealed by spectroscopy, to chemistry. He attaches great importance to the work of Main Smith and Stoner in dividing the energy levels characterised by given principal and azimuthal quantum numbers (n_k) into sub-groups distinguished by the value of the inner quantum number, j. Chemical combination is considered to be determined by the tendency of an atom to complete its outermost shell of electrons, and there is considerable evidence that the tendency to complete a sub-group, n_{kj}, is effective in this respect, as well as the tendency to complete a group, n_k. From such considerations, many of the observed chemical combinations which otherwise appear to be inexplicable receive a natural interpretation (see also NATURE, June 5, p 793).

THE INERTIA OF THE ELECTRIC CARRIER IN COPPER.—In the October number of the *Physical Review*, R. C. Tolman and M. Mott-Smith describe a comprehensive series of experiments designed to study the inertia of the electric carrier in copper. They used an apparatus similar to that used in the experiments of Tolman, Karrer, and Guernsey, in which a copper cylinder was oscillated about its axis, and the current due to the lag of the electrons in the cylinder was detected by means of a coil of many turns of fine wire connected through an amplifier to a tuned vibration galvanometer. In order to determine the phase of the effect, the alternating electromotive force in the coil was balanced against an alternating electromotive force produced in an earth inductor which rotated in synchronism with the oscillation of the cylinder, so that adjustments of the amplitude and phase of the balancing electromotive force were possible. An exhaustive investigation of the effect of the earth's field on the magnitude and phase of the effect was also made. It was found that the actual magnitude of the electromotive force observed was 19 per cent. less than that expected on the simple theory in which the effective mass of the carrier was assumed to be that of an electron in free space. The average phase of the observed electromotive force lagged 10° behind the acceleration, whereas on the simple theory it should be in unison.

OPTICAL PROPERTIES OF SUGARS.—The *Journal of the Washington Academy of Sciences* for October 4 contains a short paper on the optical properties of *l*-arabinose, fructose, *d*-glucose hydrate, α-lactose hydrate, lyxose, *d*-mannose, *d*-melibiose, raffinose, rhamnose monohydrate, *d*-ribose, sucrose, trehalose and *d*-xylose, giving the refractive indices determined by the immersion method in mixtures of mineral oil and monochloronaphthalene, in yellow light. The behaviour in polarised light between crossed nicols is also listed, as well as the appearance of the crystals. The work is due to G. T. Keenan, of the Bureau of Chemistry.

TECHNIQUE IN ENZYME INVESTIGATION—In *Die Naturwissenschaften* for October 15, appears an interesting résumé by R. Willstatter of the methods and results of the work upon enzymes proceeding under his direction at Munich. Willstatter emphasises the point that though the enzyme system is colloidal it is also a complex organic substance the chemical composition of which is of first importance in understanding its behaviour. Thus, as a catalyst, an enzyme is frequently very specific in its action, and undoubtedly chemical structure must be accountable for such specific action on saccharose as R. Kuhn is reported to have found ·Unpublished experiments suggest that there are glucosaccharases and fructosaccharases that can be isolated from fungi which, as their name suggests, attack the biose by linkage on to different constituent hexose molecules. Willstatter discusses the problem of isolation of enzymes and describes methods by which, within one day, invertase preparations can be obtained 300–500 times purer than previously. The invertase content in yeast can be increased 15–20 times by allowing it to ferment at the lowest possible sugar concentration for a day. This result raises a doubt whether conclusions can be drawn from the natural presence of an enzyme as to its significance to the organism. An account is also given of the method of purification by adsorption and regeneration of the enzyme from the adsorbent which has been developed with so much success at Munich. In this connexion, Willstatter points out that the suspended hydrates of alumina are by no means simple inorganic complexes; a whole series of compounds is possible, different in their amount of chemically combined water and in their general properties, including their behaviour as adsorbents. Thus "alumina γ" adsorbs lipase, leaving trypsin and anylase in solution; "β alumina," on the other hand, also adsorbs the trypsin. Many other interesting examples are given and the difficulties are discussed that lie in the way of attempts to estimate enzyme quantities in view of the many factors modifying the kinetics of an enzyme catalysed reaction.

Recent Industrial Research in Cotton.[1]

The British Cotton Industry Research Association, the non-confidential work of which is published yearly in this form, is pursuing a very steady policy. Nearly all of the fifteen researches described in the volume under notice are extensions of previous work, and nearly all aim at establishing on a scientific basis the many phenomena observed by the practical textile technologist in his daily work, which he has learned to use in controlling the quality of his productions. If their immediate value to the industry is not apparent, they are invaluable as records and as information available to all who follow their profession earnestly. Much of the instinctive genius which has guided the textile technologist in the past comes only of long and patient practice. Many of these technologists are men whose senses are highly developed in limited directions, with the result that they are capable of controlling complex processes in a strongly subjective way. They cannot pass on their acquired skill to their colleagues, for they never measure in units. Their skill dies with them, and educationally their activities are wasted. The reviewer looks to these published researches as a means of overcoming this difficulty and thus providing for a greater body of men whose interest in textile technology is more than a means of earning their daily bread. Unfortunately, technical scientific literature is hard reading to those in the textile industry who would profit by a more thorough understanding of its phraseology, and it is only through the efforts of textile colleges and schools that its value can be appreciated. The language barrier between the scientific textile technologist and the practical textile technologist has yet to be broken down, and one feels that these Memoirs will be better appreciated in years to come than they will be now.

The work on mildew in cotton goods has been carried to a very definite stage. With a given mould fungus, the rate at which growth proceeds is shown to be a function of the starch used in sizing and finishing; while under the same conditions of steeping, if wheat flour is used, the rate is found to vary with the type of fungus. It appears to be impossible to make generalisations, and a grouping system has been adopted.

The hygroscopic properties of scoured cotton and mercerised cotton have been compared; and, using this comparison, a method of measuring the degree of mercerisation has been established, though the reviewer is doubtful as to the possibility of its extended application. The mercerisation process continues to absorb the interest of textile scientific men, and a discussion on the rôle of the cuticle during the swelling of the cotton hair, illustrated by some excellent photomicrographs, has indicated that a final solution of the problem can only be reached by a detailed study of the micro-structure of the hair. Most workers have felt the need of more information about the cuticular structure, and some have even doubted the existence of a cuticle at all, but those who have been guided by faith and analogy with other plant structures will find this paper very interesting reading.

The problem of the swelling of cotton hairs has been attacked from a different direction. The dimensional changes have been measured after immersion of the hairs in sodium, potassium, lithium, rubidium, and cæsium hydroxides of varying concentration. Unfortunately the relation between the maximum swelling and maximum electrical conductivity has not been established with all these metallic hydroxides, though earlier work had indicated a correlation. The textile industry has always employed sodium hydroxide in the mercerising process; and it is interesting to find that once more commercial practice is right, for with this hydroxide the change in diameter of the hair is found to be about twice that with any of the others, thus suggesting its specific action on cellulose.

Earlier work on moisture absorption by cotton has been responsible for a widespread impression that Indian, American and Egyptian cottons differ in their moisture-absorbing capacity; but a careful study has failed to confirm these earlier results. A suggestive comment on the acquired skill of practical textile technologists is found in the researches on the lustre of yarns and fabrics, in which it has been considered necessary to employ the Lummer Brodhun photometer, the most accurate instrument available, in order to compete with the acute observation of those employed in the finishing trade.

The mixing of different varieties of cotton is shown to cause variation in shade during dyeing, and a purely geometrical reason is given for this intervarietal variation.

A study of the surface tension of various starch pastes used in sizing yarns has revealed an interesting analogy with viscosity determinations. The rate at which size permeates cotton is found to increase much more rapidly with increasing temperature than the lowering of the surface tension would indicate. The temperature should be carefully controlled during the sizing process if a level result is to be obtained, a conclusion which commercial practice has been slow to appreciate in England, though the advantages of thermostatic control have long been known in the United States.

Contributions to our knowledge of the chemical constituents of cotton are made in papers on the waxes of cottons of different origin and their characteristics, on the identification of fatty ingredients in sized goods, and on the ash content and ash alkalinity of typical cottons.

The photographic reproductions, graphs, tables and general lay-out of this volume are excellent. The inclusion of a short summary under the title of each paper in the table of contents is a welcome innovation.

F. P. Slater.

---

[1] Shirley Institute Memoirs, vol. 4, 1925. Pp. vii+182+iv. Didsbury, Manchester: Shirley Institute, 1926.

The Function of Chlorophyll.

Since the chemistry of chlorophyll was elucidated by the researches of Willstatter, very little progress has been made in the interpretation of its function. Recently Noack has attempted an experimental attack upon the problem along a new line, and a general account of his experiments which appeared in *Die Naturwissenschaften* for April 30, 1926, provides a convenient opportunity to review his results.

Stern has provided experimental grounds for the conclusion that chlorophyll, as present in the living plant, is fluorescent. Noack's investigations concern themselves directly with the photo-oxidative effects produced by fluorescent pigments. A saturated aqueous solution of benzidin undergoes oxidation in light, in the presence of eosin 1 in 30,000. In the absence of eosin, or in the dark, it is quite unaffected, but the light change is materially accelerated if salts of iron, manganese, or copper are present in addition to the eosin. In alcoholic solution, benzidin similarly undergoes photo-oxidation in the presence of eosin, the process being again accelerated by the presence of manganese or iron. In alcoholic solution it is possible to replace eosin by chlorophyll or by the methyl and ethyl chlorophyllides Photo-oxidation again occurs, but is not produced if the non-fluorescent copper compound is used instead of the magnesium-containing chlorophyll compounds, which are fluorescent in alcoholic solution.

Water plants, living or dead, immersed in aqueous solutions of benzidin produce brown oxidation products of benzidin in the neighbourhood of the chloroplasts when exposed to the light There is no such reaction in the dark, or in dead plant tissue which has been boiled in copper sulphate, so that the fluorescent pigment is replaced by the presumably non-fluorescent copper derivative. Dead green cells, which bleached in a few minutes in a strong light, could be kept green by the addition of neutral sodium sulphite Noack considers that this is evidence that under certain conditions the photo-oxidative change results in the destruction of the pigment. Dead green tissues in the dark showed no absorption of oxygen in twelve hours, but in a strong light at 10° strong oxygen absorption took place, proportional to the oxygen pressure.

There is an obvious difficulty in associating these photo-oxidative changes with the photo-synthetic reduction of carbonic acid Noack and Metzner have shown their close connexion with the so-called photo-dynamic action by which species of Paramœcia, normally insensitive to light, in the presence of very dilute solutions of fluorescent pigment and oxygen, become photo-tactic in the light, showing positive or negative movements according to the strength of the light or variation in oxygen pressure or pigment concentration whilst under stronger photo-dynamic action, they are killed Metzner (*Ber. der Deutsch. Bot. Ges* 41, pp. 268-274, 1923) has even extended this work to root systems growing in dilute solution of fluorescent pigments, which have thus been rendered photo-tropically sensitive, a phenomenon which he describes as induced photo-tropism.

From this point of view, Noack argues that in normal photo-synthesis the photo-oxidative change must hand energy on to carbonic acid, and he points out the interesting bearing in this connexion of the toxic action of sunlight on leaves, in the absence of carbon dioxide. This phenomenon was reported long ago by Jost. Noack now explains it as a photo-dynamic effect of the fluorescent pigment upon the surrounding protoplasm, produced in the absence of carbon dioxide. He also thus explains the death and bleaching of Fontinalis when exposed to sunlight in the presence of phenyl urethane, a substance which, as Warburg has shown, hinders photo-synthesis. Noack also offers a similar explanation of the toxic action of sulphur dioxide upon green tissues; the sulphite hinders photosynthesis and under these conditions photo-dynamic destruction of the protoplasm occurs in the light. This interpretation does not seem quite in harmony with the demonstration of the effect of sulphites in hindering photo-oxidation

Noack adds some further experiments as to the rôle of the yellow pigments in the leaf plastids In experiments *in vitro*, these carotinoids were bleached by photo-oxidation in sunlight in less than an hour in the presence of chlorophyll (1 in 100,000); without this trace of chlorophyll they remained unaltered after six hours' exposure.

Stern explains chlorophyll fluorescence as due to its solution in lipoids, but Noack finds that dry leaf tissue from which lipoids and carotinoids have been removed by 24 hours' extraction with petrol ether, still retain their chlorophyll and still show the photo-oxidation of benzidin and bleach as the result of photo-oxidation. These experiments seem in closer agreement with Willstälter's view that chlorophyll is adsorbed on some substance of high molecular weight, although in agreement with Stern's view that the pigment itself is in the fluorescent condition.

It must be admitted that the theoretical interpretation of these experiments of Noack is still far from clear, but they seem well worth consideration as suggesting yet another line of experimental approach to a very fundamental problem, the function of chlorophyll

Tide-predicting Machines.

THE simplicity of the harmonic methods of analysis and prediction of tides is very fascinating, and the invention of the tide-predicting machine by Lord Kelvin almost ensured the success of the methods. A predicting machine sums a number of harmonic variations, transmitted vertically to pulleys, round which passes a wire or chain which is fixed at one end and carries a recording pen at the free end. For the majority of ports the harmonic method of analysis is unrivalled in accuracy and cheapness; consequently we find machines in active use in the following countries. Great Britain (one at Broadstairs and one at Bidston Observatory), France, Germany, Portugal, United States, Argentina, Brazil, India, and Japan (2). In addition to these, three machines are no longer used. one was destroyed at Tokyo, and the Brazilian machine is being replaced by a model under construction at the present time. It is noteworthy that since the War five machines have been built at Glasgow by Messrs Kelvin, Bottomley, and Baird

The number of harmonic variations utilised by the machines varies from ten to thirty-seven, and much ingenuity has been practised, especially in connexion with devices to reduce the cost of predictions. Considering that a port cannot do business without tide predictions, it is remarkable that 10*l*.-20*l*. should be considered excessive cost, and that too often accuracy is subordinated to price. For the more important ports, however, accuracy is increasingly demanded. Considering only prediction, accuracy depends upon the number of constituents incorporated in the machine, and also upon the performance of the machine For some ports, especially those situated in estuaries, a machine with, say, eighty constituents would be required; the initial cost would be very great and the difficulties of operation enormously increased

The present writer has had actual experience with five of the latest machines; he has carried out tests on two others, and has witnessed the performance of another one. There is no possible doubt but that the principal source of error in performance is that of friction. A change in tension of 1 per cent at each pulley means a considerable average change over of tension throughout the wire under certain conditions. This leads either to stretching with a soft wire or to 'bowing' from the vertical with a resilient wire, and it seems impossible to find a wire of circular cross-section that will satisfy all conditions. A chain is used on two machines (United States and Germany), and a flexible tape of relatively large cross-section is used on the Liverpool Tidal Institute machine at Bidston. The machine now under construction for Brazil is being fitted with ball-bearings for each pulley.

Even if a perfect machine, with a large number of constituents, could be built, it is still doubtful whether the harmonic method can be adequately used for the direct prediction of tides for estuary ports; part of the difficulty has to do with the validity of the resolution into harmonic constituents at such places. It is possible, however, to apply adequate corrections to the machine predictions, and such corrections may be 'non-harmonic' (functions of the range of tide) or 'harmonic'; in the latter case the machine may be used with a special time-scale to run off a separate curve for the corrections. Even this method is not without its difficulties. The harmonic method has thus had to confront many serious hindrances to universal adoption, especially in the case of the most important ports where its defects are most apparent; there is no doubt, however, that the harmonic method of prediction and the use of predicting machines will increase, but perhaps with some loss of apparent simplicity of operation.

Various details of the machines hitherto constructed are brought together in Special Publication, No. 13, issued by the International Hydrographic Bureau of Monaco, entitled "Tide Predicting Machines." Most of the remarks appear to have been culled from official accounts of the machines. The whole volume would have been more useful if it had been subjected to more helpful criticism. Appendix II. and the tables of astronomical arguments for ten constituents are of no value to any one likely to be using a machine and are out of place in the volume. Certain formulæ on p. 81 are inconsistent, and the table on p. 83 cannot be understood unless certain symbols, x and y, are explained.

A. T. DOODSON.

University and Educational Intelligence.

CAMBRIDGE.—An offer has been made of 25,000*l*. by the Empire Marketing Board, through the Committee of the Privy Council for Scientific and Industrial Research, for the building and equipping of an extension of the Low Temperature Research Station.

Sir Josiah Stamp has been appointed Rede lecturer, Dr. C. Hose has been elected to an honorary fellowship at Jesus College, and C. Rimington, Emmanuel College, has been elected Benn W. Levy student in bio-chemistry. The Raymond Horton-Smith Prize has been awarded to Dr. A. J. Copeland, Pembroke College, for his thesis on "The Cocaine Substitutes, with Special Reference to Borocaines"; *proxime accessit*, Dr. T. A. Butcher, Queen's College, for a thesis on "The Normal Gastric Secretion as Determined by the Fractional Test Meal."

EDINBURGH.—At the meeting of the University Court on November 15, Prof Baldwin Brown was appointed Munro lecturer for the current academical year. He will deliver a course of ten lectures in the summer term on "Activities of Prehistoric Man in their Relation to the Origin of the Arts."

Mr. J. A. V. Butler was appointed a lecturer in the Department of Chemistry.

LEEDS.—The following appointments have been made in the Cancer Research laboratories: Mr. J. S Young to be lecturer in experimental pathology and assistant director of cancer research; Mr. Young has held appointments as resident assistant physician at the Western Infirmary, Glasgow, as University assistant to Prof. Muir, and, for the past two years, as assistant pathologist at the Western Infirmary; Mr. H. J. Channon to be bio-chemist in the Department of Experimental Pathology; Mr Channon held a Beit Memorial Fellowship for Medical Research under Prof. J. C. Drummond, University College, London; Cancer Research fellowships to Dr. Georgiana M. Duthie, who has been a demonstrator in the Pathology Department of the University since January 1925; and to Mr. G. A. Collinson, who during the same period has acted as research assistant to Sir Berkeley Moynihan.

LONDON.—The following free public lectures are announced:—"The Present Position of the Logic of Induction," Dr. C. D. Broad, at King's College, at 5.30, on December 1; "Colour Vision," Prof. H. E. Roaf, at University College, at 5, on December 1 and 8; "Nervous Affections of the Œsophagus" (The Semon Lecture), Dr. A. Brown Kelly, at the Royal Society of Medicine, at 5, on December 2; and "Influence of Environment on Bacteria," Mr F. W. Twort, at the Royal College of Surgeons of England, at 4, on December 6, 7, 9, 13, and 14.

The following doctorates have been conferred: *D.Sc. in Physiology* on Prof. D. T. Harris (University College) for a thesis entitled "Biological Action of Light"; *D.Sc* (*Engineering*) on Mr. H. E. Merritt (West Ham Municipal College) for a thesis entitled "Generated Gear Teeth."; *D.Sc. in Physics* on Mr. C. E. P. Brooks, for a thesis entitled "The Variations of Pressure from Month to Month in the Region of the British Isles," and on Mr. Wilfred Jevons for a thesis entitled "(1) A Band Spectrum of Tin Monochloride exhibiting Isotope Effects; (2) The More Refrangible Band System of Cyanogen as developed in Active Nitrogen."

MANCHESTER.—The honorary degree of D.Sc. has been conferred upon Mr. S. L. Pierce, formerly manager of the Manchester Corporation electricity undertaking and an Electricity Commissioner, Prof. A C. Seward, professor of botany in the University of Cambridge; Dr. A. E H. Tutton, formerly H.M. Inspector of Schools (Technological Branch).

THE date of the second biennial conference of the World Federation of Education Associations, to be held at Toronto, Canada, in 1927, is to be August 7–12 instead of some days earlier. The secretary of the Federation is Charles H. Williams, 101 Jesse Hall, Columbia, Missouri, U.S.A.

ACCORDING to a note in the October issue of the *Scientific American*, Princeton University is appealing to the public of the United States for an endowment of two million dollars in order to strengthen and enlarge its research work in the fundamental sciences. A further one million dollars will be granted by the General Education Board if the public subscribes the two million. The note directs attention to the large amount of research in science which has been carried out at Princeton during the past twenty-five years without an adequate endowment, and repeats Secretary Hoover's warning that the United States is falling behind in research in pure science. Several other universities of the United States are making similar appeals for endowment.

MR. W. R. BOWER, Head of the Department of Physics and Electrical Engineering at the Huddersfield Technical College and a past president of the Association of Teachers in Technical Institutions, is retiring at the end of the current term after holding his present post for thirty years. The College authorities are now creating separate departments of physics and electrical engineering. The new head of the Physics Department will be Mr. H Lowery, lecturer in physics at the Bradford Technical College and formerly assistant lecturer in physics in the

University of Manchester, who has published several papers on spectroscopic and other subjects. Mr. W. M. Wilcox, now lecturer in electrical engineering in the College, will become head of the new Electrical Engineering Department.

The League of Nations International Committee on Intellectual Co-operation held at Geneva on July 26-29 its eighth plenary session, a report of which has recently been issued. A large number of resolutions proposed by sub-committees were approved, including the following, proposed by the sub-committee on university relations: National universities' associations and similar organisations should be asked for their views and observations on a scheme for the institution of an international universities' association, to be prepared for by an inter-university conference. A summary should be published of the subjects dealt with in the various universities' courses devoted to contemporary history, foreign literature, and international law. A special committee should investigate ways and means and with the least possible delay present a detailed plan for the publication of year-books and catalogues of interest to the university and scientific world. Special agreements, on a basis of reciprocity between States, should provide for reductions in transport rates for students, and the International Institute should consider, in agreement with the Transit Section of the League of Nations, the best means of achieving this result. Among resolutions prepared by other sub-committees and approved by the plenary committee was one for establishing an international office of museums, one for constituting an autonomous international society or academy of translators, and one for convening expert committees early in 1927 for the co-ordination of bibliography in (*a*) economic sciences, (*b*) Greco-Roman antiquity, and (*c*) biological sciences.

The University of London Bill passed its second reading in the House of Commons on November 19 without a division. Lord Eustace Percy, president of the Board of Education, in explaining the provisions of the bill, emphasised the importance of the creation of a council to deal with all questions of finance, and the need to secure the direct representation of the colleges on the Senate. He disclaimed any desire on the part of the Board of Education to control the University, the chief object of the representation of the Crown and the London County Council on the Council of the University being to introduce elements outside the University "competent in matters of business administration and finance." On this point he gave the most emphatic assurance. He promised to move an amendment in Committee to meet the special position of the theological colleges which did not receive public grants. Replying to the criticism that the bill might affect adversely the interests of the external student, he said that the Government "desired to preserve the external side in the full enjoyment of its privileges." Mr. Trevelyan, on behalf of the Labour Party, supported the second reading and hoped the bill would become law this year. Dr. Graham Little, member for the University, moved the rejection of the bill. He laid stress on the present financial independence of the colleges which was threatened by the bill, because public grants to the colleges would in future be paid through the University. Those who belonged to the external side felt that the menace to their special interests would be serious. Sir A. Hopkinson, supporting the bill, said that the University of London needed the business element, though he is not sure that Crown nomination is the best method of introducing this element into the government of the University.

Contemporary Birthdays.

November 27, 1849. Prof. Horace Lamb, F.R.S.

November 28, 1840. Sir James Crichton Browne, F.R.S.

November 29, 1866. Prof. Ernest W. Brown, F.R.S.

November 29, 1859. Sir Robert A. Hadfield, Bart., F.R.S.

November 29, 1847. Sir George Greenhill, F.R.S.

November 29, 1859. Prof. John Ambrose Fleming, F.R.S.

November 30, 1858. Sir Jagadis Chunder Bose, C.S.I., C.I.E., F.R.S.

December 2, 1860. Right Hon. Lord Southborough, G.C.B., G.C.V.O.

Prof. Lamb, born at Stockport, was educated at the Grammar School there, at Owens College and at Trinity College, Cambridge, graduating second wrangler. Leaving tutorial work at Cambridge he became professor of mathematics in the University of Adelaide, returning to Manchester in 1885 on acceptance of the chair of mathematics in the University, a post he held until 1920. Prof. Lamb has received from the Royal Society the Copley medal and a Royal medal. In 1925 he was president of the British Association.

Sir J. Crichton Browne was educated at Dumfries Academy and the University of Edinburgh. An authority on mental and nervous diseases, he was from 1875 until 1922 Lord Chancellor's Visitor in Lunacy. As treasurer of the Royal Institution Sir James rendered devoted service for many years.

Prof. E. W. Brown is a graduate of Christ's College, Cambridge. From 1891 until 1907 he was professor of mathematics in Haverford College, Pennsylvania, accepting afterwards a similar chair at Yale University. He is a corresponding member of the Academy of Sciences, Paris. In 1907 Prof. Brown received the Royal Astronomical Society's medal for his researches on lunar motion, followed in 1914 by the Royal Society's award of a Royal medal for similar studies.

Sir Robert Hadfield, the well-known metallurgist, is chairman and managing director of Messrs. Hadfield's, Ltd., Sheffield. He is a corresponding member of the Academy of Sciences, Paris. In 1904 he received the Bessemer gold medal of the Iron and Steel Institute, at the hands of Mr. Andrew Carnegie, for the advancement of the metallurgy of iron and steel, in particular the discovery of manganese steel. Specimens of the first manganese-iron alloy, made in 1882, were shown on that occasion. Sir Robert is a past president of the Iron and Steel Institute and of the Faraday Society.

Sir George Greenhill graduated at the University of Cambridge. He was formerly professor of mathematics in the Artillery College, Woolwich; he received a Royal medal from the Royal Society in 1906.

Sir Jagadis Bose, emeritus professor of the Presidency College, Calcutta, and founder and director of the Bose Research Institute, Calcutta, was educated in India and at Christ's College, Cambridge. He has conducted prolonged researches and written several works on life movements in plants. His latest treatise, published this year, was entitled "The Nervous Mechanism of Plants."

Lord Southborough has been permanent secretary of the Board of Trade and of the Colonial Office. In 1910 he was vice-chairman of the Development Commission; in 1918–19, president of the Commission to India on reform. The National Physical Laboratory owes much to him for advice and assistance in the past.

Societies and Academies.

LONDON.

Royal Society, November 18.—**W. S. Patton** and **E. Hindle**: Reports from the Royal Society's Kala Azar Commission in China.—**R. Hill**: The chemical nature of hæmochromogen and its carbon monoxide compound. The hæmochromogen type of spectrum shown by compounds of hæmatoporphyrin with metals other than iron is not due to the presence of nitrogen compounds. It is suggested that the property of forming hæmochromogens is limited to the iron-porphyrin compounds. Two molecules of pyridin are necessary to convert reduced hæmatin into the corresponding hæmochromogen. Carbon monoxide hæmochromogen has one molecule of pyridin in combination when produced in the presence of the latter. The carbon monoxide compounds of reduced hæmatin and pyridin hæmochromogen both contain one molecule of carbon monoxide.—**H. Gremels** and **R. Bodo**: The excretion of uric acid by the kidney.—**C. H. Browning**, **J. B. Cohen**, **S. Ellingworth**, and **R. Gulbransen**: The antiseptic properties of the amino-derivatives of styryl and anil quinoline.—**T. S. P. Strangeways** and **F. L. Hopwood**: The effects of X-rays upon mitotic cell division in tissue cultures *in vitro*.—Sir Charles **Sherrington** and **R. S. Creed**: Observations on concurrent contraction of flexor muscles in the flexion reflex.—**S. B. Schryver** and **H. W. Buston**: The isolation of some hitherto undescribed products of hydrolysis of proteins (Part iii.).—**J. A. Crowther**: The action of X-rays on *Colpidium colpoda*.

Linnean Society, November 4.—**G. Tandy**: Abnormal fruiting branches of sweet chestnut (*Castanea vulgaris*), found by Mr. W. P. J. Le Brocq near Brecon. The catkins were wholly female, whereas usually only a few female flowers are found at the base of an androgynous catkin. Certain trees have been found consistently to produce such catkins.—**T. A. Sprague**: Visits to Wistman's Wood, Dartmoor, in May 1926.—**C. M. Yonge**: The ciliary-feeding mechanisms in the thecosomatous pteropods.

CAMBRIDGE.

Philosophical Society, October 25.—**H. Jeffreys**: On compressional waves in two superposed layers. The assumption that the compressional waves of earthquakes follow the ordinary laws of refraction, the energy within any pencil of rays remaining permanently within that pencil, leads to amplitudes too small for the indirect waves from near earthquakes. An analogous problem in the theory of sound is here considered. It is found that a large diffracted wave appears at the outer surface, having travelled with the velocity of sound in the lower medium; but it differs somewhat in character from the direct wave.—**S. Pollard**: (1) On the descriptive form of Taylor's theorem. The relation is obtained between the descriptive form of Taylor's theorem and the ordinary (Lagrange) form, and hence a precise statement of the descriptive form is found. This is employed to give a concise proof of the two-dimensional case of the descriptive form. (2) The summation of a Fourier integral of finite type. A Fourier integral is of finite type if the generative function vanishes outside a certain interval. The paper deals with the Cesaro summation of such integrals, it being assumed only that the generating function is integrable in Denjoy's sense. A necessary and sufficient condition is obtained for summability (C, k), where k is a positive integer, and this yields a special criterion which generalises the well-known criterion of Lebesque for summability $(C, 1)$.—**G. C. Steward**: Note on the Petzval optical condition. The 'Petzval' optical condition for flatness of field, produced by a symmetrical optical system, stands apart from the other aberration coefficients of the first order; it is independent of the positions of the conjugate planes considered and also of the pupil-planes of the system. An expression is obtained for the reduced focal eikonal for a single spherical surface.—**E. A. Milne**: Maxwell's law, and the absorption and emission of radiation.—**T. L. Wren**: The correspondence between lines in threefold space and points of a quadric fourfold in fivefold space, established by a geometrical construction.—**F. J. W. Roughton** and **H. Hartridge**: Improvements in the apparatus for measuring the velocity of very rapid chemical reactions (ii.). For very fast reactions an apparatus has been constructed which enables the first observation to be made on the reacting liquids in $\frac{1}{1000}$th sec. from the commencement of mixing. The fastest chemical reaction that can be investigated is one half completed in $\frac{1}{1000}$th sec. It seems improbable that these times can be reduced appreciably without either making some radical change in design or using driving pressures higher than one atmosphere. Very slow reactions of from 2 minutes to 1 second have been investigated by simply increasing the length of the observation tube. Reactions in very dilute solution have been studied by examining spectroscopically a beam of light that has been passed through the observation tube parallel with its long axis. Observations on hæmoglobin solutions of concentration so low as $M/6 \times 10^6$ have been made possible. For work on small quantities of fluid a special spectro-camera has been devised.—**F. H. Constable**: On the stability of copper catalysts produced by thermal decomposition. The thermal decomposition of salts of copper leads to the production of active catalysts. The spacing of the copper atoms in the original compound is a secondary consideration, the real factor governing the nature of the final surface being the mixed crystallisation and freezing in the amorphous state of a mass of suddenly liberated copper atoms. The results agree with the hypothesis that the centres of activity of the surface are frozen groups of atoms with strong specific external fields. At moderate temperatures the stability of these preparations is very marked.—**J. A. Christiansen**: Note on the velocity of gas-reactions.—**W. T. Richards**: Note on the effect of α-particles on paraffin.—**C. V. Hanumanta Rao**: On the figure of Pappus' theorem.

PARIS.

Academy of Sciences, October 26.—**Charles Moureu**, **Charles Dufraisse** and **Marius Badoche**: Autoxidation and antioxygen action (xix.). The catalytic action of hydrocyanic acid and of various cyanogen compounds. Cyanogen compounds as a class are not exceptional in their behaviour when compared with other catalysts. The effects on the oxidation of acrolein and styrolene are shown graphically.—**A. Desgrez** and **J. Meunier**: The detection and determination of strontium in sea water. Common salt is separated from the calcium and strontium sulphates by 30 per cent. alcohol, and the insoluble portion submitted to quantitative spectrum analysis. The ratio found was strontium to calcium = 1/47.—**S. Winogradsky**: The decomposition of cellulose in the soil. A description of a micro-organism obtained from soil capable of rapidly breaking down cellulose, probably to an oxycellulose.—**Riquier**: The integration of the partial differential equation of the second order with two independent variables.—Jacques **Chokhatte**: The asymptotic expressions of the Tchebycheff polynomials and of their derivatives.—**Véronnet**: Extension of Stokes's theorem. Each term of the development of the potential of a star on an external point is a constant independent of the internal constitution.—**L. d'Azambuja** and **H. Grenat**: The great activity of a group of sunspots followed by a magnetic storm and an aurora borealis. An exceptional eruption of hydrogen was observed in the Meudon spectro-heliograph on October 13 at 13^h 15^m: magnetic disturbances set in 31 hours later and continued for 36 hours, and the aurora borealis was also observed. Similar correlation of solar activity and magnetic disturbances was proved by G. E. Hale and by T. Royds early in 1926.—**René Lutembacher** and **Léon Gaumont**: The application to teaching purposes of the optical recording of sound, combined with the kinematograph. An account of a method for studying the heart and the voice suitable for medical instruction.—**A. Paillot**: Rôle of the spore-bearing micro-organisms in silk-worm disease.—**V. Omeliansky**: The resistance of cultures of *azotobacter chroococcum* to desiccation.

WASHINGTON, D.C.

National Academy of Sciences (Proc., vol. 12, No. 10, October).—Fabio **Frassetto**: Relations between stature and chest-girth formula of normality and normal values. A linear relationship between height and weight has been demonstrated. Using measurements of more than a quarter of a million subjects, it is shown graphically and analytically that for Italians 20-21 years old, 154 cm. height, 84·6 cm. chest-girth, the chest-girth increases 0·24 cm. for every centimetre increase of stature.—Melville J. **Herskovits**: Social selection in a mixed population. From particulars obtained at Howard University, and some 400 families in the Harlem district of New York City, it appears that there is a marked tendency for negroes to marry negresses of lighter colour than themselves. Thus generally the daughters of the unions will be darker than their mothers and the American negro population will tend to approach negroid type more and more.—G. W. **Hammar**: (1) A preliminary report on the magnetic susceptibilities of some gases. (2) A possible explanation of the 'Glaser effect' (see NATURE, November 13, p. 712).—R. C. **Gibbs** and H. E. **White**: Stripped atoms of the first long period. The '*d*' electron seems to be the most tightly bound electron through this group of elements.—Enos E. **Witmer**: The rotational energy of the polyatomic molecule as an explicit function of the quantum numbers.—R. de L. **Kronig**: The dielectric constant of symmetrical polyatomic dipole-gases on the new quantum mechanics. As for diatomic molecules, the permanent electric moment and the part of the dielectric constant due to it are related by Debye's equation derived on the classical theory, if the temperature be sufficiently high.—W. J. **Crozier** and G. **Pincus**: Tropisms of mammals. Rats creeping in contact with the surface of a block follow the vertical surface on reaching a corner; if touching blocks on each side, they creep ahead on emerging from the zone of contacts, showing definite stereotropism. As regards phototropism, the path of a very young rat illuminated from two sources can be calculated from the intensities of the light sources. Creeping up a fine-meshed wire grid, orientation is upward, depending on the angle of inclination of the grid, and, between limits, is related directly to the inclination. Thus it is possible, as in many invertebrates, to obtain a quantitative analysis of behaviour.

Official Publications Received.

BRITISH AND COLONIAL.

Aeronautical Research Committee: Reports and Memoranda. No. 1017 (M. 37): Experiments relating to the Electrification of Balloon Fabrics. By Dr. Guy Barr. (B. 1. d. Fabrics-Airships, 58.—T. 2212.) Pp. 10. 9*d*. net. No. 1037 (M. 46): Mechanical Properties of Pure Magnesium and certain Magnesium Alloys in the Wrought Condition. By S. L. Archbutt and Dr. J. W. Jenkin. Work performed at the National Physical Laboratory for the Engineering Research Board of the Department of Scientific and Industrial Research. (B. 1. a. Materials, Strength and Properties, 62.—T. 2206.) Pp. 18+2 plates. 9*d*. net. (London: H.M. Stationery Office.)

Government of Madras: Law (Education) Department. Administration Report of the Madras Government Museum and Connemara Public Library for 1925–26. Pp. 8. (Madras: Government Press.)

Union of South Africa: Department of Agriculture. Bulletin No. 9: The Codling Moth; Measures necessary more effectively to Control the Pest. By Dr. F. W. Pettey. Pp. 15+7 plates. Division of Chemistry Series No. 63: Soil Formation and Classification. By Dr. B. de C. Marchand. Pp. 8. Division of Chemistry Series No. 64: On the Composition of the Fractions separated by Mechanical Analysis from some Transvaal Soils. By Dr. B. de C. Marchand and C. R. van der Merwe. Pp. 16. (Pretoria: Government Printing and Stationery Office.)

University of Cambridge. Solar Physics Observatory. Thirteenth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1925 April 1—1926 March 31. Pp. 8. (Cambridge.)

Proceedings of the Royal Irish Academy. Vol. 37, Section A, Nos. 4, 5: Two-Electron Orbits, by Dr. A. W. Conway and G. Keating; The Dynamics of the Spinning Electron, by Dr. A. W. Conway. Pp. 40-57. 1*s*. Vol. 37, Section A, No. 6: Atmospheric Dust and Condensation Nuclei. By R. K. Boylan. Pp. 58-70. 1*s*. Vol. 37, Section B, No. 14: The Influence of the Thyroid Gland on the Plumage of the Fowl. By Dr. F. W. Rogers Brambell. Pp. 117-124+1 plate. 1*s*. Vol. 37, Section B, No. 15: A List of the Harvest Spiders of Ireland. By D. R. Pack-Beresford. Pp. 125-140. 1*s*. Vol. 37, Section B, Nos. 16, 17: Some Derivatives of γ-Piperonylidene-Methylethylketone, by Brendan O'Donoghue, Dr. Hugh Ryan and Dr. John Keane; Some Derivatives of α-Piperonylidene-Methylethylketone, by Brendan O'Donoghue, Dr. Hugh Ryan and Dr. John Keane. Pp. 141-153. 1*s*. Vol. 37, Section B, Nos. 18, 19: Notes on the Staminate Cone of *Larix leptolepis*, by Prof. Joseph Boyle; The Ovule of *Larix* and *Pseudolarix*, by Prof. Joseph Boyle. Pp. 154-180+4 plates. 1*s*. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

FOREIGN.

The University of Chicago. Publications of the Yerkes Observatory, Vol. 4, Part 5: A Comparison of the Photometric Fields of the 6-inch Doublet, 24-inch Reflector, and 40-inch Refractor of the Yerkes Observatory, with some Investigation of the Astrometric Field of the Reflector. By Alice Hall Farnsworth. Pp. v+37. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press.)

Las estrellas variables cefeidas. Por Victoriano F. Ascarza. (Publicado en el Anuario del Observatorio de Madrid para 1927.) Pp. 112. (Madrid.)

Arkiv för Matematik, Astronomi och Fysik utgivet av K. Svenska Vetenskapsakademien. Band 19A, No. 16, Meddelande från Lunds Astronomiska Observatorium, No. 109: On Star Streams. By C. V. L. Charlier. Pp. 22. Band 19A, No. 19, Meddelande från Lunds Observatorium Astronomiska, No. 110: The Relation between Absolute Magnitude and Proper Motion. By K. G. Malmquist. Pp. 32. Band 19B, No. 18, Meddelande från Lunds Astronomiska Observatorium, No. 111: Über die Entfernung des offenen Haufens NGC 752. Von K. G. Malmquist. Pp. 4. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.; London: Wheldon and Wesley, Ltd.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 535: A Fundamental Basis for Measurements of Length. By H. W. Bearce. Pp. 393-408. (Washington, D.C.: Government Printing Office.) 5 cents.

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 16, Part 2: Physico-Chemical Studies on the Specificity of Proteins of different Rice Varieties and Subvarieties, by Tetsutarō Tadokoro, Yukihiko Nakamura and Shukichi Watanabe; On the Differences between some Colloidal and Chemical Properties of Common and Glutinous Rice Starch, II, by Tetsutarō Tadokoro. Pp. 73-124. (Sapporo.)

Bulletin of the American Museum of Natural History. Vol. 55, 1926: The Distribution of Bird-Life in Ecuador; a Contribution to a Study of the Origin of Andean Bird-Life. By Frank M. Chapman. Pp. xiv+784+30 plates. (New York City.)

Annuaire de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, 1926. 92e année. Pp. 214+6 planches. (Bruxelles: Maurice Lamertin.)

CATALOGUES.

Optical Glass. Pp. 10. (Little Chester, Derby: Parsons Optical Glass Co.)

Apparatus for Radiology: a Supplementary Abridged List. Pp. 14. (London: Newton and Wright, Ltd.)

The Cambridge Bulletin. No. 56, October. Pp. 32+8 plates. (Cambridge: At the University Press.)

A Catalogue of Books relating to the Sea; also Atlases, Log Books, and Books on the South Seas. No. 487. Pp. 66+6 plates. (London: Francis Edwards.)

Lager-Katalog Nr. 190: Allgemeine Geologie, Geophysik. Pp. ii+420. (Leipzig: Max Weg.)

Catalogue of Important Books and Papers on Zoology, Botany and Gardening, Agriculture, Geology, Palæontology, and Mineralogy. No. 146, November. Pp. 56. (London: Dulau and Co., Ltd.)

Diary of Societies.

SATURDAY, November 27.

Royal Institution of Great Britain, at 3.—Dr. G. C. Simpson: Atmospheric Electricity (1).

MONDAY, November 29.

Institute of Actuaries, at 5.—H. E. Raynes: The Mortality of Europeans in British West and British East Africa.

Institution of Automobile Engineers (Loughborough Graduates' Meeting) (at Loughborough College), at 7.—S. Robertson: Crank Shafts.

Institution of Engineers-in-Charge (at Gas Light and Coke Co., Church Street, Kensington), at 7.30.—J. Ennals: The Uses of Gas in Industry.

Aristotelian Society (at University of London Club), at 8.—Dr. Dorothy Wrinch: Scientific Methodology and the Quantum Theory.

Royal Society of Arts, at 8.—Prof. H. L. Callendar: Recent Experiments on the Properties of Steam at High Pressure (Howard Lectures) (III.).

Institution of Welding Engineers (at Caxton Hall, Westminster), at 8.—Dr. J. H. Paterson: Thermal Disturbance in Iron and Steel during Welding.

TUESDAY, November 30.

Royal Society, at 4.—Anniversary Meeting.

Royal Institution of Great Britain, at 5.15.—Sir William Bragg: The Imperfect Crystallisation of Common Things (2).

Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole, Leeds), at 7.

Institution of Electrical Engineers (North-Western Centre) (at Engineers' Club, Manchester), at 7.

Royal Photographic Society of Great Britain, at 7.—H. B. Cott: A Naturalist on the Amazon (Lecture)

Chemical Industry Club, at 8.—Annual General Meeting.

WEDNESDAY, December 1.

Electrical Association for Women (at 49 Wellington Street, W.C.2), at 3.—Mrs. D. D. Cottington Taylor: Modern Housekeeping.

Royal Institute of Public Health, at 4.—Dr. P. C. Varrier-Jones: Settlements for Tuberculous Workers.

Philosophical Society of England (at 183 Piccadilly), at 4.30.—Mrs. Champion de Crespigny: The Evolution of the Inner Self.

Geological Society of London, at 5.30.—H. Williams: The Geology of the Snowdon Massif (North Wales).—Dr. A. Heard: On Old Red Sandstone Plants showing Structure from Brecon (South Wales)

Institution of Electrical Engineers (Wireless Section), at 6.—Dr. R. V. Hansford and H. Faulkner. Some Notes on the Design Details of a High-Power Radio Transmitter using Thermionic Valves.

Institution of Electrical Engineers (South Midland Centre) (at Birmingham University), at 7.

Institution of Heating and Ventilating Engineers (at Caxton Hall), at 7.—H. C. B. Berkhout: The Use of Special Slide Rules in Computing Hot-Water Installations

North-East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Newcastle-upon-Tyne), at 7.15.—G. J. Allan: Ice-breakers and their Services

North-East Coast Institution of Engineers and Shipbuilders (Graduate Section, Middlesbrough Branch) (at Middlesbrough), at 7.30.—S. Stansfield: Behaviour of Metals under Special Conditions of Temperature and Stress.

Society of Public Analysts and other Analytical Chemists (at Chemical Society), at 8.—Dr. W. G. Savage: Recent Advances in the Bacteriological Methods of Examining Food and Water.—E. B. Hughes: The Detection of Furfural in Vinegar.—H. R. Dovey: The Rapid Determination of Opium in Stomach Contents.—C. H. Manley: A Rapid Method for the Sorting of Butters and Margarines.

Royal Society of Arts, at 8.—G. Constantinesco: The Torque Converter.

Royal Society of Medicine (Surgery Section), at 5.30.—Prof. G. E. Gask, S. Handley, and others: Discussion on The Treatment of Gangrene of the Extremities.

Royal Microscopical Society (Biological Section).

THURSDAY December 2

Royal Society, at 4.30.—Prof T. M. Lowry and W. R. C. Coode-Adams Optical Rotatory Dispersion. Part III. The Rotatory Dispersion of Quartz in the Infra-Red, Visible and Ultra-Violet Regions.—Prof. O. W Richardson: Structure in the Secondary Hydrogen Spectrum. V.—R. H. Fowler: General Forms of Statistical Mechanics, with special reference to the New Quantum Mechanics.—R. H. Fowler and Dr. E. K. Rideal: On the Rate of Maximum Activation by Collision for the Complex Molecules with Applications to Velocities of Gas Particles.—Prof. H Dingle: The Spectrum of Fluorine (FI).—*To be read in title only*:—Prof H. M. Macdonald: Integrals of the Equations of Electrodynamics, with an application to the Electric Constants of a Transparent Medium.—Prof. L. N. G. Filon: The Forces on a Cylinder in a Stream of Viscous Fluid.—R. C. Johnson: The Structure and Origin of the Swan Band Spectrum of Carbon.—Prof. W. A. Bone: Studies upon Catalytic Combustion, III.—A. Ross: Absorption Spectra of Pyrone Derivatives in the Near Infra Red.—Prof. S. R. Milner: An Analysis of the Electromagnetic Field into Moving Elements.—A. J. Bradley and J. Thewlis: The Structure of γ-Brass.—H. R. Robinson and A. M. Cassie: The Secondary and Tertiary Cathode Rays produced by External and Internal Absorption of Homogeneous X-rays.—W. Edmondson and A. Egerton: The Vapour Pressure and Melting Points of Sodium and Potassium.—W. Edmondson and A. Egerton: The Chemical and other Thermal Constants of Sodium and Potassium.—Dr. G. W. C. Kaye and W. F. Higgins: The Thermal Conductivity of Vitreous Silica, with a Note on Crystalline Quartz.—Prof. E. T. Whittaker: On Hilbert's World-Function.—Prof. E. V. Appleton and M. A. F. Barnett: On Wireless Interference Phenomena between Ground Waves and Waves deviated by the Upper Atmosphere.—W. H. George: An X-Ray Study of Isomorphism in Simple Organo-metallic Series. Part I. The Tetraphenyls.—J. Aberdeen and Prof. T. H. Laby: Conduction of Heat through Powders and its Dependence on the Pressure and Conductivity of the Gaseous Phase.—D. B Deodhar: Supplementary Tables of Wave-lengths of New Lines in the Secondary Spectrum of Hydrogen.—J. A. V. Butler: The Equilibrium of Heterogeneous Systems including Electrolytes. Part II. Equilibrium at Interfaces and the Theory of Electrocapillarity.—N. K. Adam: A Further Note upon 'Inter-traction'.—J. Topping and Prof. S. Chapman: On the Form and Energy of Crystalline Sodium Nitrate.

Royal Society of Medicine, at 5.—Dr. B. Kelly: Nervous Affections of the Œsophagus (Semon Lecture).

Royal Institution of Great Britain, at 5.15.—Dr R. R. Marett: The Archæology of the Channel Islands (3): Neolithic and Bronze Ages.

Institution of Electrical Engineers, at 6.—G. F. O'dell: An Outline of the Trunking Aspect of Automatic Telephones.

Royal Aeronautical Society (at Royal Society of Arts), at 6.30.—P. B. Henshaw: Valve Steels for Aero Work.

Society of Chemical Industry (Bristol Section) (at Bristol University), at 7.30.—Dr. G Martin: The Relative Efficiency of the Grinding Media employed in Ball and Tube Mill Grinding.

Chemical Society, at 8.—F. Challenger and V. K. Wilson: Dicyanates and Dibenzoates of Triphenylbismuthine and Triphenylstibine.—F. Challenger, V. Subramaniam, and T. K. Walker: The Mechanism of Citric and Oxalic Acid Formation from Sugar by *Aspergillus niger*. Part I.

Medico-Legal Society (at 11 Chandos Street, W.), at 8.30.—Prof. H. Littlejohn and Dr. D. Kerr: Monoxide Poisoning: Its Increasing Medico-Legal Importance.

Institution of Mechanical Engineers (Glasgow Branch) (at Glasgow).—H. T. Vincent: Combustion and Detonation in Heavy Oil Engines.

FRIDAY, December 3.

Royal Astronomical Society (Geophysical Discussion), at 5.—F. J. W. Whipple: On the Propagation of Sound to Great Distances. Chairman: Sir Gilbert Walker.

Society of Chemical Industry (Manchester Section) (at 16 St. Mary's Parsonage, Manchester), at 7.—Prof. J. C. Drummond: Chemical Aspects of Organic Evolution.

Institution of Mechanical Engineers (Informal Meeting), at 7.—A. H. Harris. Industrial Ventilation.

Royal Photographic Society of Great Britain (Pictorial Group), at 7.—W. G. Hill: The Improvement of Bromide Prints: a New Method of Working-up (Lecture).

Photomicrographic Society (at 4 Fetter Lane), at 7.—F. Welch: The Photomicrography of Bacteria.

Junior Institution of Engineers (at Royal Society of Arts), at 7.30.—Presentation of Medals and Awards, and Induction of Eng. Vice-Admiral Sir Robert B. Dixon as President, and Address on The Progress of Marine Engineering.

Geologists' Association, at 7.30.—S. W. Wooldridge: The Early Pliocene Period in the London Basin.

Philological Society (at University College), at 8.—Prof. R. M. Dawkins: Medieval Cypriot.

Royal Society of Medicine (Otology, Medicine, and Neurology Sections), at 8.15.—Sir William Milligan, Dr. W. J. Adie (for the Section of Neurology), G. J. Jenkins (for the Section of Otology): Discussion on The Relations of Abnormalities of the Blood-pressure to Diseases of the Ear.

SATURDAY, December 4.

Royal Institution of Great Britain, at 3.—Dr. G. C. Simpson: Atmospheric Electricity (2).

PUBLIC LECTURES.

SATURDAY, November 27.

Horniman Museum (Forest Hill), at 3.30.—J. E. S. Dallas: Nature in Southern England.

SUNDAY, November 28.

Guildhouse (Eccleston Square), at 3.30.—Viscount Haldane: The Wider Meaning of Relativity.

WEDNESDAY, December 1.

University College, at 5.—Prof. H. E. Roaf: Colour Vision. (Succeeding Lecture on December 8.)—At 5.30.—Lt.-Col. J. M. Mitchell: The Public Library Service in America.

King's College, at 5.30.—Dr. C. D. Broad: The Present Position of the Logic of Induction.

London School of Economics and Political Science, at 6.—F. Hutchinson: Office Machinery in the United States (1)

THURSDAY, December 2.

Royal Society of Medicine, at 5.—Dr. A. Brown Kelly: Nervous Affections of the Œsophagus (Semon Lecture).

King's College, at 5.30.—M. Beza: Roumanian Customs at Christmas and New Year.

College of Nursing (Henrietta Street, W.1), at 5.30.—Prof. Winifred Cullis: Adolescent and Social Hygiene from the Standpoint of the School.

Royal Society of Medicine, at 8.—Sir Henry Gauvain: Sun, Sea, and Open Air in Relation to Health and the Prevention of Disease (Chadwick Lecture).

SATURDAY, December 4.

Horniman Museum (Forest Hill), at 3.30.—Miss M. A. Murray: Egyptian Hieroglyphs.

SUNDAY, December 5.

Guildhouse (Eccleston Square), at 3.30.—Sir George Newman: The Contribution of Medical Science to Human Life.

SATURDAY, DECEMBER 4, 1926.

CONTENTS.

PAGE
Research and the Imperial Conference . . . 793
The Significance of Animal Coloration in the Struggle for Existence. By E. B. P. . . 795
The Aurora Borealis as observed from Norway. By Prof. S. Chapman, F.R.S. 797
Official Publicity for Agricultural Research . . 799
Our Bookshelf 799
Letters to the Editor:
  Luminescence from Solid Nitrogen, and the Auroral Spectrum.—Prof. L. Vegard 801
  Properties of High Frequency Radiations.—Prof. J. A. Gray 801
  The Size of the Iodine Molecule.—B. Topley . 802
  The Oogenesis of Lumbricus.—L. A. Harvey . 803
  Magnetic Storms and Wireless Communication.—T. L. Eckersley 803
  Internal Rust Spot of Potatoes.—W. A. Millard . 804
  The Double Normal State of the Arc Spectrum of Fluorine.—T. L. de Bruin 804
  'Hard Seeds' in Leguminosæ.—Alexander Nelson 804
  The Eggs of the Sucker-fish.—H. C. Delsman . 805
  The Symmetrical Top in the Undulatory Mechanics.—R. de L. Kronig and I. I. Rabi . . . 805
  Complex Aromatic Hydrocarbons in Low-Temperature Tar.—Prof. G. T. Morgan, F.R.S., and D. D. Pratt 805
  Welsh Romani.—Dr. John Sampson; Prof. R. L. Turner 805
A Half-Century of Chemistry in America: 1876–1926. By Prof. Henry E. Armstrong, F.R.S. . . . 806
The Cretaceous Plants of Greenland. By H. H. T. 808
Electric Waves and their Propagation. By Sir Ernest Rutherford, O.M., P.R.S. 809
Obituary:
  Mr. Charles Hedley. By C. Anderson . . 811
News and Views 812
Our Astronomical Column 817
Research Items 818
Anniversary Meeting of the Royal Society . . 821
Folk Dances as a Survival of Primitive Ritual . 824
University and Educational Intelligence . . . 824
Contemporary Birthdays 825
Societies and Academies 825
Official Publications Received 827
Diary of Societies and Public Lectures . . . 827
Recent Developments of Cosmical Physics. By J. H. Jeans, Sec. R.S. . . . . . Supp. 29

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Research and the Imperial Conference.

THE Imperial Conference which has just closed in London will be memorable for the new stimulus which it will give to the enterprising spirits of our age. Little of the earth's surface is left unmapped, but over vast expanses of the British Empire there are fields of endeavour which provide a new outlet for the adventurous. It has been the privilege of the members of the recent Imperial Conference to state these fields of endeavour. They have been able to indicate the enormous potential resources of the Empire and the infinite variety and complexity of the problems which confront its peoples. What is more, they have stated their belief that for the development of their resources and the solution of their problems they must depend upon science.

This general appreciation of the function of science is the outstanding feature of the recent Imperial Conference. It is probably unique in the history of the British Empire and has a deep significance. It substitutes a scientific basis for the attempt to find a political solution for Empire economic problems. Through it the people of the British Empire have been enabled to take stock of their enormous responsibilities, to realise the tasks before them, and to understand the means by which they can rise to the height of a wonderful opportunity. Lord Balfour, in his introduction to the report of the Research Sub-Committee, the most important produced by the Conference, states in unequivocal terms that if full use is to be made of the opportunity we must turn to applied science for aid:

> "The Empire includes states and territories of the most varied economic capacity, possessing every gradation of climate and soil, every species of mineral wealth, subject in parts to special diseases with which only science can hope to deal; enjoying in parts unique natural advantages which only science can fully develop. It possesses distinguished investigators in every branch of research. It has therefore everything to gain from full scientific co-operation, yet we can hardly flatter ourselves that we practise this, either within Great Britain or throughout the Empire."

Various recommendations are made in the report regarding the organisation of research. Co-operation can best be secured, it is suggested, by the extension of the number of Imperial bureaux for special fields of investigation. The existing bureaux for entomology, mycology, and tropical medicine have greatly facilitated the interchange of results obtained in various parts of the Empire. It will be left to the delegates to the forestry conference which will assemble in Australia and New Zealand in 1928, and the Imperial Agricultural Research Conference, already arranged for 1927, to decide whether Imperial bureaux in these fields are necessary.

It is made clear that it is not assumed that any organisation intended to serve the whole Empire should necessarily be situated in Great Britain. It is suggested, for example, in the event of it being decided to create an Imperial Veterinary Science Bureau, that this bureau should set up in South Africa, which is ideally situated for purposes of research into the diseases of domestic live-stock, being faced with a greater variety of diseases than any other part of the Empire. Although it is not suggested in the report, it is not improbable that the Agricultural Research Bureau, if decided upon, would be situated in Jamaica, for it is in connexion with the development of tropical agriculture that the greatest advances are to be expected.

Reference is made to the imperfect machinery for the interchange of information. As at present conducted, correspondence fails to meet the need for rapidity, and not infrequently, because of some gap or misunderstanding, fails to reach the best objective. Instead of complete reliance upon such bodies as the Colonial Office, the Imperial Institute, the specialised Imperial bureaux, as the channels of communication of information, it is suggested in addition that direct communication should be established between the various parts o the Empire, through the accredited representatives of special broad fields of research.

The parts of the report dealing with the present position of recruitment of staffs for the various scientific services in the Empire is, in effect, a reflection upon the educational training provided in the schools and universities of the Empire and upon the inducements offered in the scientific services. "The evidence before the sub-committee shows that there is a shortage of suitable candidates for most branches of scientific services supported by Governments." The report emphasises, moreover, that this shortage will become more pronounced as the development of the Empire proceeds, since the demand for highly trained scientific workers is likely to be accelerated with the rapid development which must be expected, particularly in the tropical parts of the Empire. Various reasons have been given to the sub-committee for the shortage. Most of them have been emphasised again and again in these columns. The shortage is attributed to "the inadequate appreciation of the importance and value of scientific research on the part of the public, of the Press, and even of Governments themselves; the uncertainty in the minds of men embarking on a university course as to the amount, interest, and continuity of the employment which will be available in their branch of science when they have completed their studies"; the increasing demand by private employers for university-trained scientific workers, and ignorance on the part of parents and educational institutions of the number and attractions of careers in the scientific services overseas.

The fact is that neither the schools nor the universities of Great Britain provide adequate facilities for training in the branches of science for which there is the greatest scope in the less developed parts of the Empire There are too many chemists, too few geologists; too many engineers, too few biologists. For example, in one of the leading secondary schools in London, containing five hundred boys, about half that number are receiving instruction in chemistry or physics, but only two are taking biological subjects; and this is probably a fair indication of the instruction given in most of the secondary schools in the country. It is true that some may take up biological subjects at the university, but the general tendency is to persist in the special branches of study for which the schools provided facilities

The difficulty can be overcome, but it will take time. It involves the staffing of schools and revision of curricula; it involves considerable expenditure on laboratory accommodation and equipment; it involves the overhauling of our educational administration and the removal of the anomaly of two departments of State competing in the sphere of secondary and higher education, namely, the Board of Education and the Ministry of Agriculture and Fisheries.

We endorse the opinion of the sub-committee, that the basic remedy for the shortage of scientific staffs "is the adoption of a settled policy in regard to the application of research to development in the various parts of the Empire." We can also whole-heartedly endorse the opinion expressed that the best inducements to offer students to take up appropriate lines of training are good salaries, satisfactory status, and proper recognition of their important function. If the best brains of the country are to be attracted to the scientific services, these services must rank at least equal in importance with the administrative and fighting services They must be regarded as an indispensable part of the machinery of government and not as a luxury to be dispensed with in times of financial stringency. They must also be administered by men with a scientific outlook, which is almost impossible unless these officers have received a thorough training in the methods of science.

The sub-committee points out the desirability of interchange between members of the staffs of the research institutions and the scientific services in the various parts of the Empire. It goes further, and recommends that students should be trained for their scientific work in various institutions Obviously it would be all to the advantage of the student if, after a course at a home university, he completed his training at an agricultural college in one of the tropical colonies. If the committee's recommendations are adopted regarding the interchange of scientific staffs, one of the greatest difficulties in the way of recognising special merit of scientific officers will be removed. Even in the scientific services at home, an officer in a very small department has very little prospect of promotion unless he is afforded an opportunity, and possesses the ability after a long period of specialisation, to take up new work in another department. Unquestionably there are far greater difficulties in the way of interchange between members of scientific services than exist in connexion with the interchange between members of administrative services. But much could be done in this direction. The sub-committee appreciates the difficulty which an officer in a scientific service in a remote part of the Empire must experience in keeping abreast of the latest developments in his special branch of science. It recommends the provision of refresher courses for these officers. It also recommends that picked officers should be given every facility to hold travelling fellowships for study on the spot of the latest developments in their particular fields.

The report of the Research Sub-Committee illustrates remarkably the growing appreciation of science by members of the present government. For this welcome manifestation scientific workers owe a deep debt of gratitude to Mr. Ormsby-Gore, the Under-Secretary of State for the Colonies. He has travelled far in his quest for knowledge. In the two reports he has presented to Parliament, those dealing with East Africa and West Africa, were set out clearly the problems inherent in the development of our tropical colonies, and the rôle which science must play in their solution. Through these reports the attention of statesmen has been directed to the possibilities of science. They are now prepared to state, and find their colleagues from the Dominions in agreement with them, that 'money devoted to research is not a luxury; it is rather a condition of survival, without which the Empire cannot hope to keep abreast of its competitors in the economic field." Not content with a pious expression of opinion, they "cordially approve of the projects of fostering a chain of research stations situated in appropriate centres in tropical and sub-tropical parts of the Empire, and commend this project to the sympathetic consideration of governments, institutions, and private benefactors throughout the Empire."

It is now the bounden duty of scientific workers to ensure that practical effect be given to all the recommendations in this epoch-making document. They have to equip themselves and train others for the discharge of the duties and responsibilities involved in the realisation of the immense and varied resources of a mighty inheritance, and in the promotion of the intellectual as well as the material well-being of the peoples of the British Empire.

The Significance of Animal Coloration in the Struggle for Existence.

Camouflage in Nature. By W. P. Pycraft. Pp. xiv + 280 + 36 plates. (London: Hutchinson and Co., Ltd., n.d.) 21*s.* net.

THE aim of this excellent book is to present, as the author states in the preface, "the essential features of the coloration of animals, and the various interpretations for that coloration which have been advanced by the sportsman-naturalist, as well as the man of science. . . ." Of the fifteen chapters, the first four are devoted respectively to an introduction, pigments, the infinite variety of coloration, and the evolution of colour-types; the fifth deals with rapid changes of colour in response to stimulus; the sixth to the ninth with protective coloration, both procryptic and anticryptic; the tenth with mimicry, Batesian and Müllerian; the eleventh with warning coloration; the twelfth with the coloration of young animals; the thirteenth and fourteenth with sexual selection; the fifteenth with colour aberrations.

The subject is illustrated by examples drawn exclusively from the animal kingdom, and it would have been an improvement to justify the title "Camouflage in Nature" by including the description of a few plants. The principle of cryptic coloration has been known to operate in the vegetable kingdom ever since Burchell, more than a hundred years ago, described a Mesembryanthemum and a sluggish grasshopper, both protected, in the same locality near the Orange River, by resemblance to rounded stones. Examples of cryptic and mimetic resemblance are of course extremely rare among plants as compared with animals, but are of great interest.

It may be doubted whether 'camouflage' is a convenient name for so comprehensive a subject, including the most varied uses of colour and pattern in the animal kingdom, together with the discussion of their evolution. The word originated in the military operations of mining and countermining, when the discharge of a smoke-cloud (*camouflet*) was employed to suffocate the enemy. The next step was the use of the smoke-cloud above ground as a screen, and from this the meaning of 'camouflage' was extended to cover all methods of concealment and also the appearances by which an enemy may be misled in judging of speed and direction. Camouflage in its original meaning would be applicable only to such protective devices as the discharge of the Bombardier beetle or the inky cloud of the Sepia, but its extended meaning may be fairly held to include all methods of concealment and Batesian mimicry. The inclusion of Müllerian mimicry is doubtful, while warning coloration is opposed to the whole conception of camouflage, as are also the epigamic colours and modes of display, which the author, with his long and intimate knowledge of birds, discusses with so much insight and learning.

The coloration of desert animals, discussed by Buxton in a recent work, is treated by the author in Chap. ix., where he reaches conclusions in entire agreement with those of Canon H. B Tristram in his paper on the birds of the Sahara published in the *Ibis* for October 1859, a few weeks before the appearance of the "Origin of Species" The foundation of Canon Tristram's belief, clearly expressed in his words at this date, is of great importance in the history of evolution: "Writing with a series of about 100 larks of various species from the Sahara before me, I cannot help feeling convinced of the truth of the views set forth by Messrs. Darwin and Wallace in their communications to the Linnean Society. . It is hardly possible, I should think, to illustrate this theory better than by the larks and chats of North Africa." It is of much interest to learn that, after all the changing opinions and conflicting beliefs of well-nigh seventy years, the author builds, as Canon Tristram did, on the foundation laid by the Darwin-Wallace essays of July 1, 1858.

The confident assertions of those field naturalists who maintain that colour and pattern are of no great significance in the struggle for life, are keenly criticised, as are also the extreme opinions of the opposite school of thought. In discussing these subjects, the essential importance of behaviour in co-operation with colour and pattern is strongly emphasised. The criticism of F. C. Selous's suggestion that the leaf-like under surface of the African butterfly, *Precis artaxia*, has "more probably been produced by the influence of its environment than by the need for protection" (p. 6), would have been strengthened by pointing out that it is only the dry season form of this insect which is leaf-like, and that it produces, in the more abundant insect-life of the wet season, strongly marked eye-spots which presumably divert attack from the vital parts The description of our own wonderfully concealed Comma butterfly (p. 105) might have been improved by reference to the meaning of the *C*—the light coming through a curved crack in a weather-beaten leaf—and to Dr. R. C. L. Perkins' recent observation that the edges of the wings diverge in the attitude of rest. The author states that the Comma lies over on one side when at rest, but this is not my experience, although true of the Green Hairstreak and the leaf-like Satyrine *Melanitis leda* and doubtless many other species. Furthermore, the larvæ of the Large and Common Emerald moths are not like bits of grass but resemble respectively the catkins and the twigs of their food-plants.

Although the value of the caddis-worm's case cannot be doubted, it is too much to assume that "when at rest they defy detection by even the hungriest fish" (p. 116). I have seen the stomach of a blind trout unable to capture insects on the surface, entirely filled with these case-bearing larvæ, presumably detected by the senses of smell and touch.

Concerning the okapi, mentioned on p. 89, it would be very interesting to learn whether observations o the living animal would confirm a suggestion made to me many years ago by my friend Sir Ray Lankester—that the dark chestnut of the upper part is procryptic among the shadows of thick foliage, and the striped lower part of the legs procryptic (like the coat of the zebra) in a stronger light below the branches.

The history of the classical discovery of mimicry in the African *Papilio dardanus* is not quite as described on p. 151. By careful analysis, and comparison of the patterns of the females in Madagascar, and, so far as they were then known, in Africa, Roland Trimen revealed "the true state of affairs." He was at first disbelieved by Hewitson and Westwood, but they were soon converted—Hewitson by receiving a Wes African mimetic female *in coitu* with the non-mimetic male, Westwood by receiving from Mansel Weale the mimetic females and non-mimetic males bred from wild larvæ collected in the same spot in South Africa Families with the different forms reared from the eggs of a single female were only obtained much later.

Mullerian mimicry is illustrated by a coloured plate (opposite p. 152) reproduced from Punnett's work Five species of Heliconius are here represented in a left-hand column and five species of the Ithomiine genus Mechanitis in one to the right. The Ithomiinae have undoubtedly acted as models for the Heliconinæ, a fact which would have been more clearly conveyed if the position of the columns had been transposed. Furthermore, the species of another Ithomiine genus, Melinaea would have provided a better illustration of the principle, the Heliconines being of about the same size and presenting a closer likeness to the Melinaea patterns than to those of Mechanitis It should, moreover, have been pointed out that each of the five pairs—Ithomiine model and Heliconine mimic—belongs to a different association, characteristic of a different part of tropical America.

The significance of the markings within and at the corners of the mouth of certain nestlings is discussed and illustrated on pp. 185-188, and the interesting conclusion reached that they serve as guides to the parent birds in feeding their young.

Mr. Pycraft's book is very well illustrated with thirty-six plates, of which four are coloured. The references to these are insufficient, and it would be an improvement in future editions to number the plates and thus facilitate co-ordination with the text. The index is also very inadequate for a work so full of interesting detail. The following errors in spelling require correction: Mosely for Moseley (p. 14), Fort Hail for Fort Hall (p. 83), *prideuxi* for *prideauxii* (p. 115), *Danias* for *Danais* (p. 151), Swinnerton for Swynnerton (p. 168), *jacobae* for *jacobaeae* (p. 172), Weissmann for Weismann (p. 255), *Eudromis* for *Endromis* (p. 258), *Acentrophus* for *Acentropus* (p. 259), Bombysid for Bombycid (p. 260). Again, in the description of germ-plasm as the "stuff of which living bodies are made," 'of' has, probably accidentally, been substituted for 'from.'

Although many corrections and some additions are required, which, it is hoped, will be provided in the near future, the book is an excellent introduction to a very large and complex subject and, with its wise and well-balanced treatment of many controversial subjects, is especially welcome at the present day. E. B. P.

The Aurora Borealis as observed from Norway.

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 4, No. 7: *Résultats des mesures photogrammétriques des Aurores boréales observées dans la Norvège méridionale de 1911 à 1922.* Par Carl Størmer. Pp. 108+48 planches. (Oslo: A. W. Broggers Boktrykkeri A/S., 1926.) 12 kr.

IT is fortunate for our knowledge of the aurora that, although the regions of most frequent auroræ are mainly polar seas or cold and sparsely populated lands, they border on the country of Norway. The population of Norway is small, less than half that of greater London, but the level of culture is high, and the intellectual activity and distinction are manifested in no branch of study more signally and appropriately than in auroral investigation. Much the greater part of our exact knowledge of auroræ is due to Norwegians, among whom, though many have made valuable contributions, two are pre-eminent, Birkeland and Størmer. The generally accepted theory of auroræ, incomplete but successful in explaining a large range of facts, was originated by Birkeland, who supported his hypothesis by numerous experiments. The extent to which these bear on the actual terrestrial case is not always clear, however, whereas Størmer's mathematical development of Birkeland's theory gives incontestable proof of its soundness in essentials. But, in addition to their theoretical researches, both men have been great observers, and have organised important expeditions for auroral or magnetic investigation, or both, to regions within the Arctic circle.

Størmer's share in auroral observation has been of outstanding importance. The photography of auroræ was put on a workable basis by him, and he first achieved clear and indisputable success in the determination of the height of auroræ, though the task had previously been attempted by visual observation. For his purpose simultaneous photographs of the aurora from two or more stations connected by telephone are necessary, and from 1911 to the present time he has organised such observations, directing them himself from the base station. Initially this was at Oslo, where he is professor of pure mathematics in the university; since 1916 it has been at Bygdö, a suburb of Oslo. In addition he has made expeditions to Bossekop, in the far north of Norway, on the border of the zone of maximum auroral frequency as determined by Fritz; in 1913 he took numerous photographs from Bossekop and a neighbouring station. In 1914 Vegard and Krogness conducted similar work in the same region, and for these two years there are consequently independent (and concordant) sets of observations of the position of the aurora in space. The results of these two expeditions have already been published by the Norwegian Academy of Science in its "Geophysical Publications" instituted a few years ago. The results of the observations made or organised by Prof. Størmer in middle Norway from 1911 to 1922 are now issued in the memoir under review. Like its predecessors, it is handsomely illustrated by photographs and diagrams.

The period covered by the volume is twelve years, but during four years (1912–1915) no photographs were taken (apart from those at Bossekop, already published). These were years of minimum frequency of auroræ, and moreover the watch on the sky was less close than later, when Prof. Størmer changed his residence from Oslo to a house at Bygdö, whence there is a clear view down to 3° or 4° above the northern horizon. During 1920–22 watch was kept every night either by himself or his assistant.

In the remaining eight years, photographs were taken on thirty-five nights in all, namely, two in 1911, and 1, 4, 8, 8, 4, 6, 2 in the respective years 1916 to 1922. This number may seem small, but is explained by the difficult conditions of auroral observation; sufficiently bright auroræ do not occur every night, of course, and even when they do occur, clouds and bright moonlight limit the possibility of photography, though without in all cases precluding it. Further, apart from the difficulty of organising a watch every night and the occasional failure of telephonic communication, photography is practically limited to the winter and equinoctial months, since in midsummer the sun is only a few degrees below the northern horizon even at midnight. The actual distribution of the 35 nights of observation between the twelve months of the year (beginning with January) is as follows: 1, 5, 7, 6, 1, 0, 0, 2, 2, 7, 3, 1—a series in which the greater frequency of auroræ near the equinoxes makes itself apparent. Auroræ were of course observed on other nights but not photographed. The great majority of photographs were taken between 10 P.M. and 1 A.M., observations both before and after midnight being made on ten nights. The exposure of the photographs varied from a second to about two minutes, in general being a few seconds.

By notices inserted in the press, Prof. Størmer gained offers of assistance and was thus able to establish substations for co-operation with his own station at Oslo or Bygdö. The administration of telegraphs and telephones placed telephonic lines between these stations at his disposal during auroræ. The stations were separated by distances which ranged from 25 to 250 kilometres. Eleven stations were established for a greater or less period, but four seems to have been the greatest number working at one time; 304 sets of simultaneous photographs were taken from two stations, or in a few cases from three. In addition there were 189 photographs taken from one station only.

To obtain trigonometrical parallaxes and precise heights and positions of the auroræ, it is necessary, of course, to have pairs of simultaneous photographs of the same aurora, with star images also showing on the plates, to give indication of direction; the aurora itself must have sufficiently definite features for the same points to be identifiable on the two plates. In other cases, and when only a single photograph of an aurora is available, all that is possible is to estimate the geographical position and vertical extent of the aurora, by making probable assumptions about the height of its lower edge.

The lower limits of the auroræ observed from Oslo were mostly at about 100 km. height, but heights so low as 80 or 82 km. were observed in a few instances. The observations made at Bossekop gave 107 km. as the most frequent lower limit, and about 87 km. as the minimum. The more southerly auroræ thus appear to penetrate more deeply into the atmosphere, an observation which is doubtless connected with the fact that the aurora appears the farther south the greater its intensity. Again, the auroræ observed from Oslo are much the greater in vertical extent, the upper limit of height (about 800 km.) being roughly twice as great as at Bossekop. This difference seems to be associated with the relatively frequent appearance at Oslo of auroral rays as compared with other types of auroræ. Most of the Oslo photographs are of auroral rays (including draperies, coronæ, and striated arcs), whereas at Bossekop rays were relatively few; possibly the latter was partly due to 1913 being a year of minimum auroræ, for the Oslo observations indicate that rays are more frequent and pronounced the greater the intensity of auroral (and magnetic) activity. During the great display of March 22-23, 1920, the rays attained astonishing heights, and their bases also were far above the ordinary lower limits of height, being in some cases at a level of 400 km.

At Oslo draperies and vertically striated arcs are the most luminous forms of auroræ, and moreover the least elevated, their bases being sometimes at heights less than 85 km. Their vertical extent also is small, often only 10 or 12 km., and rarely more than 100 km. Homogeneous arcs were often observed from Oslo, generally to the north or near the zenith, and often forming the southern limit of all the auroræ visible at the time; more rarely they appeared to the south, persisting unchanged for half an hour or more, with no other aurora visible. Another rare type of arc was pulsating; this also was observed alone in the sky. The homogeneous arcs are often of great lateral extent, sometimes stretching right across the sky from the eastern to the western horizon; in such cases their length must be of the order of 1000 km. Maps are given, showing the geographical position of the measured points of auroræ; the arcs lie predominantly nearly along the circles of magnetic latitude (centred at the pole of the earth's axis of magnetisation), and are inclined at about 10° to the circles of geographical latitude; their centre of curvature is slightly to the north of the magnetic pole. The magnetic colatitude of the arcs observed from Bossekop and Oslo varies from 21° to 34°, that of Oslo itself being 30°. The colatitude of the arcs was notably greatest on the days of great magnetic activity, being, for example, 34°, 32°, and 33° respectively on March 22-23, 1920; May 13, 1921; and Dec. 16, 1917.

Sixty-one photographs of auroral coronæ are included in the series, and these enable the direction of the auroral rays to be determined to within 1° or 2°. The results show surprisingly little variation, and the mean direction is less than 1° different from that of the magnetic force at Oslo (dip 71°, W. declination 9°). The rays therefore lie almost exactly along the lines of force of the earth's magnetic field.

Besides the maps already mentioned, the volume gives full details of the photographs, and of the stars and measured points of auroræ appearing on them, both by tables and diagrams, and there is a series of interesting descriptive notes about the auroræ and conditions of observation on each night. There are also 96 beautiful reproductions of the photographs, including many simultaneous pairs, enabling the auroræ to be viewed stereoscopically. The auroræ are situated mainly over Norway and the North Sea, in some cases near to Ireland and Scotland.

Prof Størmer directs attention to the desirability of similar observations elsewhere, mentioning the Antarctic regions in particular. To the reviewer it seems even more useful to gain as detailed information as possible about one auroral zone, by observations in the British Isles, northern Canada, Greenland, Iceland, and other northern lands, simultaneous with those in Norway. The magnetic colatitude of Aberdeen, for example, is the same as that of Oslo, and there is great scope in northern Scotland and northern Ireland for a band of skilled amateur photographers working on the lines initiated by Prof. Størmer. He himself is continuing his observations in Norway, and since 1922 has obtained 250 further photographs which are now being studied.

S. CHAPMAN

Official Publicity for Agricultural Research.

Ministry of Agriculture and Fisheries. Research and the Land. an Account of Recent Progress in Agricultural and Horticultural Science in the United Kingdom. By V. E. Wilkins. Pp. xiv + 388 + 34 plates. (London: H.M Stationery Office, 1926) Paper, 2*s*. 6*d* net; cloth, 3*s*. 6*d*. net.

EVEN when they forsake their opprobrious blue and appear in hodden-grey, the publications of H.M. Stationery Office have but a feeble appeal to the lay public, but this book—in the words of the Minister of Agriculture, "not exactly a popular account" of agricultural research, but "at least one which with little trouble an educated farmer or even townsman might understand"—is in a different category. Its success as an appeal to the lay press has been undoubted, and deservedly so, for it is written in an attractive style, is profusely illustrated, and, as a whole, makes a good journalistic story. Much of the matter embodies results already familiar to readers of NATURE through the medium of recognised scientific journals, which it would be tedious to notice in any detail here. A novel feature of this publication, however, is the account which it gives of new work in progress, and even of the speculations and hopes of the workers engaged on it.

It is a commonplace of scientific work that progress can only be won at the cost of many fruitless endeavours, and in admitting the lay public to their confidence the workers concerned take their courage in both hands. On the other hand, these confidences should prove of great and even stimulating interest to workers on the same subject elsewhere. By elsewhere we mean primarily other countries; but as the book discloses, there must be a great want of jointly-shared knowledge even in Great Britain. To take one example, we find that research on 'sourness' of soil is proceeding (and on diverse lines) at various centres in Britain. There is no subject more likely to attract the interest of farmers than this, for by common consent the agricultural land of England, speaking generally, has exhausted the stores of lime so generously provided by the improvers of the nineteenth century. No economical means of replenishing the soil are in sight; and how little can the man of science satisfy the farmers' thirst for guidance! For, as it happens, the fundamentals of scientific knowledge on this subject appear to be in process of readjustment. The facile certainties of the last century have been abandoned, and the use of such new tools as hydrogen ion concentration, base exchange, and colloid chemistry is still not fully learned. Whether co-ordination—blessed word—would help is, as we know, a matter of controversy: some workers appreciate team work, some would rather hug their souls in solitude. Incidentally, an example of happy team-work is given in Mr Wilkins' book, namely, that carried on by the Rowett Institute in Aberdeen in association with the University of Cambridge, on animal nutrition. But State-supported research workers, at any rate, should recognise that co-ordination is desirable.

The publicity given by such books as this is, however, the price that departments dominated by a democratic Parliament must pay even if that body has still to learn what a 'gamble' (from an economic viewpoint) scientific research must always remain. But it would be unfair to the author of the work under notice to lay the burden of such considerations upon him. He has performed his allotted task with distinguished ability, and has earned, we trust, the gratitude of his superiors.

Our Bookshelf.

A Manual of Hygiene. By Sir William H. Hamer and Dr. C. W. Hutt. Pp. xi + 821. (London: Methuen and Co. Ltd., 1925.) 30*s*. net.

THIS manual is designed to meet the requirements of those seeking to obtain a diploma in public health, though at the same time the authors take the opportunity of referring to most questions now uppermost in public health work. A few of the chapters have been contributed by writers having special knowledge of the subjects dealt with, *e.g.* tuberculosis and sanitary administration and law, by Dr. James Niven; school hygiene, by Dr. Kenneth Fraser; venereal disease, by Mr. Kenneth Walker; chemical disinfectants, by Dr. Wynter Blyth; and air, by Dr. King Brown. The arrangement of the matter and contents of the chapters follow well-known lines and present little or no novelty. The book is well produced, is illustrated with 94 figures in the text, and is very readable.

The book is exceptionally complete, and the information is accurate and up-to-date. Thus, the vitamins are adequately considered, the possible influence of deficiency of iodine in the production of goitre is mentioned, the life-histories of the various parasites are correctly given, and the causation of rickets is particularly well discussed. In addition to the diseases of Great Britain, several tropical diseases are also described, *e.g.* sleeping sickness, leishmaniasis, undulant fever, and others, and in all cases the information given appears to be accurate.

Here and there, perhaps, a section might have been extended or differently worded with advantage, but on the whole there is singularly little to criticise. We miss any reference to the Owens' instrument for the determination of atmospheric pollution, and manganese poisoning does not seem to be mentioned. Chlorination of water is somewhat briefly dealt with, and in the excess lime method of purifying water the unlimed water finally added is described as 'untreated,' whereas this should have been first purified by long storage. Under filter candles (p. 137) the reference to "Bullock and Crow" should be "Bulloch and Craw." Under "Vital Statistics" we question the value of introducing the complicated subject of life tables (though we are aware that it usually appears in public health text-books) and consider the space might be better utilised. The index might be somewhat extended with advantage.

We consider that this book gives an adequate presentation of present-day public health work within the limits imposed, and can recommend it to the student with confidence.

General Physics for Students: a Text-Book on the Fundamental Properties of Matter. By Edwin Edser. Reprinted, with additions. Pp. ix + 676. (London: Macmillan and Co., Ltd., 1926) 8*s.* 6*d.*

THE merits of this well-known text-book are sufficiently attested by the demand for a fourth issue. It should not, however, be allowed to pass without renewed recognition that there exists no other text-book dealing so thoroughly with mechanics, elasticity, surface tension, hydrodynamics, and kinetic theory, without mathematical aid more advanced than elementary algebra and trigonometry.

The new portion is of a different character from the rest of the book, being an appendix on surface tension, embodying the author's recent researches. The most important part is a calculation of the surface tension and internal pressure for assemblages of molecules attracting according to some inverse power of the distance. The difficulties of applying the calculus of continuous functions to molecules comparable in size with the range of attractive forces, are overcome by estimating the probable number of centres of molecules within an infinitesimal region of space, and integrating. The assumptions seem legitimate, at any rate as a first approximation for more or less symmetrical molecules; the conclusion is reached that the attractive force varies as the inverse eighth power of the distance, and that nearly all the surface energy is resident in a single layer of molecules.

There is a good deal of miscellaneous information on capillarity, and though the author's avoidance of the modern view which ascribes the phenomena to the surface properties of the molecules—that is, their chemical properties—and takes account of their motions and orientations according to kinetic theory, probably leads to incorrect explanations in some cases, it is an excellent thing to have Mr. Edser's long-considered views set forth in a convenient form. It may not be long before the obscure points are cleared up, with much advantage to both points of view.

N. K. A.

Lehrbuch der physiologischen und pathologischen Chemie in 75 Vorlesungen: für Studierende, Ärzte, Biologen und Chemiker. Von Prof. Dr. Otto Fürth. Zugleich zweite völlig neubearbeitete und erweiterte Auflage der "Probleme der physiologischen und pathologischen Chemie." Band 1: *Organchemie.* Lieferung 1: *Bausteine der Organismus—Blut.* Vorlesung 1 bis 16. Pp. xiii + 208. (Leipzig: F. C. W. Vogel, 1925.) 15 gold marks.

IT is fifteen years since the first edition of this work was published and the text has required drastic revision. The complete work will consist of two volumes, each divided into three parts of about 200 pages. The present part contains accounts of the chemistry of the proteins, fats, and carbohydrates, and also of the blood and lymph. The treatment of the more purely chemical side of materials of physiological significance appears full, yet concise and up-to-date The chapter on blood serum is considerably condensed, especially on the subject of the hydrogen ion concentration, but fuller treatment can, of course, be obtained from special monographs. The account of the gases of the blood is reserved for a later part. There are copious references to the literature, structural formulæ are given in detail, and the paper and printing are of the best. Altogether the volume is a most useful work on this branch of chemistry.

Fishery Board for Scotland. Scientific Investigations, 1926, No. 1: *Rays and Skates; a Revision of the European Species.* By Dr. Robert S. Clark. Text. Pp. 66 + 15 plates. 9*s.* net. Plates. Pp. iii + 36 plates. 5*s.* net. (Edinburgh and London: H.M. Stationery Office, 1926.)

THE increasing importance of rays and skates as marketable food-fishes emphasises the need for a greater knowledge of their life-histories than is at present available. Dr. Clark's revision of the European species is therefore a most welcome monograph. In this work, which represents several years of patient labour in a trying task, twenty-three species are separately described and finely illustrated by beautiful photographs, and in each case a full discussion on the troublesome matter of nomenclature is given. It would have been rather more convenient for the reader if the successive sections of the text had been more clearly indicated by the use of appropriate type; in its present form the text is a little confusing. This monograph, used in conjunction with Dr. Clark's earlier account of the egg-capsules and young (*Jour. Mar. Biol. Assoc.*, vol. 12, No. 4, 1922), should prove of the greatest assistance to workers for the identification of their material.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Luminescence from Solid Nitrogen, and the Auroral Spectrum.

IN NATURE of September 18 and 25, McLennan and his collaborators have published statements regarding the origin of the auroral spectrum which call for some remarks. Dealing with the N_2-band from solid nitrogen, they confirm the result which I published in June 1925, showing that N_2 consists of a number of components. Applying this to the auroral problem they say (p. 409):

"Since no band of anything like this character has ever been shown to be a feature of the spectrum of the aurora, in the neighbourhood of λ5230, it would appear that Vegard's theory that finely divided solid nitrogen exists in that portion of the upper atmosphere where auroral displays originate is not tenable."

Now according to my experiments the structure of the N_2 band varies considerably with experimental conditions, and we cannot yet tell which structure corresponds to the conditions which, according to my view, exist in the auroral region. But even if we had experimented under comparable conditions, we cannot make any comparison with the auroral spectrum for the simple reason that we do not know anything about the structure of the auroral line (or group of lines) at λ5230 Å U. This line has never been obtained on spectrograms, although I have tried with spectrographs of small dispersion and very high illuminating power, but has merely been observed with spectroscopes of small dispersion and by using a broad slit. *Under these conditions also the N_2 band would appear as a line.*

Thus our present knowledge of the auroral line 5230, *as well as the present state of the experimental conditions for obtaining N_2, do not enable us to compare the structure of N_2 with that of the auroral line* 5230.

The identification of the auroral line with an oxygen line observed by McLennan under certain special conditions seems to be in contradiction to observed facts. Thus

(1) The line is a spark line, while the auroral spectrum from blue to ultraviolet is a nitrogen *band* spectrum.

(2) The density required to obtain the line is 10,000-100,000 times greater than that present in the auroral region.

(3) The excess of inert gases necessary to enhance the line does not exist in the auroral region.

(4) No other oxygen lines, or lines of the inert gases, are observed in the auroral spectrum.

(5) If light gases are dominant in the upper atmosphere, nitrogen must also dominate greatly over oxygen, and at altitudes of 500-600 km. the amount of oxygen should be negligible. All the experimental evidence we have at present shows that all oxygen lines are greatly suppressed by the presence of nitrogen.

(6) McLennan obtains approximate coincidence of wave-length of a single line, but fails to interpret the whole type of spectrum shown by the aurora, *and his interpretations would involve a spectrum quite different from that of aurora.*

On the other hand, my continued experiments with solid nitrogen have shown that solid nitrogen gives the whole typical auroral spectrum from red to ultraviolet. Regarding the auroral line 5577, I have been able to show that the band N_1—in accordance with the consequences of my theory—is contracted and displaced when the nitrogen particles are diminished. A neon layer is found to have no specific influence on N_1, and if the nitrogen particles are diffused into neon, the N_1 band by diminution of the nitrogen concentration approaches a position which within the limit of experimental error coincides with the auroral line. For small concentration (*c*) the position is given by the following expression determined by the method of least squares:

$$\lambda = 5577{\cdot}56 - 0{\cdot}8754c.$$

L. VEGARD.

Physical Institute, Oslo,
October 29.

Properties of High Frequency Radiations.

IT is impossible to state accurately the properties of high frequency radiation (wave-length $<0{\cdot}02$ Å U.), for we have no exact knowledge of the variation, with wave-length, of the intensity and distribution of scattered radiation. We have good reason for believing that the intensity of the radiation scattered by an atom is, on an average, proportional to its atomic number, and that the distribution becomes more and more asymmetrical as the frequency increases. I have found that a formula of Dirac's (*Roy. Soc. Proc.*, A, 3, p. 405, 1926) fits some of the results obtained by Mr. H. M. Cave and myself in a series of experiments on the γ-rays of radium better than any other so far put forward. It may be stated that the best way to test this formula will be to examine the distribution of scattered radiation.

Owing to scattering, there is a tendency for γ-rays to become less penetrating as they pass through matter (see Gray, *Phil. Mag.*, 26, p. 611, 1913, and Oba, *Phil. Mag.*, p. 601, 1914). This is shown by the following experiment. γ-rays from radium, initially filtered through 2·2 cm. of lead, passed through a conical hole in a lead block, the hole having an average diameter of 1·9 cm. and a length of 20 cm. These rays were examined by absorption plates of brass and lead. An electroscope was placed one inch above the lead block. From the readings, what may be called the apparent mass absorption coefficient μ'/ρ (to distinguish it from the true coefficient μ/ρ) could be obtained. μ'/ρ was not constant but, owing to scattered rays having a greater wave-length, increased in 2·28 cm. of brass from 0·0208 to 0·0287, and in 2·06 cm. of lead from 0·034 to 0·041. The true coefficients were (μ/ρ) brass $= 0{\cdot}0470$ and (μ/ρ) lead $= 0{\cdot}0560$; μ'/ρ is greater for lead, mainly because of the greater fluorescent absorption. As the thickness of absorbing material is increased, in each substance a state will be reached after which (μ'/ρ) will have a constant value which will be about 0·037 for brass and 0·043 for lead. If the rays for which (μ'/ρ) brass $= 0{\cdot}037$ were examined by lead 4·8 cm. thick and water of corresponding thickness, it would be found that the respective values of μ'/ρ were about 0·046 and 0·040. These values have been obtained by rough calculations from known data. It will be seen that there is not a great deal of difference between the absorption in brass, lead, and water.

The most penetrating γ-rays we could use were obtained by filtration through lead plates placed at appropriate distances in the conical hole. For these rays (μ/ρ) copper was equal to 0·0443 and (μ/ρ) lead 0·0472, so it is not possible to obtain much further information in this way about the effect of scattering on apparent absorption coefficients. It seems certain, however, that, as the primary frequency increases, the differences in apparent absorption in water and lead will diminish. Indeed, as water contains more electrons per unit mass, it is to be expected that the apparent absorption per unit mass will ultimately be greater in water. In any case, maximum values of μ'/ρ will diminish as the frequency increases, and judging from the above experiment will not be greater than the corresponding initial values of μ/ρ. In particular, if we assume Dirac's formula to be the correct one, (μ/ρ) air for rays of wave-length 0·0004 Å.U. will be equal to 0·00236, and if such rays enter the earth's atmosphere, μ'/ρ will increase, but at any depth below, water will absorb the rays just as much as lead, μ'/ρ for both substances being not greater than 0·00236.

Dr. Millikan has recently put forward the view that a cosmic radiation of wave-length of the order of 0·0004 Å U. is the primary cause of the ionisation observed in closed vessels, the effect of γ-rays and other disturbing causes being accounted for. If this were true, I should expect 4·8 cm. of lead to reduce the ionisation only 12·1 per cent (taking $\mu'/\rho = 0{\cdot}00236$). Millikan and Otis, however, found that on Pike's Peak the number of ions per c.c. dropped from about 12·5 to 4·28 when their electroscope was shielded by 4·8 cm. of lead, a reduction in intensity of 56 per cent In obtaining these figures I have made allowance for ionisation due to radiation from the walls and external radioactivity. It will be found that (μ'/ρ) lead $= 0{\cdot}0194$ On the other hand, Millikan and Cameron found that for these rays (μ'/ρ) water varied from 0·0030 to 0·0018, values agreeing with the view that the ionisation is due to rays of the wave-length assumed above The comparatively large value of (μ'/ρ) found for lead, however, is not in agreement with this view and cannot, I believe, be accounted for by any of the following factors which I have not hitherto allowed for:

1. Scattered rays can enter the electroscope from the air and earth below it, and are more absorbable in lead than water.

Some years ago I found that the ionisation in an electroscope was increased only 12 per cent. by placing a block of graphite, thick enough to give the maximum effect, directly below the source of radiation, namely, radon contained in a glass tube. This percentage increase will diminish as the primary frequency increases, and so can have very little effect on the absorption by lead. It should be noted that scattering materials of low atomic number will produce a greater increase in ionisation than materials of high atomic number.

2. Secondary β-rays will produce X-rays which will be more absorbable in lead than light substances.

Our knowledge of the properties of such X-rays is rather fragmentary, but, so far as they go, experiments indicate that the intensity of these X-rays produced in lead screens will more than compensate for the absorption in the screens of X-rays produced outside them.

3. Secondary β-rays produced outside the electroscope may have sufficient energy to enter it. Such β-rays would be absorbed by the lead screen.

This absorption by lead will be compensated by the production of secondary β-rays in the lead. Experiment indicates that the ionisation produced in closed vessels by rays of high frequency tends to increase with the atomic number of the material of which the vessel is made.

From what has been stated above, it would appear that no conclusive evidence has been found to prove the view that the radiation causing the ionisation in closed vessels is a cosmic radiation of high frequency. It is possible to explain some of the properties of the radiation by assuming that it consists of electrons of very high energy, which, in passing through atoms, 'collide' sometimes with their nuclei and thereby lose energy. There are certain difficulties in the way of obtaining a complete explanation by this means. I should like to suggest that a great deal of light would be thrown on the problem by carrying out experiments with closed vessels of different materials surrounded by different screens of variable thickness.

An account of our experiments and of some of the views given here was presented at the annual meeting of the Royal Society of Canada. J. A. GRAY.

Queen's University,
Kingston, Ontario,
October 23.

The Size of the Iodine Molecule.

IN a recent paper (*Jour. Amer. Chem. Soc.*, October 1925) E Mack has calculated the cross-section of the iodine molecule from the results of his experiments upon the rate of diffusion of iodine in air; the result of the calculation is a value agreeing closely with the figure given by Prof. A. O. Rankine ($15{\cdot}6 \times 10^{-16}$ cm.^{2}). But the agreement would seen to be accidental, and to arise from two circumstances: (1) Mack's experimental result for the diffusion coefficient is about 30 per cent. too large. (2) The method employed to calculate the cross-section is illegitimate

With regard to (2). Mack calculates the 'radius of the iodine molecule' from "the Stefan-Maxwell-Jeans equation," which is actually the formula given by Jeans as a result of correcting Meyer's formula for diffusion for persistence of velocities in a collision. This formula at best gives only the value of S, the distance of the centres of the molecules in an average collision at the temperature of the experiment, S is therefore the sum of two 'effective molecular radii,' and varies with temperature in so far as the diffusion coefficient ($D \propto T^x$) is variable with temperature according to an index which exceeds ½. Mack, however, obtains the 'radius of the iodine molecule' by subtracting from S the figure $1{\cdot}542 \times 10^{-8}$, which is taken to represent the radius of the average air molecule. But this figure is calculated from viscosity data by introducing a term containing the Sutherland constant, and refers to the actual radius of the molecule (on the assumption that it behaves as an elastic sphere exerting an attractive force) and not merely to the radius which is effective in collision. This 'actual' radius is thus invariant with temperature.

Measurements of the diffusion coefficient of iodine vapour in air have been carried out by me for another purpose; at 25° C and 760 mm. pressure, the mean value is $0{\cdot}0815 \pm 1$ per cent., instead of Mack's result, $0{\cdot}108 \pm 1{\cdot}2$ per cent.

I have attempted to compare this new value with Rankine's experiments on the viscosity of iodine vapour. For this purpose it is necessary to estimate the viscosity at 25°, calculation by means of the Sutherland constant $C = 590$ is obviously unjustified, but the extrapolation has been made by assuming that the viscosity can be expressed by $\mu \propto T^x$; the value of x obtained from the highest and lowest temperatures employed by Rankine is $x = 0{\cdot}9837$, and the corresponding value for the viscosity at 25° is $\mu = 1{\cdot}388 \times 10^{-4}$. Then the effective radius is calculated by Chapman's formula for viscosity, and comes out to $\sigma_{I_2} = 3{\cdot}656 \times 10^{-8}$ at 25°. Similarly, the effective radius of the average air molecule is $\sigma_{air} = 1{\cdot}86 \times 10^{-8}$ at 25°.

If it is assumed that the effective radius in collisions of like molecules is also appropriate to the collision of unlike molecules, then the average distance apart of the centres of an iodine molecule and an air molecule in collision would be $(\sigma_{I_2}+\sigma_{\text{air}})=5{\cdot}516\times 10^{-8}$ as calculated from viscosity data On the other hand, the diffusion coefficient $D=0{\cdot}0815$ enables the quantity $(\sigma_{I_2}+\sigma_{\text{air}})$ to be calculated from Chapman's formula for diffusion :

$$(\sigma_{I_2}+\sigma_{\text{air}})^2=\frac{3\sqrt{\bar{c}^2_{I_2}+\bar{c}^2_{\text{air}}}}{32\pi\rho D}.$$

The value of $(\sigma_{I_2}+\sigma_{\text{air}})$ at 25° is found to be $4{\cdot}783\times 10^{-8}$. If we subtract $1{\cdot}86\times 10^{-8}=\sigma_{\text{air}}$, we have $\sigma_{I_2}=2{\cdot}923\times 10^{-8}$ at 25°, as calculated from the diffusion coefficient This is considerably smaller than the value $3{\cdot}656\times 10^{-8}$ calculated above from Rankine's viscosity data

The discrepancy is in the same direction as that found with gases, but is rather greater in magnitude, as is to be expected for a vapour

Calculation of the actual molecular radius (*i e* of the attracting elastic sphere model) from diffusion data is admittedly unsafe, even for comparatively permanent gases In the case of iodine the corresponding calculation from viscosity data would seem to be open to some question; the specific heat of iodine vapour is changing rapidly at the temperature of Rankine's experiments, presumably owing to a progressive increase of vibrational energy; this might be expected to affect somewhat the value of the Sutherland constant obtained from the temperature coefficient of viscosity. B. TOPLEY.

The University, Leeds

The Oogenesis of Lumbricus.

I TRUST that I may be allowed a small space in order to reply to certain criticisms of my work on *Lumbricus terrestris*, which have been made in a recent paper by Prof. J. B. Gatenby and Dr. V. Nath (*Q. J. Mic. Sci.*, 70, pp. 371-389, 1926)

In the first place I am accused of not referring to much of the literature on the subject. But much of the work which they cite as having been omitted was published after my paper had gone to press in the early summer of 1924, and Gatenby and Nath still ignore what Dr Cannon pointed out in his contribution to the previous discussion in these pages (NATURE, 116, 1925, p 97), that my work was more in the nature of a critique of the methods of argument used by this school, rather than of their observed results.

In the second place, my technique and powers of observation are called in question. The thread-like mitochondria in my preparations are stated to be "artefacts due to long exposure of the fresh ovaries to water of unsuitable tonicity, or to unsuitable fixation" The ovaries used for the work were not brought into contact with any fluid other than those of the worm itself before being transferred immediately into fixative. Further, Prof Cowdry states ("General Cytology," p 317, l 11) that in cell injury "first we often observe a breaking up of filaments into granules (this may also be induced by faulty technique). . . ." The point need not, I think, be laboured

Again, my critics "are at a loss to understand Harvey's difficulties in giving a clear account of the behaviour of the Golgi apparatus . . .," because of the favourable nature of the material used. In this connexion it is interesting to recall Nath's reference (*Pro. Roy Soc. Lond*, B., 98, 1925; footnote to p. 54) to this organ as being remarkable and representing Calkin's yolk nucleus. The latter structure has now been shown to consist of mitochondria.

To take one more criticism, they state that there is no yolk in the egg of Lumbricus at all, that I have mistaken degenerating Golgi bodies for yolk droplets and also for Calkin's yolk plates, which I found in all my preparations. I have re-examined my slides, and find that I cannot modify my former statements. The yolk plates, yolk droplets, and Golgi elements are present side by side in many preparations, and there can be no mistaking one for the other. There is, however, little yolk present compared with the amount found in many molluscs, ascidians, and arthropods, but perfectly distinct, yellowish droplets are present in many young oocytes, and these, in the older oocytes, become colourless.

Finally, Prof Gatenby and his school are content to accept the view that yolk is a general term covering anything in the cell which cannot otherwise be identified, and originating from all possible primordia. Is it not time that cytologists made some attempt to bring the observations on oogenesis to as orderly a state as are those on spermatogenesis? Possibly there will be found to be much minor variation, but the materials from which yolk is derived will, it is to be hoped, be reduced to two or at most three definite sources in the ovary.

L A. HARVEY.

Zoology Department.
University, Edinburgh.

Magnetic Storms and Wireless Communication.

IN the issue of NATURE of November 6, p. 662, Sir Joseph Larmor directs attention to the fact that during the magnetic storms of October 14 and 15, the Canadian beam signals were greatly reduced in strength The explanation that appeals to me is connected with the fact that ionic refraction is not the only factor which determines long distance short wave ($\lambda < 60$ m) transmission. Together with this there is the effect of energy absorption by collisions of electrons with molecules That this absorption plays an important part in transmission seems to me to be upheld by a considerable body of evidence, not the least of which is that afforded by the action of magnetic storms

The ionic absorption factor for the ray which traverses the ionised medium is well known to be $4\pi c/\rho$, where ρ is the effective resistivity (at the frequency concerned). This quantity can be expressed in the form .

$$\frac{1}{\rho}\propto\frac{Ne^2}{m}\frac{T^2}{\tau},$$

where T is the time period of the waves and τ the average time between successive collisions of an electron with a molecule or positive ion.

The essential point is that the absorption factor is proportional to N, the number of electrons per c c, a fact which is obvious from the physical consideration that the total energy drawn from the waves is proportional to the number of collisions, *i.e.* N.

We have only to suppose that there is an appreciable increase in N, due for example to the injection of charged particles or increased ionisation as a result of the solar activity, to account for the increased absorption and consequent decrease of signals during sunspot activity That absorption plays a very considerable part in long distance short wave transmission is evidenced by the fact that the range of a station in summer and in low latitudes is less than that in winter and high latitudes.

On the ionisation theory the numerical value of N will be greater in summer and at low latitudes than in winter and high latitudes. The range is therefore correlated with the value of N, decreasing as N increases, and vice versa. Reasonable values for $\bar{N}$ and T show that this factor $e^{-\frac{4\pi c}{\rho}}$ has an appreciable effect in transmission over distances greater than about 1000 km

At short distances the effect of increased bending, due to increased N, is most apparent. The strength of local stations received in England was considerably augmented at times during the magnetic disturbances.

T. L. ECKERSLEY.

Research Department,
Marconi's Wireless Telegraph Company, Ltd.,
Marconi Works, Chelmsford,
November 15.

Internal Rust Spot of Potatoes.

THE cause of sprain or internal rust spot on potatoes has long been a subject of speculation among mycologists, and the macroscopic resemblance of the disease to that of net necrosis, whilst adding to the interest of the problem, has still further increased its complexity. The disease is a very serious one in certain of the potato-growing areas in Yorkshire, and we have therefore been anxious to ascertain its true nature. A short preliminary announcement of the results of our investigation may be of interest.

Two organisms have now been isolated by my colleague, Mr. Sydney Burr, which in inoculation experiments have reproduced the disease in a very definite and characteristic way. The commonly accepted symptom of the disease is the appearance of rusty brown spots in the medullary and cortical parenchyma of the tuber which are closely invested by a thick layer of cork cells. It is now clear that in addition to this formation of disease 'islands,' the xylem of the vascular ring is frequently attacked, but in this case wound cork is not formed unless the adjoining cells of the pericycle are also involved. This xylem infection is sometimes invisible to the naked eye. So far as the infected tubers have been examined, it appears that the phloem bundles are not *directly* attacked, although ultimately they may be involved by the infection of the neighbouring parenchyma. Thus, net necrosis, which is primarily an infection of the phloem bundles, may now be definitely dissociated from rust spot disease.

Each of the organisms in question is an extremely short and motile rod which is cultivated on artificial media only with difficulty They thrive best in liquid media, and have been grown in peat soil extract and in nutrient potato broth. On soil extract agar, each organism produces minute dew-like colonies in seven to ten days, which, later, become steely blue in colour Slight growth has also been obtained on lactose agar and nutrient gelatine, and one of the organisms gives a poor thin growth on nutrient potato agar There thus appears to be no resemblance between either of the organisms and the two variants of *B. solaniolens* isolated by Paine from potatoes showing similar symptoms of disease.

Further attempts to define the organisms are now in progress, and it is hoped to publish a detailed account of this work in due course, together with an account of the field experiments which have been carried out with the object of ascertaining some possible remedy for the disease.

W. A. MILLARD.

Department of Agriculture,
University of Leeds,
November 12.

The Double Normal State of the Arc Spectrum of Fluorine.

IN an earlier paper (*Proc. R.S.*, Amsterdam, June 1926) I have made a preliminary analysis of the arc spectrum of fluorine. I found it possible to arrange all strong lines in the red part of the spectrum in multiplets. The following terms are recorded :

$^4P_{123}$ $\Delta\nu$ = 160·0 ; 274·5.
$^4D_{123}$ $\Delta\nu$ = 83·4 ; 144·4 ; 176·6. (This term was found by Carragan, *Astr. Jour.*, 63, 145, 1926.)
^4S
$^4P'_{123}$ $\Delta\nu$ = 102·1 ; 122·7.
$^2P'$ $\Delta\nu$ = 325·6.
^2P $\Delta\nu$ = 145·5.
^2S ?
^2D $\Delta\nu$ = 250 3.

The structure of the Fl I spectrum resembles that of N I (C C. Kiess, *Jour. Opt Soc., America*, vol. 11, 1, 1925) and O II (A. Fowler, *Proc R.S.*, London, vol 110, 476, 1926). Doublet-quartet intercombinations are not found in the red part of the spectrum. Millikan and Bowen (*Phys. Rev.*, 23, 1, 1924; *Phil. Mag*, 48, 259, 1924) have investigated the fluorine spectrum in the extreme ultra-violet. This spectrum has only two strong lines :

(7) 606·9 (Fine structure: 605·64 ; 606·23 , 606·83 ; 607·43 ; 607·99).
(5) 656·4 (Fine structure: 656·00 ; 656·34 ; 656·84 ; 657·69 ; 658·31), indicated as L_α.

The purpose of the present note is to identify the line 606·9 as a $^4P\,^2P'$ combination and the lines 657·69, 658·31, as a ^2P combination We assign one of the ^2P term differences 145·5 (expressed in volts, 0·02) or 325·6 (expressed in volts, 0·04) to the double normal state (*Grundterm*) of the fluorine atom. These values agree well with the value predicted by Franck (0·025 volt). More details will be given in a forthcoming paper in the *Zeitschrift für Physik*.

T. L. DE BRUIN.

Physical Laboratory "Physica,"
University of Amsterdam, September 21.

'Hard Seeds' in Leguminosæ.

WHEN offered ideal conditions for germination there commonly occur in seed of most cultivated Leguminosæ, seeds which do not absorb moisture and, in consequence, fail to swell up and germinate : they do not soften, and are therefore known generally as 'hard seeds.' This inability to absorb moisture endures for an indefinite period, extending possibly for many years, though ideal conditions for germination may be continuously or intermittently offered. The cause of 'hardness' has always been attributed to some peculiarity of the seed coat itself, largely because very slight damage, such as abrasion, enables the seed to behave in a normal way.

This summer, working with sweet peas and other legumes, I found good evidence for the belief that 'hardness' does not lie in the seed coat itself, but is the result of a varnish-like deposition on the seed surface, produced within and by the pod. On a nearly ripe but still green pod being opened, a quantity of watery fluid is found bathing the seeds, and, as ripening proceeds, this fluid becomes concentrated, so as to appear quite sticky on the fingers. It is suggested that this fluid, when fully concentrated, deposits the 'varnish' which on drying becomes insoluble in water and forms an impermeable film on the surface of the seed

The chemical nature of neither the fluid nor the film has, as yet, been investigated, but it is interesting to note that treatment with dilute sulphuric acid, even for a short period, causes 'hard seeds' to behave normally. Prolonged digestion with concentrated caustic potash, on the other hand, has no effect, though normal seeds are reduced to a gelatinous mass in some thirty minutes

The belief that hardness is not a characteristic of the seed coat, but is due to the deposition of an impermeable film during the last few days of ripening, offers a simple explanation of some facts long known to practical men. For example, 'hard seeds' occur quite promiscuously in any and every consignment, in some more, in others less, the nature of the weather just previous to harvest having a considerable effect on the number. Further, the best ripened seeds always contain most hard seeds.

I hope to proceed further and more critically with the work next summer, but the considerable commercial importance of the subject seems to justify this preliminary note. ALEXANDER NELSON.

Scientific Department,
David Bell, Ltd.,
17 Coburg Street, Leith,
October 26.

The Eggs of the Sucker-fish.

IN a letter on the eggs of the pilot-fish in NATURE of August 14, 1926, p. 228, Mr K. H. Barnard also mentions the eggs of the sucker-fish (*Echeneis naucrates*) "which are apparently still undescribed" During my researches on the eggs and larvæ of East Indian fishes (cf. *Treubia*, vol. 2, p 97; vol 3, p. 38; vol. 5, p 408; vol. 6, p. 297, vol. 8, p. 199, and vol. 9, p. 389), I also became acquainted with the pelagic eggs of the sucker-fish. They are very large, having a diameter of 2·5 mm. The yolk is colourless and fills up the egg membrane fairly well. It contains a small oil globule of a bright yellow colour, diameter 160 μ, and the developing embryo is yellow also, as a consequence of the presence of a large number of yellow pigment spots. Besides these yellow spots there are also black ones, especially on the head and behind the eyes. In due time I hope to give a figure of the egg in *Treubia*.

I have reared these eggs, isolated from the catches with the surface egg net, several times on board the investigation steamer *Dog*, in glasses with pure seawater. They invariably died, however, after some $2\frac{1}{2}$ days, about the moment of hatching. I counted 16 + 16 myotomes in an embryo freed artificially from the egg membrane, whereas *Echeneis naucrates* has 14 + 16 vertebræ. My determination is founded chiefly on the examination of a few fresh females with perfectly ripe eggs. These agreed in every respect with the pelagic eggs which I have known for a long time from the Java Sea. H. C. DELSMAN.

Laboratory for Marine Investigations,
Batavia, Java, October 2.

The Symmetrical Top in the Undulatory Mechanics.

BY applying the methods of Schrödinger (*Ann. d Phys.*, 79, 361, 489, 734, 1926), which have proved so fruitful in treating atomic problems, to the case of the symmetrical top, we have obtained a complete quantum mechanical solution for this system. The results agree with those found by Dennison (*Phys. Rev.*, 28, 318, 1926) by means of the matrix mechanics, the energy values are

$$W_{jn} = \frac{h^2}{8\pi^2}\left[\frac{1}{A_x}j(j+1) + \left(\frac{1}{A_z} - \frac{1}{A_x}\right)n^2\right],$$

$A_x = A_y$ and A_z being the moments of inertia of the top.

The quantum number j and n must have integral values, a result which follows directly from the nature of the characteristic functions, which involve hypergeometric series. This question was not definitely decided by the matrix mechanics, both integral and half-integral values appearing to satisfy the problem Each value W_{jn} occurs $(2j+1)$ times as the characteristic value of the system, corresponding to the fact that a state with this energy will divide into $2j+1$ levels under the action of an external field.

Full details will be published elsewhere in the near future R. DE L. KRONIG.
I. I. RABI.

Department of Physics, Columbia University,
New York, October 26.

Complex Aromatic Hydrocarbons in Low-Temperature Tar.

FROM a tar produced by distillation of Pooley Hall-Wearmouth coal, carbonised at 600°, a fraction boiling at 313°-360° was obtained which yielded a complex mixture of aromatic hydrocarbons distinguished even in an impure state by their bright colours. Predominant among these hydrocarbons is β-methylanthracene which was identified by conversion into β-methylanthraquinone and anthraquinone-β-carboxylic acid. The identity of the β-methylanthraquinone obtained in our experiments was established by comparison with a specimen of synthetic β-methylanthraquinone furnished by Mr. W. H. Dawson of the British Alizarine Co. Additional proof of the identity of β-methylanthracene was obtained by comparing its carboxy acid with the anthraquinone-β-carboxylic acid prepared by oxidising the β-methylanthraquinone from the British Alizarine Co.

Investigation of these complex aromatic derivatives from low-temperature tars is being continued in collaboration with H.M. Fuel Research Station.

G. T. MORGAN.
D. D. PRATT.

Chemical Research Laboratory,
Teddington, Middlesex.

Welsh Romani.

AS a believer at any rate in the constancy of the law which accords the last word in a discussion to the reviewer, and since the columns of NATURE seem scarcely the place for it, I do not propose to deal further here with the novel Romani etymologies propounded by Prof. Turner. The place for this is obviously the *Journal of the Gypsy Lore Society*, of which he is a member, and where scholars who understand Romani and are familiar with what has already been written upon it, will have an opportunity of forming their own opinion. We should then, I presume, learn Prof. Turner's reasons for supposing that **suil* could in any dialect of Romani be a possible word, and why a Welsh Gypsy variant of a south European Gypsy word should have a separate origin in a different Indian stem.

JOHN SAMPSON.

The University,
Liverpool.

DR. SAMPSON has not replied in any particular to the charge I advanced that in many of his etymologies he had violated the principle of the constancy of the "laws of sound change."

R. L. TURNER.

School of Oriental Studies,
University of London.

A Half-Century of Chemistry in America: 1876–1926.

IN commemoration of its fiftieth anniversary, the American Chemical Society has issued a "golden jubilee number" under the above title. In the earlier part an account is given of the origin and development of the Society. Four of the first chapters in the section are written by original members: I. on The Priestley Centennial, by Samuel A. Goldschmidt; II. on The Organisation of the Society, by William H. Nichols; III. on The Evolution of the Society, by Frank Wigglesworth Clarke; IV. on The First General Meeting and the First Local Section, by Charles E. Munroe; V. on The Activities of the Society, by Dr. Parsons, the Secretary. Part 2 consists of articles on progress in various branches of chemistry in America—Mineral Chemistry being discussed by Edgar F. Smith; Physical, by Wilder D. Bancroft; Inorganic, by James Lewis Howe; Organic, by Treat B. Johnson; Agricultural, by Charles A. Browne; Industrial, by Charles E. Munroe; The Chemistry of Physiology and Nutrition, by Graham Lusk; Chemical Education, by Samuel R. Powers. The Society is to be congratulated upon the issue of a historical volume full of interest, containing not a little that is informative to chemists generally.

The first important chemical meeting of a national character to be held in the United States was the Priestley Centennial celebrated at Northumberland, Pennsylvania, on August 1, 1874. The Society owes its origin largely to influences then set in action. To-day, it numbers little short of 15,000 members. At first, the Society held monthly meetings in New York but the best American contributions to chemistry were not published in its journal and the Society had little more than a local existence. Other societies were established. The need of uniting the several existing organisations as local sections of a national society was not fully realised until 1891. The change was gradually effected and the present constitution came into force in April 1901. At first, the reorganised society had four local sections. Others were soon organised and now the sections number seventy, fairly covering the whole area of the United States. The sections hold their own meetings but general meetings, for the transaction of general business, are held twice a year.

The Society publishes three journals: *The Journal of the American Chemical Society*, *Chemical Abstracts* and *Industrial and Engineering Chemistry*: the first accommodates the academic, the last the industrial element. The United States is far in advance of Great Britain in the way in which the interests of chemists have been consolidated, especially is it to be congratulated upon having established and maintained a firm union between science and practice. With us cliques and chaos reign and receive almost monthly additions; the interests are in no way co-ordinated and there is constant overlapping and great waste of energy and funds: the consequence is, chemistry has no acknowledged place in the State, whilst in America it is not only publicly recognised but even regarded with respect and highly valued by the commercial class. Our Chemical Society is now a positive danger as it is supposed to be representative of the subject generally, whilst, in effect, it is but the preserve of a narrow academic clique, aloof from the world. On the other hand, the Society of Chemical Industry does not sufficiently represent the higher industrial interests. Here there is no bond of social union, as chemists acknowledge no leadership: our subject has yet to rank socially. No mere *Corner House* will give it status.

The American Society has done much to consolidate publication but still allows the separate publication of a *Journal of Physical Chemistry*, which it even patronises. There is no reason why this should be continued. It has recently instituted a new publication, *Chemical Reviews*, but on the 'penny-wise, pound-foolish' plan of not paying contributors; this is not supplied to its members. Under strong editorship, such a journal might well be made an invaluable asset—nothing is more in need of encouragement at the present time, than the writing of considered, critical scientific essays—thus far, the journal has contained useful but usually limp, monographic surveys. Chemists have yet to learn to put their thoughts into satisfactory essay form. The Society has also undertaken the issue of *Book Monographs*. The enterprise is one of extreme difficulty. Men with sufficient experience and literary ability, who will study a subject until they have mastered it and then deal with it critically, dispassionately and judicially, are scarcely to be found.

The American Society began to publish *Abstracts* in 1907. Our Society's activity in this direction dates back to 1872. There never should have been two such publications *in English*. A real effort *was* made, on both sides, to institute a joint publication, but adverse influences in Britain, the narrow outlook of a few leading members of the Society of Chemical Industry, made this impossible. The magnitude of the enterprise grows daily; the number of abstracts published by the American Society in 1918 was 13,357, whilst in 1925 it was 26,426. The average length of the abstract has been reduced from 0·251 of a page in 1917 to 0·190 in 1922.

There is little to choose between the two publications, except that the English abstracts are at least readable, whilst often the American are not, on account of the contractions used. The American survey of the literature is probably the more nearly complete. To-day, neither is much more than a subject index and the sooner we recognise this and so treat the work, the better it will be.

Having been an abstractor at the beginning and being able to overlook an even longer period than that covered by the English enterprise, I am of opinion that the gross effect of the publication of abstracts has been greatly to the detriment of chemistry. In my early days, we read everything as it appeared: many of us bought at least the leading English and foreign journals. We were, therefore, constantly learning and constantly kept in training: the voices of the master-workers were continually in our ears. To-day, very few read and scarcely any one maintains a library Students and even workers glance through this or that section of the abstracts, just as they skim *Tit-Bits* in the train. 'Tit-bitry,' in fact, prevails everywhere, the art of reading is uncultivated and all but unknown, the whole chemist is a fast disappearing species, the 'bit-o-chemist' will soon be sole survivor. As of Cock Robin, we may ask—"And what will the chemist be worth then, poor thing?" To-day, already, he can scarcely be hired. Abstracting and examining together are killing chemistry as a science and preventing the upgrowth of men of real worth. Our younger generation cannot even appreciate its own work, cannot criticise, because it is not sufficiently informed and is being 'trained' on unscientific, dogmatic lines.

The *Journal of Industrial and Engineering Chemistry*, we are told, is the one journal of the American Chemical Society which is financially remunerative, yielding through its advertisements a net income of approximately 70,000 dollars a year: this has enabled the Society to publish at a reduced cost to its members the Journal and Abstracts. Everyone knows its taking 'get-up'—the area and mass of polished china clay to be handled. Obviously it is highly attractive to advertisers but has it any special value for industrial and scientific workers? Might it not, with advantage, be less loosely strung together and more compact in form? Yes! but then it would not appeal to advertisers—our *Blue Bits*, we know, is not specially attractive to the class. Ought not we to face this problem squarely, in the interests of our science—whether pure or applied? Surely, in a country like the U.S.A., a country of high ideals, a country of untold resources with a vast superabundant wealth, a country which can spend millions upon 'the pictures' (the industry ranks fourth), it should be possible to find the 20,000*l.* a year necessary to enable the corporation which represents chemistry to dispense with advertisements. Chemistry being the science of life, the science underlying all earthly, if not heavenly change, advertisements are no more in place in its journals than in a Family Bible. Surely, we may say to America and to ourselves in lesser degree, *Schame Dich*! at such failure to recognise what is owing to our *science*! To what better purpose could a multi-millionaire wishing to save his soul devote his fortune than to the endowment of a great organisation charged with the publication of the considered results of real chemical inquiry by English-speaking peoples? That the English and the Americans are destined some day to work together in this direction cannot be doubted. The task is not difficult: given the will! given a few leaders!

It is disappointing that these and similar problems should not have been considered by the Americans in their survey of progress. Much will happen during the next fifty years but dare we hope that, at their centenary, they will be able to come forward and paint chemistry as a pure religion? There is nothing in the chapter on chemical education to show that such is their aim. In America, as here, leaders are called for to fashion higher ideals.

Turning to the reviews of progress, that on mineral chemistry by the veteran Edgar F. Smith, whose worn-out Göttingen degree was returned to him replated at the meeting in Philadelphia, is specially interesting, inasmuch as he chiefly portrays the activities of five past presidents, all remarkable men, Frederic Augustus Genth, J. Lawrence Smith, T. Sterry Hunt—with whom he links Wolcott Gibbs—William Francis Hillebrand and Frank Wigglesworth Clarke. Essentially, the essay is an appeal for greater attention to mineral chemistry.

Wilder D. Bancroft follows with a rambling essay, without any clear, logical, underlying *leitmotif*, in which the *Impresario* plays the veritable 'bull in the china shop of physical chemistry' to perfection—little is left unbroken. Recognising this, apparently, and the need of glue to mend things, he ends by asking for two new institutes of colloid chemistry. To comfort us he quotes a leading American chemist as saying—

> Physical chemistry exists no longer. The men who have been called physical chemists have developed a large number of useful methods by which the concrete problems of inorganic chemistry, organic chemistry, biochemistry and technical chemistry may be attacked. As the applications of these methods grow more numerous, it becomes increasingly difficult to adhere to our older classification.

It will be interesting to "Kahlenberg in America and Traube in Germany," as it is to "H. E. Armstrong in England" to be told that they are members of a Triptych: "three irreconcilables who do not believe at all in the electrolytic dissociation theory" and that whilst "they have not accomplished what they set out to do, they are not likely to." The only interpretation I can give of this cryptic statement is, that we set out hoping to find an intelligent appreciation and interpretation of the facts of chemistry and are now persuaded that such is non-existent. Still, there is hope for the sinner that repenteth, as follows:

> It is easy enough to point to one factor which has been neglected practically completely and which may be the one which has caused most—and perhaps all—of our difficulties. For years H. E. Armstrong in England has chided the physical chemists for considering water only as water, whereas it is a complex and variable mixture. This criticism seems well founded; but, unfortunately, Armstrong has never succeeded in showing what could be done with his idea and consequently the idea has been valueless hitherto.

To have an American 'high priest' admit that water has been left out of account is certainly amusing. The gibe is proof of the thesis I have long advocated that publication in the *Proceedings of the Royal Society* is a form of decent burial. However, Bancroft is evidently 'reading some' and perhaps, having swallowed the water-complex in this age of prohibition, will ultimately come to realise what are the essentials of chemical change. It is pitiable that we should have wandered these fifty years past in the wilderness of doubt on such a subject. I await the day when he will call out—

> O ——, speak no more:
> Thou turn'st mine eyes into my very soul
> And there I see such black and grained spots
> As will not leave their tinct.

In the remaining essays, a rapid survey is given of American contributions; we all know these to have been of consequence in many fields and it is interesting to be reminded of particular cases, to be led to think back to work such as that done by Morley and Richards, by Michel, by Osborne, by Franklin, by Gomberg. What is missing from all the essays, however, is the attempt to assess the value of chemical study in its various branches. That chemical discovery has contributed greatly to public and industrial welfare is beyond question. What, however, has been done, what is being done, to make the study of mental and moral value? Is not its value for all purposes steadily diminishing under the influence of examinations and the degree-hunger? Instead of being severely trained in scientific method and the worship of truth, the student to-day is taught didactically and dogmatically and 'faith' now plays as great if not a greater part in science than it does in religion. The 'research' work for the degree, for the most part, is mere exercise work, the equivalent of figuring out an untried example in the mathematical primer. there is no element of imagination or discovery in it. The teacher dare not set a task of difficulty of doubtful outcome. We talk etstatically of the great increase in the number of papers published in our journals but the work, in large part, is of no real scientific merit or value. Much of it were better left unpublished.

The pursuit of science is necessarily an anti-human practice as it involves an all but impossible self-abnegation and a modesty which is more than rare. Let us admit that publication is largely a matter of personal advertisement: we shall then realise what is desirable in the interests of scientific altruism.

Problems such as these are in sore need of attention in Britain and America, if the faith of our forefathers is to be justified. Science to-day is as much in danger as is religion—there is a lack of morality behind it as there is behind religion—it is being overcome by the democracy of ignorance, by our failure to recognise that it is probably only attainable by the few, by the lack of discipline owing to lack of leadership. The American Jubilee proceedings are particularly disappointing in this respect. Chemists are in no way alive to the greatness of the subject of which they are guardians. HENRY E. ARMSTRONG.

The Cretaceous Plants of Greenland.[1]

IT was a noteworthy event in the annals of the University of Cambridge when a Master of a College undertook a successful expedition to Arctic regions shortly before becoming Vice-chancellor, and the publication of the scientific results of the expedition must also be described as an important event. For the significance of this work goes beyond the confines of palæobotany and geology into the regions of cosmic history. A knowledge of the plants which grew in Greenland in the far past provides, within certain limits, good evidence as to the former climate of the region, and so provides data for the study of secular climatic changes. This paper concerns the evolution of plants and the evolution of climate.

It has long been known that the remains of abundant vegetation are found in high latitudes. These are not merely fragments of plants which have been drifted by ocean currents far from their place of origin, but, as Prof Seward has shown, may be accompanied by beds containing remains of roots and rhizomes *in situ*. In one place a great mass of remains of the fern Gleichenia indicates a district covered with this bramble-fern, while at another locality the abundance of conifer leaves reminded Heer of the carpet of fir-needles in a modern forest.

The Cretaceous plants of Greenland are of especial interest because the majority are allied to plants now living. It has been assumed that the Cretaceous forms grew under climatic conditions closely approximating to those under which their modern representatives grow to-day. Prof. Seward points out, however, that as times have changed in the world the plants themselves have in all probability changed in their relations to external factors. But no conclusions can be drawn without a thoroughly sound knowledge of all the forms making up the flora. Hitherto our information has been mainly based on the determinations of the famous Swiss palæobotanist, Oswald Heer, but his work belongs to an epoch when fossil species were established somewhat less critically than to-day. Seward has had the heavy task of working through Heer's results and reducing them to data which will satisfy modern requirements. A part of this critical review recently appeared in the jubilee volume of the Geological Society of Belgium, and it is here completed.

The list of species now given is very different from that of Heer, for many of his specimens were found to be too fragmentary or too badly preserved for reference even to their genera, while other remains of leaves were referred to modern genera on quite inadequate grounds. The names of many modern genera have therefore disappeared from the list, while others have been altered to indicate that leaves of the form possessed by certain modern genera were present, though their actual identity with these genera is not yet proved; for example, some leaves previously called Magnolia are now called Magnoliæphyllum. But while the author is very cautious in attributing fossil-leaf impressions to modern genera, he considers that many of them belong to modern families, and, after considering the distribution of some of these, he comes to the unquestionable conclusion that the fossils point to an Arctic environment very different from that of to-day. From the study of the chief forms he infers that "the climate of Greenland in Cretaceous times was probably comparable with that of Southern Europe to-day. Genera that are now characteristic members of tropical floras, the floras which are in part legacies from the Cretaceous age, were then represented by species less sensitive than their modern descendants to external factors."

The importance of these conclusions is that the changes in temperature needed to enable such a flora to live at high latitudes is not great. A freer interchange between the Arctic Ocean and the tropica oceans might be quite sufficient to allow the growth o the flora described, in the absence of the Greenland ice sheet. There is no need to postulate considerable movements of the pole.

On the evidence of fossils, the view has been widely maintained that during the Mesozoic period the climate was uniform throughout the world. Prof. Seward does not think this theory tenable, and he brings forward evidence to show that the Greenland plants were not contemporaneous with the forms from the Wealden beds of England and from the Cretaceous rocks of the United States, which resemble them so closely. He holds that some of the older European plants migrated northwards, where they became mingled with new forms, and afterwards many species of the Greenland flora travelled southwards again. Distinct climatic zones may then have already existed and "it is reasonable to assume that in Cretaceous Greenland, as at present, short summers with continuous sunshine alternated with longer periods of comparative darkness."

---

[1] "The Cretaceous Plant-Bearing Rocks of Western Greenland," by A. C. Seward, *Phil. Trans. Royal Society*, Ser. B, vol. 215, pp. 57-175. London, 1926

For the botanist these Cretaceous plants are of special interest, for they grew in the period when angiosperms, agreeing with the present-day flowering plants in the morphological character of their foliage shoots, assumed a prominent position in the vegetation of the world. This work has led its author to the view that "the Greenland Cretaceous flora represents more fully than the floras of other countries the early stages in the transitional period from an older Jurassic-Wealden vegetation in which flowering plants were absent, to a type of flora which still persists in regions remote from its ancestral home." Together with ferns and gymnosperms of an archaic type were found dicotyledonous leaves of a surprisingly modern form, and the view is supported that the evolution of the deciduous angiosperms progressed with greater rapidity in these high latitudes. The alternation of prolonged periods of continuous activity with complete rest from growth through the winter, may have provided conditions of the type under which we should expect the evolution of the deciduous habit.

Prof. Seward makes the important suggestion that the shifting of the balance of the vegetation types was not merely the expression of a stage in organic evolution, but may have been a response to some physical stimulus. He does not make any suggestion as to the nature of the stimulus, but in this connexion the work of Garner and Allard, and Tincker may be significant. These investigators have found that alterations in the number of hours of daylight in which plants are grown produce changes in the time of flowering and also in some morphological features of many of the species investigated. Thus the northern and southern migrations referred to above may have induced morphological changes owing to the changes of illumination experienced in the course of the migration.

The rapid evolution of the angiosperms in high latitudes is no new theory, but though flowering plants appear to be quite absent from the lowest Cretaceous rocks, it is likely, as Seward points out, that they had antecedents in much earlier times. It may be that the evolution of the deciduous habit led to the frequent and abundant preservation of leaves from plants the evergreen ancestors of which had little chance of fossilisation, and so the sudden appearance of the flowering plants in the rocks does not represent the real history of the group.

The general conclusions which have been discussed above form but a small portion of this publication and, whatever their fate in the future, the great bulk of accurate and critical information which Prof. Seward has amassed will always remain of the greatest value and serve as a solid foundation for future work. The paper terminates with a fine paragraph in which the author hopes that his labours may stimulate others to extend and render more precise our knowledge of the Cretaceous plants of Greenland. It is interesting to record that within a few days of the publication of the work Mr. T. M. Harris, whose help is acknowledged in the introduction, landed in Greenland with the intention and prospects of making a more extended examination of the Rhætic plant-bearing beds of eastern Greenland than has hitherto been possible. We may look forward to further important contributions from Cambridge in this fascinating study.

H. H. T.

Electric Waves and their Propagation.[1]

By Sir ERNEST RUTHERFORD, O.M., P.R.S.

AMONG the many developments of science during the past thirty years, none has left a deeper impression on the lay and scientific mind alike than the remarkable growth of wireless as a means of long-distance transmissions of signals, speech, music, and even of pictures. The history of this new method of signalling is of special interest to all scientific men, for it illustrates in a vivid way the value of a close co-operation between pure and applied science for rapid progress. The first great chapter in the history of radio-communication we owe to the genius of Maxwell, who, in a paper communicated to this Society in 1864 entitled "A Dynamical Theory of the Electromagnetic Field," showed that electric and magnetic effects cannot be produced instantaneously at a distance, but must be propagated through space with the velocity of light. He demonstrated the wave-nature of these electrical disturbances in space and the mode of their propagation. It is no exaggeration to say that the complete theory of electrical waves and their transmission in space is contained in his famous equations, and that too at a time when no experimental methods were known of producing or studying such electrical waves.

The next great step in advance we owe to the brilliant researches of Hertz, who in 1887, in his laboratory at Karlsruhe, showed how electrical waves in space could be produced by an open electric oscillator, and devised methods for their detection and study.

It was not long before the results of these small-scale laboratory experiments were applied for practical ends. In 1896, attempts began to be made in England to utilise electric waves for signalling purposes, and the rapid development of this new branch of applied science owes much to the pioneer work of Marconi and Lodge. Progress in the later stages has been largely influenced by the utilisation of another scientific discovery, namely, the use of electric currents in vacuum tubes as a powerful method of producing and detecting electrical waves. It is of interest to note that the first use of an electron tube as a detector of electrical waves was made by Prof. J. A. Fleming.

---

[1] From the anniversary address delivered before the Royal Society on November 30.

It is not my object to detail later progress except to refer to the noteworthy developments that have taken place this year. On January 1 the new Post Office station at Rugby was opened for the transmission of messages to ships in all quarters of the globe and for Foreign Office messages. This long-wave installation is in many respects unique. It is the only high-power electron-tube station in the world, and contains many novel features in its design and operation. The frequency of the continuous waves emitted by this station is controlled with great accuracy by a vibrating tuning-fork, and the numerous high-power electron tubes in parallel are used to magnify five hundred thousand million times the energy of one of the harmonics of a small triode valve operating the tuning-fork. The extraordinary flexibility of these electron tubes both as oscillators and receivers has been fully utilised in the design of the installation, which incorporates all the latest developments in this branch of science. The success of the station for the purposes for which it was designed is a tribute to the breadth of the scientific knowledge and the boldness of the initiative displayed by the Imperial Wireless Commission and the engineering staff of the Post Office. This station has been also successfully used for experiments in radio-telephony with the Long Island station near New York, It is now possible, and will, it is expected, soon be practicable, to connect any telephone subscriber in western Europe with any telephone subscriber on the North American continent.

During the past two or three years, telegraphy on a commercial scale by the aid of short waves has been conducted in many countries. A still further development by the Marconi Company is to be recorded this year. Short-wave stations, in which a series of parallel wires are arranged to act as a reflector, and emit a beam of waves in a definite direction, have been erected near Bodmin in Cornwall and near Montreal in Canada. After a successful series of experiments, these stations began to operate commercially last month. Similar stations for communicating with the other Dominions are in the course of erection. It will be of great interest to see how far a continuous service is feasible by these new methods, in spite of the atmospheric disturbances which sometimes so seriously affect ordinary short-wave transmissions.

It is remarkable how the progress of applied science in many instances depends on the utilisation of some obscure property of matter discovered in the course of purely scientific experiments. For example, in 1888, the brothers J. and P. Curie, working on the properties of crystals, discovered the piezo-electric properties of quartz. In a suitably cut crystal of quartz, an electric charge on the surface appears when the crystal is compressed or extended. Conversely, a charge applied to the surface of the crystal alters its dimensions. No one at that time could have foreseen that this property could be utilised to control, automatically and with great accuracy, the frequency of the waves emitted by broadcasting stations, and thus be a factor of great importance in reducing interference between stations. Illustrations of this kind can easily be multiplied. For example, the discovery about thirty years ago in the laboratory of the photo-electric effect, in which certain substances exposed to light produce a copious emission of electrons, has formed the essential basis of the methods used to-day in transmitting radio-pictures and in experiments on television.

I should like to add a few words in connexion with the problem of the propagation of long and short electrical waves over great terrestrial distances, which has been the subject of discussion for many years, but on which valuable new data have been recently obtained. When wireless signals were first transmitted across the Atlantic, the late Lord Rayleigh immediately raised the question whether the waves were able to follow the curvature of the earth by the agency of diffraction alone. This problem has attracted the attention of many able mathematicians who have shown conclusively that some other agency must enter into the transmission of these waves over great distances. It was early suggested by Kennelly and Heaviside that the bending of the rays might be accounted for by supposing that there was in the upper atmosphere a layer which was electrically conducting and which guided the waves round the earth's surface. Precision was given to this view by the work of Eccles and others, who showed that ionised gases could refract and absorb electrical waves passing through them. A still further advance was recently made when Sir Joseph Larmor pointed out the paramount importance of the long free-path of the electrons in the upper atmosphere in producing scattering and refraction of electrical waves. He showed that a comparatively sparse distribution of electrons was sufficient to bend the path of the rays round the earth.

A direct attack on this problem has been recently made in Great Britain by several methods, and convincing evidence has been obtained of the existence and height of this refracting layer. Appleton and Barnett, using wave-lengths of about 400 metres, have shown that at moderate distances from a wireless transmitter two sets of waves are received which produce interference phenomena. One set of waves travels in a straight line from the transmitter along the ground, and the other passes into the upper atmosphere, where it is refracted or reflected back to the receiving station. These experiments are of much interest as providing large-scale analogues of the ordinary optical interference experiment but carried out with wave-lengths a thousand million times as long. From the results of these investigations the height of the effective layer is estimated to be about 90 kilometres. In general, the refracted ray is elliptically polarised, an effect no doubt connected with the action of the earth's magnetic field on the motion of the free electrons. Similar results by other methods have been obtained by Smith-Rose and Barfield of the National Physical Laboratory.

These observations not only give an explanation of night-time errors in direction-finding and of signal variations, but also in a general way throw light on the vagaries observed in the transmission of short waves, where a signal may be undetectable a few miles away from the transmitter but may be received strongly a thousand miles away.

While the study of the propagation of electrical waves through our atmosphere is of much interest in itself, it is of even more value as giving us a new and powerful

THE HISTORY OF CIVILIZATION

Latest Volumes. Each, royal 8vo, prices as below.

The Aryans

By V. GORDON CHILDE, B.Litt With 36 illustrations. 10s. 6d. net.

"Be the final word on the subject what it may, here is a book of perennial interest, for it covers the whole of the field to the time of writing and is precisely what such a work should be. Mr. Childe pursues truth for its own sake."—*New Statesman.*

From Tribe to Empire: Social Organization among the Primitives and in the Ancient East. By Professors A. MORET and M. DAVY. "Full of valuable and curious information. No student of human origins can afford to neglect this careful investigation."—*Journal of Education.* With 54 illustrations and maps. 16s. net.

Race and History: an Ethnological Introduction to History. By Professor E. PITTARD. "A luminous conspectus of what anthropology has to tell us of the question of races from the earliest times to the present."—*Saturday Review.* With 9 illustrations. 21s. net.

The Civilization of the South American Indians. By Professor RAFAEL KARSTEN. Preface by Dr. EDWARD WESTERMARCK. "The most important contribution to the study of certain aspects of South American native civilization which has yet appeared."—From the *Preface.* 25s. net.

Travel and Travellers of the Middle Ages: a Series of Essays edited by Professor A. P. NEWTON. "The reader will be grateful to Mr. Newton for giving him such pleasant access to a world of knowledge as obscure as it is exciting."—*Manchester Guardian.* With 8 plates. 12s. 6d. net.

The History of Medicine

By C. G. CUMSTON, M.D. With 24 plates. 16s. net.

Introduction by F. G. CROOKSHANK, M.D., F.R.C.P. "Dr. Cumston opens up his large subject in a large way. In a clear style, with full references and some well-chosen illustrations, he depicts the evolution of medicine as it has proceeded hand-in-hand with the development of civilization. His chapters on Islamic medicine, the Empirics, Salerno . . . fill a real gap in knowledge. The book should be as interesting to the general public as to the doctor." —*Sunday Times*

Full Prospectus of the First Thirty Volumes on Application.

THE LIBRARY OF PSYCHOLOGY

Latest Volumes. Each, demy 8vo, prices as below.

Crime and Custom in Savage Society

By B. MALINOWSKI, Ph.D. With 6 plates. Demy 8vo, 5s. net.

"In this first-hand investigation into the social structure of a primitive community Dr. Malinowski has broken new ground. It is probably no exaggeration to say that the book is the most important contribution to anthropology that has appeared for many years past. It should be read by all who have to deal with primitive peoples and by all who are interested in human nature as manifested in social relationships, which is to say that it should be read by every one."—*Outlook.*

Theoretical Biology. By J. VON UEXKULL. An application of Kant's philosophy to the problems of biology, a stringent criticism of the materialistic teaching of the extremer Darwinians. 15s. 6d. net.

Biological Memory. By Professor E. RIGNANO. "It contains extremely interesting passages. It aims at providing a hypothesis which shall reconcile Neo-Darwinism and Lamarckism, as well as a general theory of embryological development."—*Observer.*

Language and Thought of the Child. By Professor J. PIAGET. "Every one interested in psychology, education, or the art of thought should read it. The results are surprising."—*Nation.* 10s. 6d. net.

Personality. By R. G. GORDON, M.D. "A very useful critical discussion of the most important work bearing on the mind-body problem, knit together by a philosophy as promising as any of those current." —*Times Literary Supplement.* 10s. 6d. net.

Psychology and Ethnology

By W. H. R. RIVERS, F.R.S. Preface by PROFESSOR G. ELLIOT SMITH. 15s. net.

Some of Dr Rivers's most important ideas on anthropology, sociology, psychology, and psycho-medical subjects, hitherto inaccessible, are contained in this volume, where the reader may trace the development of his thought and understand his conversion to the "diffusionist" point of view.

Full Prospectus of the First Fifty Volumes on Application

The Babbitt Warren

By C. E. M. JOAD. Crown 8vo, 6s. net.

"Merry and witty. Ostensibly about the United States, his book is in essence an attack upon the false values of our 'decadent' modern civilization. Seldom is it given to a serious philosopher to have so vivacious and sparkling a humour."—*New Statesman.* "A witty and entertaining book, a great success."—*Country Life.*

By the same author, in collaboration with JOHN STRACHEY. After-Dinner Philosophy. Just published, 3s. 6d. net.

:: :: :: KEGAN PAUL :: :: ::

Broadway House, 68-74 Carter Lane, London, E.C.4

¶ W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE, will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ CATALOGUE 269. Scientific Books and Publications of learned Societies.

Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone: [illegible] (2 lines).

That Book you want!

Foyles can supply any Scientific Book that is in print and most of those that are out of print. They have a Special Department for this class of literature under a Manager who has experience and knowledge of the Natural Sciences. Call and consult him, or write and you will get an intelligent reply. Books sent on approval. Over a million volumes Second-hand and New on every conceivable subject in stock. Twenty-one Departmental Catalogues issued, any of which will be sent gratis and post free on mentioning interests.

That Book you do not want!

Foyles will buy it.—A single volume to a library.

Expert valuers sent any distance.

FOYLES, 121 Charing Cross Road, London.

PATENTS AND CHEMICAL RESEARCH.

By HAROLD E. POTTS, M.Sc.,
CHARTERED PATENT AGENT.

Demy 8vo. Cloth. 8/6 net.

"There can be no question of the Author's grasp of the fundamentals of patent law; the discrimination with which he has selected his leading cases when discussing the validity of patents demonstrates this."—*Nature.*

**THE UNIVERSITY PRESS OF LIVERPOOL, LIMITED,
HODDER AND STOUGHTON, LIMITED, LONDON.**

RHEINBERG MICROMETERS and other GRATICULES by the processes of Grainless and of Filmless Photography. Stock list of standard articles on request. RHEINBERG & Co., 57-60 Holborn Viaduct, London, E.C.1

KING'S PATENT AGENCY LTD., 146a Queen Victoria Street, E.C.4. Advice handbook free. 40 years' refs.

J. POOLE & CO.
ESTABLISHED 1854

NEW & SECOND-HAND
SCIENTIFIC AND EDUCATIONAL
BOOKSELLERS

ENQUIRIES BY LETTER RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

CHEMICAL AND TECHNICAL BOOKS

We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms.

Write for Catalogue.

**WILLIAM BRYCE, Scientific Bookseller,
54-54a Lothian Street, EDINBURGH.**

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

Just Issued

from the Natural History Department of
DULAU & COMPANY LTD.
54-56 Margaret St., Cavendish Square, London, W.1
**CATALOGUE No. 143:
PHYTO-PATHOLOGY AND HORTICULTURE.**
Post free on request.

GENERAL DISCUSSIONS OF THE FARADAY SOCIETY.

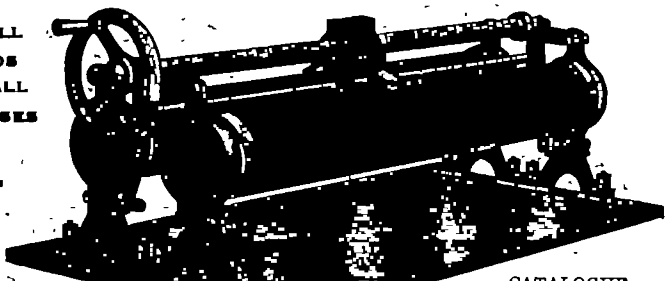
A list of REPRINTS available can be obtained from Messrs. GURNEY & JACKSON, 33 Paternoster Row, London, E.C.4, Official Publishers to the Society. Information relating to the Society may be obtained from the SECRETARY, 90 Great Russell Street, London, W.C.1

ZENITH

REGULATING RESISTANCES

OF ALL KINDS FOR ALL PURPOSES

THE ZENITH ELECTRIC CO. LTD.
(Formerly the Zenith Manufacturing Co.)
Sole Makers of the well-known ZENITH Electrical Products.
*Contractors to the Admiralty, War Office,
Air Ministry, Post Office, L.C.C., &c.*
**Zenith Works, Villiers Road,
Willesden Green, London, N.W.2**
Phone: Willesden 4087-8. Telegrams: Voltaohm, Willroad, London



CATALOGUE ON REQUEST

NEW McGRAW-HILL BOOKS

MANUAL OF PLANT DISEASES

By F. D. HEALD.

This new book is an attempt to present a view of the whole field of plant pathology, including environmental and virus diseases as well as those of bacterial and fungus origin.

891 pages. 272 illustrations. **35s.** net.

CHEMISTRY OF CELLULOSE AND WOOD

By A. W. SCHORGER.

A valuable contribution to chemical literature and will be found particularly valuable in the textile industry, the pulp and paper field, and in all industrial enterprises where cellulose and wood are utilised by chemical methods.

596 pages. Illustrated. **30s.** net.

BREEDING AND IMPROVEMENT OF FARM ANIMALS

By VICTOR A. RICE.

Principles of genetics and reproductive physiology are carefully presented and their influence on the art of breeding is clearly explained.

Of special interest is the material on Inheritance in Farm Animals included in the appendix.

362 pages. 113 illustrations. **17s. 6d.** net.

THE HYDROUS OXIDES

By H. B. WEISER.

This new book represents the first endeavour to correlate systematically and summarise critically the numerous scattered facts in an old but increasingly important field. It attempts to furnish scientist and industrialist with a more intimate acquaintanceship with hydrous oxides.

452 pages. 31 illustrations. **25s.** net.

⁂ *Sectional Catalogues, giving full particulars of these and other books, sent on request.*

McGRAW-HILL PUBLISHING CO. LTD., 6-8 Bouverie Street, LONDON, E.C.4

Now ready. **Third Edition.**

A TEXT-BOOK OF

EXPERIMENTAL PSYCHOLOGY

By CHARLES S. MYERS, M.A., M.D., Sc.D., F.R.S.,
and F. C. BARTLETT, M.A.

In two parts. **Price 16s net.**

The two parts are also sold separately—Part I, Text-book, **10s 6d** net, Part II, Laboratory Exercises With 40 Figures and Diagrams, **7s** net.

"The edition just issued is probably the most complete text-book of experimental psychology in this or any other language. Every page is loaded with trustworthy statements of verified fact, yet the argumentation is so well ordered, and the style so concise and clear, that the book can be read with ease and pleasure."

Nature on the Second Edition.

Prospectus on application.

CAMBRIDGE UNIVERSITY PRESS
Fetter Lane, London, E.C.4

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals, General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"*This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale.*"

NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

THE JOURNAL OF GENERAL PHYSIOLOGY.

Edited by W. J. CROZIER, JOHN H. NORTHROP, W. J. V. OSTERHOUT.

CONTENTS OF VOL. X., No. 2, NOVEMBER 20, 1926.

DAVENPORT, CHARLES B. Human growth curve.

MERRILL, HENRY BALDWIN The effect of enzyme purity on the kinetics of tryptic hydrolysis.

FRIES, E. F. B. Temperature and frequency of heart-beat in the cockroach.

GALTSOFF, P. S., and PERTZOFF, VLADIMIR. Some physico-chemical properties of dissociated sponge cells.

CROZIER, W. J., and PINCUS, G. The geotropic conduct of young rats

IRWIN, MARIAN. The penetration of basic dye into *Nitella* and *Valonia* in the presence of certain acids, buffer mixtures, and salts

COOK, S. F. The rôle of certain metallic ions as oxidation catalysts.

STEARN, ALLEN E. Amphoteric behavior of complex systems I. Theoretical.

STEARN, ALLEN E. Amphoteric behavior of complex systems. II. Titration of sulfanilic acid-glycine mixtures.

MURRAY, HENRY A., JR. Physiological ontogeny. A. Chicken embryos. XII The metabolism as a function of age.

IRVING, LAURENCE. Regulation of the hydrogen ion concentration and its relation to metabolism and respiration in the starfish.

Subscription Price per Year (One Volume), $5.00.

Published bi-monthly by

THE ROCKEFELLER INSTITUTE for MEDICAL RESEARCH,
Avenue A and 66th Street - - New York, N.Y.

ARNOLD BOOKS

THE EPIC OF MOUNT EVEREST. A Condensed Account of the Three Expeditions. By SIR FRANCIS YOUNGHUSBAND, K.C.S.I., K.C.I.E. With Illustrations. **7s. 6d.** net.

This popular account in one volume is based on the explorers' original narratives, and has been written at the request of the Mount Everest Committee.

THE RIDDLE OF THE TSANGPO GORGES. By Capt. F. KINGDON WARD, author of "The Romance of Plant-Hunting," etc. With Contributions by EARL CAWDOR. With Illustrations and Map. **21s.** net.

Records the exploration of an unknown stretch of the Brahmaputra, or Tsangpo, in which there is a drop of many thousand feet through mighty gorges.

AMONG THE KARA-KORUM GLACIERS. By JENNY VISSER-HOOFT. With Contributions by PH. C. VISSER. With Illustrations and Maps. **21s.** net.

In the heart of Asia, between the two great ranges of the Karakorum and the Hindu-Kush, lies a high mountain region which presents one of the most difficult fields of exploration in the world. Although a caravan route exists through the dark Hunza gorge from India to Chinese Turkestan, there are large stretches of unknown country on either side, which it was the aim of the Visser expedition in 1925 to investigate. The story of the expedition is told in this lively and attractive volume.

ACROSS THREE OCEANS. A Colonial Voyage in the Yacht *Saoirse*. By CONOR O'BRIEN. 1 vol. With Illustrations and Map. **16s.** net.

A stirring account of a remarkable feat of seamanship. The author will always be remembered as the man who brought a 20-tonner round Cape Horn.

ANCIENT EGYPTIAN MATERIALS. By A. LUCAS, F.I.C., Chemist in the Department of Antiquities, Cairo. 240 pages. **7s. 6d.** net.

A STUDY OF THE OCEANS. By J. JOHNSTONE, D.Sc., Professor of Oceanography in the University of Liverpool; Author of "The Mechanism of Life." Illustrated. Demy 8vo. **10s. 6d.** net.

ELEMENTARY BOTANY: An Introduction to the Study of Plant Life. By W. WATSON, D.Sc., Biology Master, Taunton School. 225 Illustrations. **6s. 6d.**

A HANDBOOK OF ORGANIC ANALYSIS. By H. T. CLARKE, B.Sc., F.I.C. With an Introduction by Prof. J. NORMAN COLLIE, F.R.S. Fourth Edition. 372 pages. **8s. 6d.** net.

THE CORROSION OF METALS. By U. R. EVANS, M.A. Second Edition. 248 pages. Illustrated. **15s.** net.

EDWARD ARNOLD & CO.
41 & 43, MADDOX ST, LONDON, W.1

The Ideal Present This Year

There is a reason in not saying this *Christmas*, or even this *new* year, for the ideal present is one which will bring pleasure to the recipient and remember you to your friend *the whole year round.*

Discovery

is a monthly popular journal of knowledge, "intended," in the words of *Nature*, "to promote intelligent interest in all branches of intellectual activity and practical achievement."
Its Trustees are: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Prof. A. C. Seward, Sc.D., F.R.S., Prof. R. S. Conway, Litt.D., F.B.A. "With such distinguished patronage and competent opinion," *Nature* says, "DISCOVERY should be able to provide interesting fare month by month for the delectation and profit of many thoughtful minds."

Special Christmas Offer

On receipt of your subscription* for 1927, we will send a *free* specimen copy of DISCOVERY, mentioning by your request, to any of your friends.
Better still, ensure their receiving the ideal present by posting a subscription* for them *now*—and, do not forget, for yourself as well.

* ANNUAL SUBSCRIPTION 12s. 6d. POST FREE

Benn Brothers Ltd., 154 Fleet Street, London, E.C.4

ANNOUNCEMENT OF THE CONTENTS
OF THE DECEMBER NUMBER
OF THE

PHILOSOPHICAL MAGAZINE
AND
JOURNAL OF SCIENCE

Published the First Day of every Month. Price 5s.

X-ray Examination of the Crystal Structure of Certain Compounds. By A. NATH SARKAR. (Plates XXI. and XXII.)
The Making of a Salt Haze. By J. S. OWENS.
The General Theory of the Sensation of Flickers in Peripheral and Centra Vision. By Prof. P. LASAREFF.
The Legendre Function of Order $-\frac{1}{2}$. By H. V. LOWRY.
The Thermoelectric Properties of Certain Metallic Solid Solutions. By A. L. NORBURY.
The Adsorption of Nitrogen at Low Pressures by Activated Charcoal. By R. CHAPLIN.
On Sir J. J. Thomson's Model of a Light-Quantum. By Prof. N. P. KASTERIN.
The Resistance of High-Frequency Circuits. By R. R. RAMSEY.
The Radioactivity of Potassium and its Geological Significance. By A. HOLMES and R. W. LAWSON.
On the Stresses in a Spoked Wheel under Loads applied to the Rim. By Prof. A. J. S. PIPPARD and J. F. BAKER.
Critical Potentials and X-ray Term Values. By A. C. DAVIES and Prof F. HORTON, F.R.S.
Dimensional Analysis Again. By P. W. BRIDGMAN.
The Atomic Structure of AgMg and AuZn. By E. A. OWEN and G. D. PRESTON.
On the Condenser-Telephone. By B. S. COHEN.
Luminous Discharge in a Rapidly Alternating Field. By F. KIRCHNER.
On the Existence and Half-Period of Radium C. By A. W. BARTON.
The Loud-Speaker as a Source of Sound for Reverberation Work. By M HART.
Notices respecting New Books. Index, Title-page, Contents, etc.

152 *Pages with 2 Plates and numerous Illustrations in the Text.*

Subscription for 1927, including six Double Numbers and tw Supplementary Parts, £5, post free to any part of the worl

TAYLOR & FRANCIS,
Red Lion Court, Fleet Street, London, E.C.

Supplement to NATURE

No. 2979 DECEMBER 4, 1926

Recent Developments of Cosmical Physics.[1]

By J. H. Jeans, Sec. R.S.

UNTIL recent years astronomy was concerned almost entirely with the sun, moon, and planets; the stars were mere points of light so inconceivably remote as to be of only minor interest. To-day Urania has wearied of the speck of dust we call the solar system, and claims the whole universe for her playground; the astronomer's interest centres almost exclusively on the stars. The dynamical astronomer, for example, having lost interest in the motions of the planets and their satellites, studies the arrangement and motions of the stars in the hope of discovering the general plan at least of the architecture and mechanism of the universe; for him the whole universe is a single dynamical system formed of innumerable particles—the stars—each of which attracts each other according to the universal law of gravitation.

The physical astronomer finds a different interest in the stars. For him each separate star is a complete physical system: it is a crucible in which matter is subjected to temperatures and pressures far beyond any available to the terrestrial physicist. From a study of the radiation emitted by the stars, the physical astronomer tries to unravel their physical structure, to discover how they generate their energy, and by what mechanism this energy is transmitted to their surfaces and discharged into space as radiation. In this way he may perchance happen upon properties of matter which have eluded the terrestrial physicist owing to the small range of physical conditions at his command. If the simile may be pardoned, on the plea that it is at least true to scale, the animalculæ which inhabit a raindrop may learn something of the properties of water by manipulating the particles of the raindrop with their puny strength, but they may also learn something by watching the uncontrollable fall of torrents over Niagara. The primary study of the physical astronomer is precisely this external fall of torrents over Niagara; his ultimate aim is to weld cosmical physics on to terrestrial physics so as to form one all-embracing science. Only when this has been done will it be possible to understand the main trend of events in the physical universe.

The Interpretation of Stellar Spectra.

There is only one method available to this end, namely, a study of the radiation emitted by different stars. Apart from unscientific speculations, physical astronomy may be said to have come to birth in 1863, when Huggins attached a spectroscope to a telescope and found that certain lines in the spectra of the stars were identical with lines emitted in the laboratory by the known chemical elements. The early stellar spectroscopists believed that they were investigating 'the chemistry of the stars' although we know now that they were merely opening up a fundamental problem of the physics of the stars. The spectrum of Sirius, for example, was found to exhibit hydrogen lines very strongly and calcium lines very weakly; in the solar spectrum the relative strength of these two sets of lines was reversed, calcium being strong and hydrogen weak. They concluded that hydrogen was specially prominent in the constitution of Sirius and calcium in that of the sun. Believing that Sirius must one day develop into a star similar to our sun, they conjectured that its substance must gradually change from hydrogen into calcium and other more complex elements, thus finding support for the long-established hypothesis that the more complex elements were formed by gradual evolution out of the simplest.

The true interpretation of these early observations, as the investigations of Saha, R. H. Fowler and Milne have abundantly proved, is merely that the surface of Sirius is at a temperature at which hydrogen is specially active in emitting and absorbing radiation, while the sun's surface is at a lower temperature at which hydrogen is comparatively inert, calcium, iron, etc., having become active in its place. Just as the laboratory physicist can produce different spectra from the same vacuum-tube by varying the mode and conditions of excitation, so Nature produces different spectra from the same stellar material by varying its temperature.

Clearly this circumstance robs stellar spectra of all direct evolutionary significance. The spectra of the stars merely tell us their present surface temperatures, so that even if we could arrange the stars in order of age, a comparison of their spectra would only show whether their surfaces were becoming hotter or cooler; it would give no information as to chemical changes occurring in their substance.

---

[1] A lecture delivered at University College, London, on November 9, 1926.

THE SIZES OF THE STARS.

The knowledge of a star's surface temperature nevertheless opens the door to further valuable knowledge. The hotter a surface is, the more energetically it radiates heat, and from a knowledge of a star's surface temperature it is easy to calculate its radiation per square inch of surface—the sun, for example, radiates approximately 560,000 calories a minute, which is about the energy output of a 50 horse-power engine, from each square inch of its surface. The hottest stars of all probably radiate at least a thousand times as much per square inch of surface.

In this way we can estimate a star's radiation per square inch of its surface. We can also estimate the radiation from its whole surface; this can be calculated at once from its distance and apparent brightness. Simple division gives the area of the star's surface, and hence its radius and volume. Calculated stellar radii range from about 300 times the sun's radius for Betelgeux to about 0·03 times the sun's radius for the companion of Sirius.

As is well known, the diameters of certain stars have recently been observed directly with the Michelson interferometer, and the measured values agree almost perfectly with those calculated in the simple way just explained. The interferometer method is only available for the largest stars, but at the extreme other end of the scale the theory of relativity has come to the rescue. The shift of spectral lines toward the red, which Einstein predicted to be a necessary consequence of the theory of relativity, has been observed in the light received from the companion of Sirius, and its amount corresponds exactly to the radius calculated for the star in the way just explained. So much of a sensational kind has been written about the observational measurements of the diameters of Betelgeux and of the companion to Sirius, that it may be well to remember that, while the *methods* were novel and of the greatest interest and importance, the *results* were precisely those that were generally expected, and such as a simple arithmetical calculation showed to be practically inevitable. Indeed, this calculation could only have failed in one way. It is based on the assumption that the surfaces of the stars emit their full temperature-radiation like the surface of the sun. If the stars had been transparent bodies like the planetary nebulæ, or solid bodies like the moon, this assumption would have been false, and the observations would have revealed its falsity.

Our gain of positive knowledge from these observations is that Betelgeux and the companion to Sirius are neither transparent nor solid bodies, but full radiators like the sun. Moreover, as the three stars just mentioned are about as different as any three stars possibly could be, representing approximately the two extreme ends and the middle of the scale in almost any ordered arrangement we please to make, it seems reasonable to suppose that all stars are full radiators and so, as regards their mechanism of radiation, are essentially similar structures.

THE PHYSICAL STATE OF STELLAR INTERIORS.

What, then, is this mechanism of radiation? And what, as a preliminary question, is the physical state of stellar matter? In the early days of spectroscopy it was commonly supposed, from a faulty analogy with laboratory experiments, that a hot gas always gave a line spectrum, and that a continuous spectrum, such as is exhibited by the stars, could be emitted only by a solid or a liquid body. It is now generally conceded that this view was erroneous, and it is recognised that the continuous spectrum of a star merely indicates that the star is not transparent, thus leaving the question of stellar structure almost entirely open.

The view of stellar structure now universally accepted is that stars are formed of matter which, as a consequence of its high temperature, is to a very large extent broken up into its constituent electrons and nuclei, these all moving about independently like the molecules of a gas. The electrostatic attractions which in more peaceful surroundings would rapidly unite the wandering nuclei and electrons into complete atoms and molecules, are powerless in the general whirl of rapidly moving projectiles and in face of the shattering blows of the quanta of high-frequency radiation which the high temperatures of the stellar interiors generate. When I first put forward this view in 1917 (Bakerian Lecture, *Phil. Trans.*, 218, p. 209), I thought it was entirely novel, but I have since found that in 1644 Descartes had conjectured that the sun and fixed stars were made of matter "which possesses such violence of agitation that, impinging upon other bodies, it gets divided into indefinitely minute particles." My own suggestion was not conjecture, being based on incontrovertible scientific grounds. In 1907 Emden had published calculations ("Gas Kugeln," p. 96) on the interior states of the sun and stars, in which he assumed the stars to be masses of gas resting in an equilibrium similar to that of the lower strata of the earth's atmosphere—the so-called 'adiabatic' equilibrium in which there are assumed always to be sufficient currents to keep the constituent gases thoroughly mixed by a process of stirring. On this supposition he found that if the sun were composed of air or other diatomic gas of equal molecular weight, its central temperature would be 455 million degrees, while if it consisted of hydrogen, or other diatomic gas of molecular weight 2, its central temperature would be 31·5 million degrees. These temperatures are so high that no atom or molecule could survive them; at 31·5 million degrees the quantum of radiation has energy $2{\cdot}1 \times 10^{-8}$ ergs, which is sufficient to move an electron through a potential difference of 13,500 volts. Even with such quanta flying about, the atomic nuclei are still safe, far higher than stellar temperatures being needed to dissociate these into their constituent electrical charges, but the electrons must of necessity nearly all be torn off atoms of moderate atomic weight and the nuclei left almost or entirely bare.

To a first rough approximation we may regard stellar matter, at any rate in the star's hot central regions, as consisting of a mixture of bare nuclei and free electrons. Passing outwards towards the star's surface, the temperature falls, and we come to atoms which are more and more fully formed, until finally, close to the surface, we meet atoms which are completely formed except perhaps for one or two of their outermost electrons. In the surfaces of the coolest stars of all, we even find complete molecules, as, for example, the molecules of titanium oxide and magnesium hydride, which appear in the spectra of certain classes of stars.

THE MECHANISM OF STELLAR INTERIORS.

The mixture of free electrons and bare nuclei or imperfectly formed atoms will behave like a mixture of monatomic gases. In completely broken-up hydrogen, each hydrogen molecule gives rise to four flying units—two protons and two free electrons—so that the effective molecular weight of the mixture will be 0·5 The corresponding figure for helium is 1·33, for calcium 1·90, for iron 2·07, and for lead 2·50, but since atoms of lead would not be completely broken up at stellar temperatures, the actual value for stellar lead would be somewhat higher. If we momentarily adopt 2 as a mean molecular weight of stellar matter, we find that Emden's calculations give 31·5 million degrees for the central temperature of the sun if formed of hydrogen molecules (mol. wt. 2). Various adjustments must be made in this figure, but they are of comparatively minor importance, and Emden's original figure of 31·5 million degrees is probably not very far from the actual temperature of the sun's centre. Indeed, Russell has recently suggested that the great majority of stars have central temperatures fairly close to 32 million degrees (NATURE, Aug. 8, 1925).

One of the necessary adjustments arises from Emden's calculations having neglected the pressure of radiation in stellar interiors.[2] At 31·5 million degrees the pressure of radiation is about 2500 million atmospheres. Huge though this is in comparison with terrestrial pressures, it is only some five per cent. of the ordinary gas-pressure of the broken-up atoms and electrons at the sun's centre. We could allow for its dynamical effects by decreasing our assumed mean molecular weight by 5 per cent., but this mean molecular weight is not in any case known to within 5 per cent.. In exceptionally massive stars, the pressure of radiation assumes somewhat greater importance. For example, at the centre of a star of some ten times the sun's mass, radiation pressure is about equal to gas-pressure. To allow for its effects in this case we should have to suppose the assumed mean molecular weight halved—reduced perhaps from 2 to 1. In every case we shall get a true picture of stellar structure if we think of the layers of stellar matter as held up against gravitation by the incessant impact of a certain number of atomic nuclei or partially stripped atoms, the 'molecular weight' of which is practically the same as that of the corresponding complete atoms, together with a far greater number of free electrons of standard 'molecular weight' 0·00055, and a rather small number of 'molecules' of radiation the molecular weight of which is negligibly small. The combined impacts of these three types of projectiles prevent the star from falling in under its own gravitational attraction.

This gives us, I think, the best snapshot picture of a star's structure. The corresponding picture of its mechanism is obtained by thinking of the nuclei as α-ray particles, of the free electrons as β-ray particles, and of the radiation as γ-rays (although in most stars the main bulk of the radiation has the wave-length of X-rays); and, precisely as in laboratory work, the β-rays are more penetrating than the α-rays, and the γ-rays are more penetrating than either.

THE TRANSPORT OF ENERGY INSIDE A STAR.

In ordinary kinetic theory of gases, conduction of heat is studied by regarding the molecules of the gas as carriers of energy; each molecule has a carrying power which is jointly proportional to its heat energy, its velocity and its free-path. In the interior of a star there are, as we have seen, three distinct types of carriers—the nuclei (or atoms), the free electrons, and the radiation. We can compare the relative carrying capacities of these three types of carriers by multiplying up the energy, velocity, and free-path of each.

---

[2] I first directed attention to this in reviewing Emden's book (*Astrophys. Jour.*, 30 (1909), p. 72, and gave a reasonably accurate estimate of the ratio of this pressure to ordinary gas-pressure in stellar interiors in 1917 (Bakerian Lecture, May 17, 1917, p. 209). Some months previously Eddington had given an estimate which made this ratio some hundreds of times too large. He corrected this at the earliest opportunity (*Mon. Not R A.S.*, June 1917), but not in time to overtake sensational statements, still occasionally encountered, that pressure of radiation is of predominant importance in the dynamics of stellar interiors.

The nuclei and the free electrons have, of course, quite definite free-paths. The same is true of the radiation if this is regarded as consisting of discrete quanta; when a quantum is emitted a free-path begins, and when it is re-absorbed the free-path ends. Whether we think in terms of undulatory theory or quanta, we may suppose that a beam of radiation is reduced in intensity by a factor $e^{-k\rho x}$ on passing through a thickness x of matter of density ρ, where k is the 'coefficient of opacity' of the matter. By comparison with the kinetic theory formula $e^{-s/\lambda}$ for the reduction in strength of a shower of moving molecules, we see that the 'free-path' of the radiation must be taken to be $1/k\rho$. When we use this value for the free-path of radiation and calculate carrying capacities in the way already explained, the carrying capacity of both nuclei and electrons is found to be insignificant in comparison with that of the radiation. The nuclei and electrons may have the greater amount of energy to carry, but the distance over which they carry it, their free-path, is far less than that of the radiation, and their speed of transport is also less, since radiation transports energy with the velocity of light. In this way it comes about that practically the whole transport of energy from the interior of a star to its surface is by the vehicle of radiation.

This general principle was first clearly stated by Sampson in 1894 (*Mem. R.A.S.*, 51, p. 123), but his detailed applications were vitiated by his using an erroneous law of radiation. Twelve years later, Schwarzschild independently advanced the same idea (*Gött. Nach.*, 1906, p. 41); he showed how the temperature of any element of a star's interior must be determined by the condition that it received just as much radiation as it emitted, and gave accurate equations of radiative equilibrium which have formed the basis of every subsequent discussion of the problem.

THE CONFIGURATIONS OF A STAR IN EQUILIBRIUM.

As a consequence of radiation completely outstripping the material carriers in the transport of energy to the star's surface, the build of a star is entirely determined by the values of k, the coefficient of opacity in its interior. If this coefficient is everywhere zero, the star is entirely transparent, and so cannot retain any heat; we now have a star of zero temperature and therefore of infinite extent. If, on the other hand, the coefficient of opacity is everywhere infinite, the star is completely opaque, so that all radiation accumulates where it is generated until the star's temperature becomes infinite, and we have a star of infinite temperature but of infinitesimal radius. It is, of course, the intermediate values which are of practical interest, but the two extreme cases just mentioned show how the whole build of a star depends on the value of the opacity coefficient k. So much is this the case that all attempts to investigate the build of stars before the value of this coefficient was known can only be regarded as speculation.

The first attempt to evaluate it theoretically by Eddington in 1922 (*Mon. Not. R.A.S.*, 83, p. 32) proved unsuccessful and was withdrawn. In the next year Kramers (*Phil. Mag.*, 46, p. 836) put forward the theory of opacity which has now gained general acceptance. Using the value of the opacity coefficient given by this theory, it is possible to determine the complete build of a star having any given mass and any given rate of generation of energy. In this way I have shown (*Mon. Not. R.A.S.*, 85, pp. 196 and 394) that a star of given mass can rest in equilibrium with any radius from zero to infinity, different radii corresponding to different rates of generation of energy from zero to infinity by the star. A star adjusts its radius to suit its rate of generation of energy, and in so doing fixes its surface temperature and spectral type. If a star's rate of generation of energy were suddenly to change, the star would expand or contract until it had assumed the radius and temperature suited to its new rate of generation of energy. Contrary to common belief, an increase in a star's rate of generation of energy causes it to contract its radius and increase its temperature, while a slackening in its generation of energy is found to result in expansion and cooling. Thus we see the giant red stars such as Betelgeux do not owe their immense size to their radiating so much energy, but to their radiating so little; indeed, comparatively compact stars such as Plaskett's star and V Puppis are radiating far more in proportion to their masses. The general theoretical principle can be verified by the examination of pairs of stars of approximately equal mass, as for example the two pairs in the following table. The surface temperatures are here deduced directly from the observed spectra, the radii then being calculated in the way already explained.

Star.	Mass (in terms of sun).	Generation of energy per gram (ergs per second).	Observed temperature	Radius (in terms of sun).
{Sun . . .	1·00	1·9	5750	1 00
{a Cent. B .	0·97	1·4	3700	2·03
{Procyon . .	1·13	10·2	8300	1·17
{a Cent. A . .	1·14	2 3	5000	1·56

STELLAR EVOLUTION.

There is not likely to be any abrupt change in the rate of generation of energy of an actual star. There will be a slow secular decrease, but this will be associated with a slow secular decrease of the star's mass resulting from its continual emission of radiation. For example, the 560,000 calories of radiation which stream out every minute from each square inch of the sun's surface have a mass of $2{\cdot}5 \times 10^{-8}$ gm., whence it is readily calculated that the sun's mass must diminish by 250 million tons every minute. After millions of millions of years this rate of wastage produces an effect even on the gigantic mass of the sun. To trace the changes in the radius and temperature of an actual star we must study the sequence of configurations assumed in turn as the mass and the rate of generation of energy change together. In this way I have found (*Mon. Not. R.A.S.*, January 1925) that a normal star would first decrease in size and get hotter, but would ultimately expand and get cooler again. This result provides a simple dynamical interpretation of the sequence of 'ascending and descending temperatures' which was first suggested by Lockyer, and formed the outstanding feature of Russell's 1913 theory of stellar evolution—although our physical interpretation is very different from that suggested by Russell.

THE ATOMIC WEIGHT OF STELLAR MATTER.

In the simplest case, in which energy is generated uniformly throughout a star's mass, the surface temperature T assumed by a star of mass M and of given luminosity (or rate of generation of energy) is given by the equation—

$$\text{Star's luminosity} = C\left(\frac{N^2}{A}\right)^{-0{\cdot}8} T^{0{\cdot}8}\mu^{6{\cdot}8} f(M).$$

Here C is a known constant, N and A are the atomic number and atomic weight of the stellar atoms, and μ the effective molecular weight (about 2) of the broken-up stellar material; T is the temperature of the star's surface and $f(M)$ is a quantity I have calculated and tabulated, which depends only on the star's mass (*Mon. Not. R.A.S.*, 85, p. 395).

The quantity N^2/A necessarily occurs in the foregoing formula, because the coefficient of opacity, by which the star's whole structure is determined, is proportional to N^2/A. If a Maxwell demon could cut every atomic nucleus in a piece of matter into two equal halves, he would halve both N and A and so also N^2/A, with the result that the substance would become twice as transparent as before. This shows that a large clot of matter in the form of a massive nucleus is far more effective in absorbing X-radiation than a large number of small clots of equal total mass. It is for this reason that the physicist and surgeon both select lead as the material with which to screen their X-ray apparatus; a ton of lead is far more effective in stopping unwanted X-rays than a ton of wood or of iron. If we knew the strength of an X-ray apparatus, and the total weight of shielding material round it, we could form a very fair estimate of the atomic weight of the shielding material by measuring the amount of X-radiation which escaped through it

A very similar method may be used to determine the atomic weight of the atoms of which the stars are composed. A star is in effect nothing but a huge X-ray apparatus. We know the total mass of many stars, and we can readily calculate the rate at which they are generating X-rays—it is merely the rate at which they are radiating energy away into space. If we could shut our Maxwell demon inside a star and make him cut each atomic nucleus in half, keeping the star's mass and rate of generation unaltered, we should halve the coefficient of opacity of the star. This would necessitate a change in the star's build: in actual fact its radius would increase fourfold while its surface temperature would be halved. We could follow the progress of the demon's work by watching the changes in the surface temperature of the star. Hence from the observed surface temperature of any star the mass and luminosity of which are known, it must be possible to estimate the atomic weight of the atoms of which the star is composed. The formula given above provides the means.

I ought perhaps to mention in passing that Eddington and others have approached this question from the other end, assigning conjectural values to N^2/A from our knowledge of the elements which occur in the atmospheres of the sun and stars. Such a course appears to be very risky. A star's spectrum gives no indication of the selection of elements which occur in its interior; and there is at least an *a priori* possibility that the elements occurring there may be entirely different from those which appear in its surface; consider into what errors an extra-terrestrial observer might be led if he assumed that the earth contained no chemical elements beyond those appearing in its atmosphere.

When, however, the risk has been taken, and such values assigned to N^2/A, all the quantities which occur in the luminosity formula are known, and the only question which remains is whether the values calculated for the luminosity agree with those observed through the telescope. They do not.

It is clear that the value of N^2/A must be adjusted until agreement is obtained, and this amounts to precisely the same thing as determining N^2/A, directly and at once, from the luminosity formula. On doing this for a series of stars, I have found (*Mon. Not. R.A.S.*, June 1926) that two very significant facts emerge. First, most of the values so determined prove to be higher than the value for uranium, the heaviest element known on earth. Second, the different values of N^2/A show an ordered arrangement, the youngest stars generally giving the highest values for N^2/A, and this value falling as we pass to older stars.

The second of these results has far-reaching implications. Contrary to the views of the early spectroscopists, and contrary to what is still probably the prevalent belief, it now looks as though the atoms in a star become simpler as the star grows older; evolution appears to be from complex to simple, and not, as in biology, from simple to complex. There is at present no direct experimental evidence bearing on this question except that provided by radioactivity, where evolution is certainly from complex to simple, atoms of lower atomic weight being continually produced by the disappearance of atoms of higher atomic weight.

The evidence of physical astronomy, pointing to an evolution of matter in the same direction, suggests that the main evolution of matter in the universe may be of the same type as, but a generalisation of, the radioactive processes as they occur on earth. The evidence so far given has been based entirely on Kramers' theory of opacity for X-radiation. This theory has been found to agree very well with the observed absorption in the laboratory of radiation of about the wavelength which occurs in stellar interiors, while its theoretical basis has been discussed fully and critically by Eddington, Milne, and others, who have been unable to suggest any substantial alteration. Still, if the evidence from Kramers' formula were the only evidence available, our conclusions would be open to the charge of resting, if not on a slight, at least on a single, foundation. But there is plenty of further evidence, as we shall now see.

DISTRIBUTION OF CHEMICAL ELEMENTS IN A STAR.

A star necessarily arranges itself so that there is a great concentration of matter near its centre. This is primarily a consequence of the inverse square law of gravitation, although the opacity law is involved also to some extent. With Kramers' formula for the opacity the arrangement is such that the central density is 100 or more times the mean density, while at least some 90 or 95 per cent. of the star's total mass is concentrated in a sphere of half the radius, and so of only one-eighth the volume, of the star. But the degree of central condensation is rather insensitive to changes in the opacity formula, and any reasonable formula would still give very high central condensation. A strict mathematical argument based on this circumstance (*Mon. Not. R.A.S.*, June 1926, p. 561) enables us to rule out the possibility of convection currents stirring up a star's interior in the way in which boiling water is stirred up in a kettle. Convection occurs in a kettle because the hot water at the bottom is of lower density than the cool water at the top; it is absent in a star because the hot matter near the centre, notwithstanding its intense heat, is still far, far denser than the cool matter near the surface. Thus, the mixture of matter in a star's interior is not analogous to that in the earth's lower atmosphere, where the constituent gases are kept thoroughly mixed by winds and storms, but rather to a serene upper atmosphere in which the lightest elements float to the top while the heaviest sink downwards under gravity.

Such considerations as these suggest at once that the elements which indicate their presence in the spectra of the outermost layers of the sun and stars are only the very lightest of the series of elements existing in the star. It is natural that the earth, formed originally out of the sun's outer layers, should contain precisely the same chemical elements as these outer layers, but it now appears that there ought to be heavier elements inside. The calculation which assigns to stellar matter atomic numbers higher than that of uranium no longer looks suspicious or paradoxical; it begins to look natural, and indeed almost inevitable.

THE GENERATION OF ENERGY IN A STAR.

Further evidence that the atomic weights of stellar atoms are higher than those of any known terrestrial atoms may be obtained by considering the rate of generation of energy inside a star. The sun radiates energy at about 2 ergs per second for each gram of its mass, and so must generate energy at this rate in its interior. To the best of our knowledge it has generated and radiated at this, or a greater, rate for some millions of millions of years. Could the sun have any such radiating capacity if its interior were formed of the common terrestrial elements, calcium, iron, silicon, etc.?

One's first impulse is to say, No. Even if the sun were built of pure uranium, its radiating power would be only about one-half of that observed, and would only last for a minute fraction of what is believed to have been the sun's life. A sun of pure radium would radiate more than enough for the moment, but its life would be limited to a few thousand years. No possible combination of terrestrial elements can give the combination of high radiation and of staying power which is observed in the sun and stars.

We must, however, remember that stellar interiors are at pressures and temperatures which are quite unattainable in our laboratories. We are led to wonder whether our terrestrial elements would behave quite differently if they were exposed to stellar conditions. Is it possible, for example, that the sun's interior is formed of ordinary terrestrial elements, which owe their high generation of energy merely to their high temperatures and pressures?

A general survey of astronomy throws a good deal of light on this question. We find immediately that the stars which radiate most energetically (per unit mass) are not, broadly speaking, the hottest stars, and neither are they the densest. Some of the hottest and densest stars are entirely put to shame in the matter of radiation by very cool stars of low density such as Antares and Betelgeux. If we arrange the stars in order of radiation per unit mass, we shall find that we have arranged them neither in order of temperature nor of density, but very approximately in order of age; the youngest stars radiate most energetically, regardless of their interior temperatures and density; the older stars appear to be tired out.

The general tendency is shown in the following table:

Star.	Generation of energy (ergs per gram).	Central temperature	Central density	Age
Plaskett's Star .	1000	500,000,000	Very great	Less than 10^{11} yr
V Puppis . .	640	300,000,000	More than 1,000	
Antares . .	320	1,000,000	0 005	
Capella A . .	50	8,000,000	0·5	Less than 10^{12} yr
Sirius . . .	21	150,000,000	1,000	10^{12} yr
Sun . . .	1·88	70,000,000	300	7×10^{12} yr.
a Cent B . .	1·39	15,000,000	10	7×10^{12} yr.
Kruger 60 B .	0·02	70,000,000	30,000	Very old.
Sirius B . .	0·003	Unknown	More than 53,000	Unknown.

If it is asked whether densities so high as these can really exist at the centres of the stars, the answer is provided by the companion to Sirius (Sirius B). Direct observation has shown that the *mean* density of this star is about 53,000, and the central density must of course be higher. Incidentally, as Eddington has remarked, this provides striking confirmation of our view that stellar matter consists of atoms broken up into their fundamental constituents. It is impossible to compress matter formed of complete atoms of radii 10^{-8} cm. or more to anything approaching these high densities, but there is no difficulty as regards minute nuclei and electrons of radii of the order of 10^{-13} cm.

It has to be admitted that many of the entries in the table are highly conjectural, and few can claim any great accuracy. But while many astronomers may prefer different values for individual entries in the table, I doubt if any would seriously challenge the general contention that a star's energy-generating capacity depends primarily on its age, and not, at any rate primarily, on its central temperature or density.

No doubt exceptions to the general rule can be found. An extreme example is provided by the earth and sun; the matter of which these two bodies are formed must be of the same ultimate age, yet they radiate at very different rates per unit mass. This is readily explained if we suppose the heavy atoms from which the sun's energy originates to have sunk deep into its interior, and so not to have entered into the composition of the earth and planets: a similar explanation will account for the different radiating capacities of the components of binary systems. But these exceptions result from special conditions prevailing in special cases; they do not affect the general law that a star's generation of energy is not determined by either its density or its temperature.

The accompanying table shows that the law is well supported by observational astronomy; it can also be reached from a theoretical study of the actual process of generation of energy in a star. A mass of evidence, mostly dynamical, indicates that the stars must have existed for millions of millions of years To take one example, newly formed binary stars have circular, or nearly circular, orbits; this is a consequence of the manner of their formation. Every gravitational pull on a circular orbit tends to make the orbit more elliptical, so that the older a binary star is, the more elliptical its orbit ought to be. This is actually found to be the case. But from our general knowledge of the number and masses of the stars wandering about in space, we can estimate the rates at which the ellipticities of the orbits of binary stars ought to increase, and this in turn makes it possible to estimate the ages of actual stars. It is a mere problem of dynamics, and the answer comes out in millions of millions of years.

We can now estimate the total amount of radiation which must have been emitted by particular stars in the millions of millions of years they have existed; and, except in the case of the youngest stars of all, the total mass of this radiation is found to be far greater than the present mass of the star. We obtain the mass of the star at its birth by adding the mass of all this radiation to that of the matter now remaining in the star. Thus its mass at birth must have been far greater than now. But, as a star's mass at any instant consists almost wholly of the mass of the matter of which it is composed, we see that the greater part of the matter contained in the original star has ceased to exist as matter; it has been annihilated and transformed into radiation which the star has radiated away into space. So far back as 1904 (NATURE, 70, p. 101) I put out the suggestion that energy might be created by the annihilation of matter; it now appears that this process must in actual truth be the source of the energy emitted by the sun and stars. Throughout a star's interior, electrons and protons must at intervals fall into one another and mutually destroy one another, the energy of their fall being set free as radiation.

The energy of this fall is enormous, being sufficient to set both the masses involved into motion with a velocity of 0·866 times that of light. In no other way can a given mass of matter be made to yield energy of amount comparable with this; for example, whereas the ordinary combustion of a ton of coal provides energy enough to drive an express locomotive for an hour, the annihilation of a ton of coal would provide enough energy for all the heating, lighting, power, and transport in Great Britain for a century.

Each proton or atom, as it is annihilated, makes a splash of radiant energy which travels through the star until, after innumerable absorptions and re-emissions, it reaches the star's surface and wanders off into space. Each splash is similar to the splashes produced by radioactive material in the spinthariscope, except for being many thousands of times more powerful. The great energy of the splashes is to some extent counterbalanced by their rarity. In the sun, for example, only about one atom in every 10^{17} annihilates itself each hour. A cubic centimetre of the sun's mass contains, let us say, 10^{22} atoms, and of these about 100,000 are annihilated every hour. The energy produced in a cubic centimetre of the sun's mass is thus not very great, averaging about 9400 ergs or 0·00022 calories per hour; the enormous flow of energy from the sun's surface results from the fact that all the energy produced in a cone 433,000 miles in depth has to stream out through the mouth of this cone.

Such, in brief, is the mechanism by which stellar energy is generated. The question immediately before us is whether this generation of energy proceeds more merrily, whether the electrons and protons fall into one another more frequently, when the stellar matter is in a state of high temperature and high density.

It is a matter of direct observation that ordinary radioactive processes cannot be either inhibited or intensified by such temperatures as are available in the laboratory; the quantum theory provides the reason. Einstein has shown how a sub-atomic generation of radiation can occur in either of two ways, spontaneously or through the stimulus of incident radiation, and it is easy to calculate the temperature at which the second process becomes operative. It is found that the quantum of radiation at this temperature must have energy equal to the energy set free by the sub-atomic change in question. The temperature necessary to expedite the disintegration of uranium is in this way found to be of the order of 120,000 million degrees, and it at once becomes clear why warming up uranium in the laboratory cannot speed up its disintegration. A similar calculation shows that the temperature necessary to influence the rate of subatomic annihilation of matter is of the order of 7,500,000 million degrees. It may be argued that a lower temperature, although not adequate to bring about the actual annihilation of matter, might set up sub-atomic processes of adequate intensity. This is true as regards a star's momentary radiation, but such processes cannot provide an adequate duration for the radiation. All processes which are affected by temperatures of less than about 7,500,000 million degrees leave the total number of electrons and the total number of protons in a star unaltered, whereas the whole evidence of astronomy is that the number of electrons and protons in a star must continually decrease.

With this figure before us, it is clear that the comparatively feeble stellar temperatures of less than a thousand million degrees must be quite inoperative in regard to the main generation of stellar energy; indeed the heat of the hottest of stellar interiors can have no more influence on the rate of annihilation of matter than a warm summer's day has on the rate of disintegration of uranium. Thus it seems abundantly clear that what is annihilating the matter of the stars is neither heat nor cold, neither high density nor low, but merely the passage of time.

These considerations notwithstanding, it has been suggested by Russell (NATURE, Aug. 8, 1925), whose ideas were afterwards adopted by Eddington (NATURE, May 1, 1926), that the annihilation of matter (which they agree to be the ultimate source of stellar radiation) may be produced by the raising of ordinary matter to a critical temperature of some 30 or 40 million degrees. Russell suggests that matter is, broadly speaking, inert until it reaches this critical temperature, when an unlimited transformation of matter into radiation suddenly takes place.

In addition to running foul of the physical principles just explained, this suggestion encounters the difficulty that the generation of energy it provides would not only be unlimited but also illimitable; when once it began there would be no stopping it. The proposal of Russell and Eddington would, in effect, make matter thermodynamically unstable at stellar temperatures by endowing it with the properties of an explosive at its flash-point. When once stellar matter reached its flash-point, its resulting annihilation would generate so much heat that the adjacent matter would also in turn be raised to the flash-point, and the whole star would almost instantaneously explode into radiation. The sky would show no steady star-light, but merely a succession of apparitions of novæ of the most terrifying kind, as the various stars reached their flash-points and 'popped off' in turn. In spite of the astronomical eminence of its father and stepfather, I, for one, find it impossible to accept a hypothesis which is not only contrary to the general principles of physics, but also against which the very stars fight in their courses.

A general mathematical discussion of the stability problem shows that a star built of matter the rate of generation of energy of which is absolutely unaffected by changes of temperature and density, will be dynamically stable. But such a star, although stable, has not much stability to spare. If we change the properties of our stellar matter in the sense of making an increase of temperature increase the rate of generation of energy, we lessen the already small margin of stability. Any substantial step in this direction would render the star dynamically unstable.

Combining this purely dynamical result with the physical principles already explained. it becomes clear that we may, to a good first approximation at least, suppose that an increase in the temperature of stellar matter produces no increase at all in its rate of generation of energy.

Stellar radiation must either originate in types of matter known to us on earth or else in other and unknown types. When once it is accepted that high temperature and density can do nothing to accelerate the generation of radiation by ordinary matter, it becomes clear that stellar radiation cannot originate in types of matter known to us on earth. Other types of matter must exist and, unless physics and chemistry have gone very far astray in recent years, these other types can only be elements of higher atomic weight than uranium. The significance of the calculation which showed that stellar atomic weights are, in the main, higher than that of uranium now becomes apparent.

RECAPITULATION AND INTERPRETATION OF RESULTS.

We have now reached the conclusion, by three distinct paths, that the atomic weights of stellar atoms must in the main be higher than that of uranium :

(1) By direct calculations from Kramers' formula.

(2) From the consideration that the atoms near the centre of a star must be substantially heavier than those near its surface.

(3) From the consideration that atoms of atomic weight less than uranium, no matter how much they were heated or compressed, could not provide the intense and lasting radiation emitted by the stars.

The atomic weights of stellar atoms are not only found to be higher than that of uranium, but also they vary systematically from star to star. In brief, the youngest stars are found to have the highest atomic weights, and with this clue all the pieces of the puzzle are found to fit together.

We have to suppose that matter in its earliest state consists of a mixture of elements of different atomic weights, those elements the atomic weights of which are highest having the greatest capacity for the spontaneous generation of radiation by annihilating themselves, and, in consequence, having the shortest lives. These elements will be the first to disappear as the star ages, their disappearance reducing not only the mean atomic weight in the star but also the mean rate of radiation per unit mass, since these heavy elements are the most energetic radiators. Just as, on the coast, the hardest rocks survive for longest the disintegrating action of the sea, so in a star the lightest elements survive for longest the disintegrating action of time, so that ultimately the star contains only the lightest elements of all and so has lost all radiating power. Our terrestrial elements have so little capacity for spontaneous transformation that they may properly be described as 'permanent.' Calculation shows that if they underwent any appreciable transformation in periods comparable with the life of a star (say 10^{13} years) the spontaneous generation of heat by the earth's mass would make the earth too hot for human habitation. The radioactive elements are of course an exception ; they probably represent the last surviving vestiges of more vigorous primeval matter, and so form a bridge between the inert permanent elements and the heavier and shorter-lived elements of the stars.

An interesting question is whether the heavy atoms change into radiation instantaneously, or only through successive stages of transformation. Astronomical evidence makes it fairly certain that the most massive stars contain more atoms than our sun, there being a wider range in the weights of the stars than in the atomic weights of their atoms. As these stars must in time become reduced to the mass of our sun, the process of evolution clearly calls for an actual annihilation of atoms ; it is not enough to postulate a mere gradual decrease in the atomic weight of each atom until it ends as a permanent atom. Radioactivity suggests that this latter process may also occur, but the evidence of astronomy is that it is at best a subsidiary process.

The number of 'permanent' atoms in a massive star such as Antares or V Puppis cannot undergo any perceptible diminution in the next 10^{13} years, so that they must all survive in the final star of mass perhaps only a fiftieth of that of the present star. Thus some ninety-eight per cent. of the present masses of these stars must consist of non-permanent atoms. To put it in another way, the present mass of a star such as Antares or V Puppis must consist, as regards 98 per cent., of atoms which are destined to change into radiation, and as regards only 2 per cent., of atoms which cannot change into radiation. Clearly the primary matter of the universe must be of non-permanent type; our terrestrial atoms are a mere residue of non-transformable ashes. Like the animalculæ of the raindrop looking out on to Niagara, we discern that our physics and chemistry are only the fringes of far-reaching sciences; beyond the seashore we have explored in our laboratories lies the ocean the existence of which we are only just beginning to suspect.

We are thus led to picture the youngest stars as formed of matter practically all of which is unknown on earth, being of atomic weight higher than that of uranium. This possesses the capacity of annihilating itself spontaneously, the energy produced in the process being set free as radiation. Its rate of generation of energy, as estimated from the luminosities of the youngest stars, is of the order of 1000 ergs per gram per second. As the annihilation of 1 gram of matter produces 9×10^{20} ergs of energy, the matter must have a 'period of decay' of 9×10^{17} seconds, or about 30,000 million years. As the star ages, and only less transformable matter remains, the period of decay is correspondingly lengthened. The matter in the sun, radiating 2 ergs per gram per second, must have a period of decay of 15,000,000 million years. It is these periods of decay which determine the rates of evolution and length of life of the stars. Broadly speaking, a star lasts as long as the atoms of which it is composed, and the lives of these atoms are constants of Nature.

We notice that the periods of decay of stellar atoms are long compared with the periods of ordinary radioactive decay, suggesting that the radioactive elements are mere transitory formations in the evolution of the elements.

THE CRITICAL CENTRAL TEMPERATURE.

A group of stars selected for having approximately equal masses—as, for example, the sun, Procyon, and the two components of α Centauri—might be expected *a priori* to have very different rates of generation of energy, with the result that the stars would have very different surface temperatures and also very different central temperatures. Indeed, on first approaching the question, the whole range of temperatures from zero to infinity would seem to be open for each of these quantities. Yet in actual fact the surface temperatures of the four stars mentioned, as also of all stars of the same mass, lie within the narrow range between 3700 and 8300 degrees; their central temperatures probably lie within the range from 15 to 100 million degrees. For stars of other masses the limits are different, and are substantially wider for stars of great mass. But the stars of any definite mass always show a definite upper limit of temperature, both for the surface temperature and for the central temperature. These limits are never exceeded, but the majority of stars of the particular mass in question seem to crowd towards them. The existence of one limit of course implies the existence of the other, and it seems likely that the limit to the central temperature is the more fundamental. Stars having the same mass as our sun never have central temperatures higher than 80 million degrees, while the majority have central temperatures not very far below 80 million degrees. For stars twenty times as massive as our sun, the corresponding limit is probably somewhere about 300 million degrees, while there are intermediate limits for stars of intermediate mass.

This is obviously one of the fundamental facts of physical astronomy: What does it mean? The normal event for a star like V Puppis, losing mass and capacity for generation of energy together, would be a gradual shrinkage of size accompanied by a steady increase of central temperature. What is it that checks this normal course of evolution so soon as the central temperature touches 300 million degrees?

I have recently suggested that the upper limit of temperature for any star is simply that at which its central atoms begin to be stripped nearly or entirely bare of electrons. This is merely a matter of simple calculation, but we have to suppose the atoms at the star's centre to have the high atomic weights which other considerations, as we have seen, assign to them. For example, a temperature of 300 million degrees suffices to strip the last electrons off atoms of atomic weight 300 or more. The fall in the critical central temperature as a star gets older and less massive is, on this view, a direct consequence of the decrease in the atomic weight of the stellar material, which occurs as the heaviest atoms gradually annihilate themselves.

It remains to explain why this temperature constitutes an upper limit, why a star cannot go on getting hotter after its innermost atoms are stripped bare of electrons. So far as I can see, only one answer is possible: the stripping of the electrons from an atom must remove its power of annihilating itself, and so must inhibit its capacity for generating radiation. The central atoms of the star now act precisely like the governor of a steam engine, regulating the generation of energy so that the central temperature is kept close to the critical temperature. If the star begins to get too hot, the central atoms become stripped bare of electrons, and so leave off generating energy. The star then begins to cool off, and as it does so the atoms reform and resume their generation of energy, again heating up the star. The mechanism provides a perfect thermostat, and it is easily shown that its action is stable. As a star ages the heavier atoms at its centre are the first to be transformed into radiation and so to disappear; their place is taken by lighter atoms, and as a lower temperature suffices to strip these lighter atoms bare of electrons, the critical central temperature of the star falls.

An interesting confirmation of this hypothesis is provided by the components of newly formed binaries. These have the high energy-generating capacity per unit mass of young stars, associated with the small mass appropriate to much older stars. Clearly the 'governor' action ought to be particularly active in checking the generation of energy in these stars, so that they ought to have central temperatures close up to the maximum for their mass. This is in actual fact found to be the case.

All the evidence at present available points to the annihilation of matter being a quantum phenomenon; possibly it represents nothing more than the spontaneous drop of an electron to a zero-quantum orbit. This would suggest an explanation of why bare nuclei and free electrons should be immune from annihilation, and hence why atoms stripped bare of electrons cannot generate energy.

HIGHLY-PENETRATING RADIATION.

If our earth exhibits only one end of the chain of chemical elements, where shall we look for the other end? Moving backwards along the evolutionary sequence we come to younger and yet younger stars, containing elements of higher and higher atomic weight. Passing beyond the stars altogether we come to the nebulæ; here we ought to find the elements of highest atomic weight of all, and the matter of greatest radiating capacity.

Visually the nebulæ are extremely faint objects; their emission of visual radiation per unit mass is only about equal to that of our sun. There is, however, an essential difference between the radiation generated in the stars and that generated in the nebulæ. Radiation, when first generated, must have enormous penetrating power; the simultaneous annihilation of a single electron and proton produces radiation of wave-length only $1\cdot3 \times 10^{-13}$ cm. The high penetrating power of this short wave-length radiation, nevertheless, only suffices to carry it through a small fraction of the radius of a star, and successive absorptions and re-emissions soften it, by a sort of generalised Compton effect, until it finally emerges from the surface of the star as ordinary temperature radiation. The density of the nebulæ is, however, so much lower than that of the stars that similar radiation, when generated inside a nebula, passes almost unchecked directly into outer space. Here and there the radiation may devastate isolated atoms in its passage, ejecting a few million-volt electrons in the process, but the majority of it will pass on unhindered until it meets a medium of substantial absorbing powers. Thus we should expect the atmospheres of the stars, sun, and earth, and even the solid body of the earth, to be under continual bombardment by highly-penetrating radiation of nebular origin.

Such radiation has been detected in the earth's atmosphere by Kolhörster, Millikan, and many others, who are satisfied that it is of extra-terrestrial origin. If it originated in the stars, the amount received would depend largely upon the position of the sun. As it does not, the radiation must originate in nebulæ or cosmic masses other than stars. Quite recently (NATURE, October 9, 1926), Kolhorster and von Salis have found that its intensity varies with the position of cosmic masses, in a way which indicates that the radiation is received largely from regions near the Milky Way, especially the regions of Andromeda and Hercules.

I have calculated that the total amount of highly-penetrating radiation actually received is of the order of twice that which ought to be received from the Andromeda nebula alone (NATURE, December 12, 1925) if this consisted solely of matter of the same radiating power as the very youngest of the stars. Clearly the total amount of radiation which is observed to be received on earth is of the right order of magnitude; it is, moreover, so large that it is difficult to imagine any possible origin for it other than that just mentioned. Its penetrating power appears to be rather less than might have been expected if it originated in the actual annihilation of electrons and protons, but I do not think the difficulty, if it exists, is insuperable. Quite recently Rosseland (*Astro. Jour.*, May 1926) has suggested that bombardment by this radiation may be the cause of the observed bright lines in stellar spectra; I had previously (NATURE, December 12, 1925) suggested a similar origin for the luminosity of the irregular nebulæ.

There is a temptation to try to probe still further into the physics of the nebulæ, to try to understand the properties of matter in its still earlier forms, perhaps even to get a glimpse of it in the actual process of creation. But to yield to this temptation would carry us too far into the realms of conjecture and speculation. So far the course of our argument has not depended on either conjecture or speculation. Where there has appeared at first to be a choice of ways, all ways except one have proved on further examination to be prohibited either by observational knowledge or by well-established principles of physics or dynamics: there has never been any real choice. For this reason the conclusions we have reached, although certainly novel and perhaps unexpected, appear to me to be, in their main lines, inevitable; I can see no means of escape.

LIFE AND THE UNIVERSE.

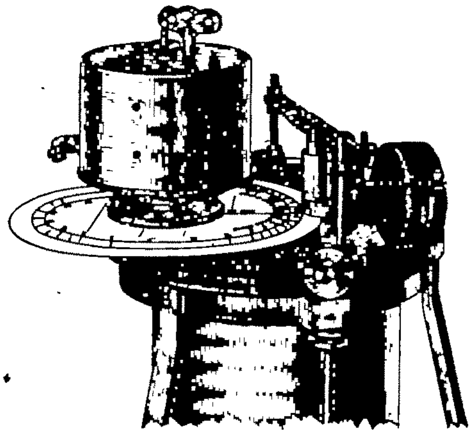
A general survey of the results obtained by cosmical physics has suggested that terrestrial laboratory physics is a mere tail-end of the general science of physics. The primary physical process of the universe is the conversion of matter into radiation, a process which did not come within our terrestrial purview at all until 1904. The primary matter of the universe consists of highly dissociated atoms, a state of matter which, again, was not contemplated before 1917. The primary radiation of the universe is not visible light, but short-wave radiation of a hardness which would have seemed incredible at the beginning of the present century. Indeed, our whole knowledge of the really fundamental physical conditions of the universe in which we live is a growth of the last quarter of a century.

The simple explanation of this situation is to be found in the fact that life, naturally enough, begins its exploration of Nature by studying the conditions which immediately surround it; the study of the general conditions of the universe as a whole is a far more difficult task which life on this planet is only now approaching. Now the physical conditions under which life is possible form only a tiny fraction of the range of physical conditions which prevail in the universe as a whole. The very concept of life implies duration in time; there can be no life where the atoms change their make-up millions of times a second and no pair of atoms can ever become joined together. It also implies a certain mobility in space, and these two implications restrict life to the small range of physical conditions in which the liquid state is possible. Our survey of the universe has shown how small this range is in comparison with the range of the whole universe. Primeva matter must go on transforming itself into radiatio for millions of millions of years to produce an infinitesimal amount of the inert ash on which life ca exist. Even then, this residue of ash must not be to hot or too cold, or life will be impossible. It is difficul to imagine life of any high order except on planet warmed by a sun, and even after a star has lived it life of millions of millions of years, the chance, so far a we can calculate it, is still about a hundred thousan to one against its being a sun surrounded by planets In every respect—space, time, physical conditions—life is limited to an almost inconceivably small corne of the universe.

What, then, is life? Is it the final climax toward which the whole creation moves, for which the million of millions of years of transformation of matter in uninhabited stars and nebulæ, and of waste radiation int desert space, have been only an incredibly extravagant preparation? Or is it a mere accidental an possibly quite unimportant by-product of natura processes, which have some other and more stupendou end in view? Or, to glance at a still more modest lin of thought, is it of the nature of a disease which affect matter in its old age, when it has lost the high temperature and capacity for generating high-frequency radiation with which younger and more vigorous matte would at once destroy life? Or, throwing humility aside, is it the only reality, which creates, instead o being created by, the colossal masses of the stars and nebulæ and the almost inconceivably long vistas o astronomical time? There are too many ways even to enumerate of interpreting the conclusions we have reached; I do not, however, think there is any one way of evading them.

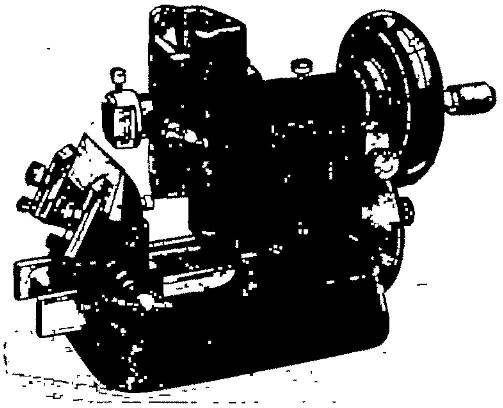
Printed in Great Britain by R. & R. CLARK, LIMITED, *Edinburgh.*

SMOKE POLLUTION



Dr. Owens's Instruments for Measuring Atmospheric Pollution are made by
C. F. CASELLA & CO. LTD.
Parliament St., London, S.W.1

NO. 3.
AUTOMATIC ROTARY MICROTOME



NEW AND IMPROVED MODEL
WITH —
DETACHABLE KNIFE HOLDER WITH FINE ADJUSTMENT FOR ANGLE.
UNIVERSAL OBJECT CLAMP, RIGID AND PRACTICAL
TOTALLY ENCLOSED MECHANISM
HEAVY CONSTRUCTION (WEIGHT 28 lbs).

PRICE £17:17:6

LABORATORY EQUIPMENT CO.
MICROSCOPES AND ACCESSORIES, MICROTOMES, PHOTOMICROGRAPHIC APPARATUS, BENCHES, Etc
Showroom: 310/312 Regent Street, London, W.1
Telephone: Langham 3111

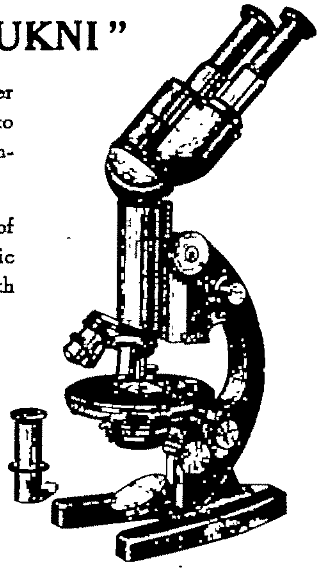
HOPKIN & WILLIAMS, Ltd.
16 & 17 Cross St., Hatton Garden, London, E.C.1
Works: Ilford, Essex. Telegrams: "Cerium, Smith, London." Telephone: Holborn 6684 and 6685.

The Leading British House for
CHEMICAL REAGENTS
PURE, FINE, AND RARE CHEMICALS
Manufacturers of Guaranteed
Chemical Reagents for Analysis and Research.
Made and supplied to standards and specifications described in the publication
"Analytical Reagents: Standards and Tests."
Compiled by
EDMUND WHITE, B.Sc. (Lond.), F.I.C.
Published by
HOPKIN & WILLIAMS, LTD.
NEW EDITION, 1925.
CLOTH BOUND. INTERLEAVED.
Price 1/6 post free from the Publishers.

ZEISS
Binocular Tube Attachment
"BITUKNI"

Enables the observer to look obliquely into the microscope without inclining it.

It affords a means of viewing microscopic objects in relief with single objectives, even with the highest power immersion objectives.



Full particulars in List "M. 408" from the British Representatives:
CARL ZEISS (LONDON) LTD.
Winsley House, Wells St., Oxford St., London, W.1

WHATMAN FILTER PAPERS

The range of WHATMAN Filter Papers now manufactured is the most complete produced by any mill in the world, and covers practically all the requirements of modern high-grade technical work.

They are obtainable from all Laboratory Furnishers and are packed in sealed and labelled packages.

Manufactured by W. & R. BALSTON, LTD., Maidstone, KENT.

Samples and Price List on application.

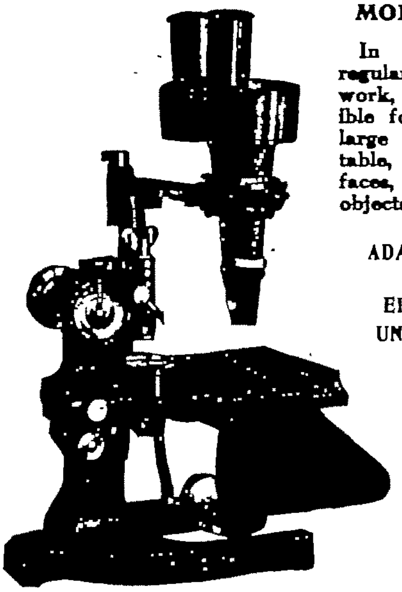
In case of difficulty apply to Sole Mill Representatives:—

Telephone:
CITY 7413 (3 lines).

H. REEVE ANGEL & CO., LTD., 9 Bridewell Place, LONDON, E.C.4.

SPENCER BINOCULAR MICROSCOPE

MODEL 58



In addition to regular microscopic work, it is convertible for examining large objects on a table, vertical surfaces, and high objects.

ADAPTABILITY AND EFFICIENCY UNEQUALLED

MICROSCOPE LAMPS FOR ALL REQUIREMENTS

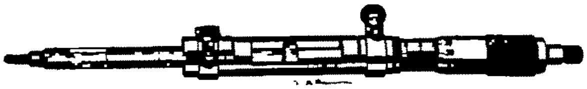
NEW DAYLIGHT LAMP

MICROTOMES, THOMA-HAWKSLEY HÆMACYTOMETERS, ETC.

Catalogues free.

REPAIRS A SPECIALITY

HAWKSLEY & SONS, LTD.
83 Wigmore Street, London, W.1.



'AGLA'—
Micrometer Syringe Apparatus

Secures a fine degree of accuracy in—
Immunological titrations with small quantities of Sera. Micro-chemical titrations and micro-gas analyses. Calibration of pipettes of small volume.

Price in London, 55/- Net. Further Information on request

BURROUGHS WELLCOME & CO., LONDON

xx 4609 *All Rights Reserved*

NELSON-DALLINGER MICROSCOPE LAMP

As described in, and recommended by, the standard text-books. The most perfect illuminant for visual microscopy available. Complete with aplanatic bull's-eye, insulated metal chimney, etc.

Full particulars on request.

JAMES SWIFT & SON LTD.

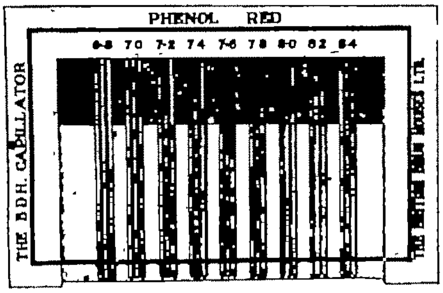
Makers of the Highest Grade Microscopes and Accessories.

81 Tottenham Court Road, London, W.1.

B.D.H. CAPILLATOR

THE B.D.H. "Capillator" provides an improved method for the colorimetric determination of Hydrogen Ion Concentration.

The "Capillator" consists of a series of capillary tubes filled with buffer solutions containing an indicator. These tubes are mounted in threes on a white card, and form a series of coloured strips, each strip being marked with its exact PH value. Each card illustrates the complete colour change of the indicator.



A determination of PH is carried out by mixing equal quantities of liquid and indicator, and comparing the colour produced with that of the standard tubes of the "Capillator." By means of the "Capillator" determinations of PH are carried out expeditiously and accurately, and as little as one drop of the liquid will suffice for a test.

Prices and further particulars will be supplied on application.

THE BRITISH DRUG HOUSES, LTD.

Makers of Fine Chemicals

Graham Street, LONDON, N.1

"POSTLIP"

(No. 633 Mill)

ENGLISH FILTER PAPERS

Manufactured in
ANNUALLY INCREASING QUANTITIES
for upwards of 50 years.

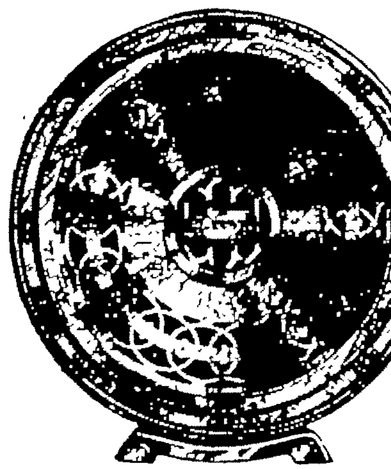
White and Grey Plain, Antique, Crinkled, and Embossed.

All sizes in Squares, Circles, and Folded Filters. Rolls made to order.

Pure Filterings for Laboratory Work and in quantities for all industrial purposes.

See Report of TESTS made by The National Physical Laboratory, a copy of which will be sent on application, together with free samples if required.

EVANS, ADLARD & CO., LTD.
POSTLIP MILLS,
WINCHCOMBE, CHELTENHAM, ENGLAND.



Like the Potter at his wheel

THE modern mechanic at his lathe, and the old-time potter at his wheel—craftsmen both! Though the electric motor has replaced the foot pedal, much of the potter's skill and deftness in fashioning his ware is needed by the worker responsible for making the modern Loud Speaker.

Those engaged in the production of Brown Loud Speakers and Headphones have not allowed the necessity of mass production to exclude the human element. It is this which is responsible for the many unique features for which the Brown is noted. Through every stage—from the original designing of the instrument to the final, rigorous testing—the Brown receives from the hands of its makers almost the care and attention of a parent. You can only appreciate the full meaning and effect of this conscientious workmanship when you see and hear the Brown for yourself. In its flawless appearance, in its superb tone, and in its remarkable volume—alike in *every* phase of the Broadcast—the Brown stands by itself—ahead of comparison.

¶ The new DISC. Brown reputation is fully upheld in this, the latest model. Strongly housed in its handsome metal case, in volume and tone it is unequalled. In two models (both 2000 ohms):

Cream, Brown or Black and Gold **£7.7.0** Oxidised Steel finish **£8.8.0**

S. G. BROWN, LTD.
Western Avenue, North Acton, W.3

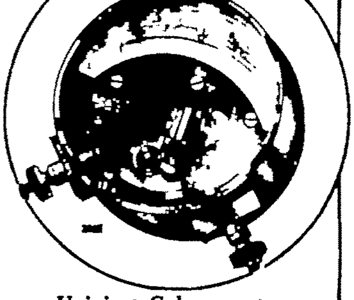
Retail Showrooms: 19 Mortimer Street, W.1; 15 Moorfields, Liverpool; 67 High Street, Southampton.

Wholesale Depots: 2 Lansdown Place West, Bath; Cross House, Westgate Road, Newcastle; 120 Wellington Street, Glasgow; 5-7 Godwin Street, Bradford. Howard S. Cooke & Co., 59 Caroline Street, Birmingham; N. Ireland: Robert Carmany, Union Chambers, 1 Union Street, Belfast.

Brown

G.A. 6486.

— Rail Bond Testing Sets



Unipivot Galvanometer
Pattern A

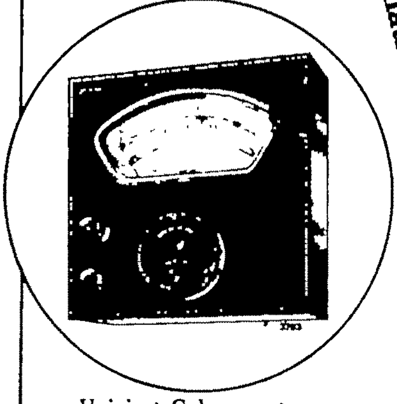
— Decade Pattern Wheatstone Bridges

— Cable Testing Outfits

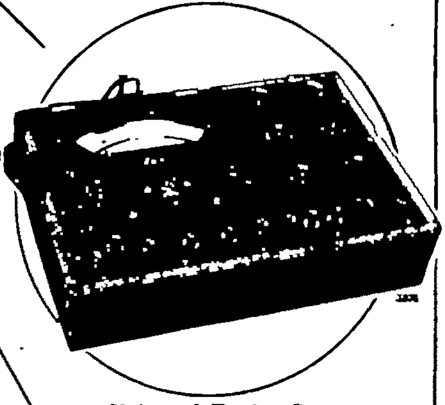
— Capacity Test Set

— Unipivot Galvanometers

— Insulation and Continuity Detector



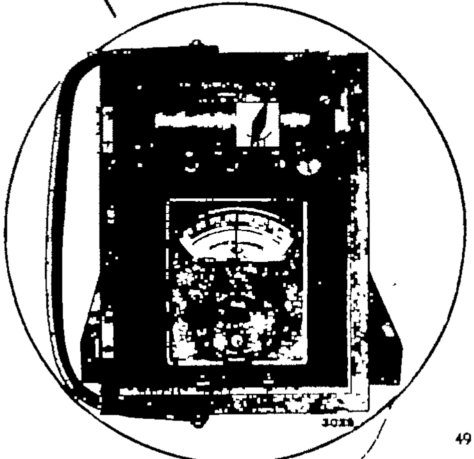
Unipivot Galvanometer
Pattern L



Universal Testing Set
Pattern V

THIS 27-PAGE BOOK

No. 160-N free on request.



— Direct Reading Fault Localiser —

CAMBRIDGE
INSTRUMENT CO LTD

WORKS:- LONDON & CAMBRIDGE

Head Office & Showrooms:- 45, GROSVENOR PLACE
LONDON, S.W.1.

49
3701

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

method of attack on the problem of the electrical state of our atmosphere, particularly at heights where direct observations are impossible. We may anticipate that an extension of such experiments will provide us with much valuable information not only on the degree of ionisation of the upper atmosphere but also on its diurnal and seasonal variations. Although only preliminary observations have so far been made on this question, the results obtained show that there is much promise in this new method of attack on a difficult problem

The phenomena of the aurora and the diurnal variation of the earth's magnetism have long been supposed to indicate that the upper atmosphere is highly ionised and an excellent conductor of electricity. The origin of the ionisation is a matter of much interest. Part, no doubt, is due to the ultra-violet light emitted by the sun, but there may be other important contributory causes. During this year, E. A. Milne has shown how certain atoms of matter, ejected from the sun, notably those of calcium, may, in consequence of absorption and emission of radiation, acquire sufficiently high velocities to penetrate deeply into our atmosphere. It may be that the brilliant auroræ and magnetic storms which so often accompany sunspot activity are a consequence of the projection into our atmosphere not only of electrons, as has long been supposed, but also of swiftly moving atoms of matter.

Another source of ionisation to be taken into account is the very penetrating radiation in the upper atmosphere brought to light by the experiments of Kolhorster and Millikan. The origin and nature of this radiation is still *sub judice*. Some have supposed it to be of cosmical origin and see in it evidence of the disintegration or formation of atoms of matter in worlds remote from us. On the other hand, we must not exclude the possibility of a mundane origin, for C. T. R. Wilson has given very strong reasons for believing that very high-speed electrons and penetrating radiations may be produced as a result of the movement of electrons in the intense electric fields which arise during thunderstorms. This penetrating radiation has been detected by the minute ionisation observed in electroscopes at high altitudes. The effects are very small and the experiments difficult, but we may hope to obtain more definite information as to the origin and nature of this radiation by the experiments now in progress.

Obituary.

MR. CHARLES HEDLEY.

THE sudden death of Mr. Charles Hedley at Mosman, Sydney, on September 14, deprives Australia of one of its foremost scientists, who was deservedly popular among a wide circle of friends. Hedley was the younger son of the Rev. Canon Hedley, and was born at Masham, Yorkshire, on February 27, 1862. Though in later years he was capable of great physical endurance, as a youth he was delicate, and on that account his school life was limited to two years at Eastbourne College; his wide knowledge was acquired by reading and observation, and instruction received from his father, who was a distinguished graduate of the University of Cambridge. For health reasons he spent much of his youth in the south of France and in Switzerland, where he acquired a taste for long walks and mountain climbing, two avocations from which he always derived much pleasure.

At the age of eighteen Hedley emigrated to New Zealand, where he proposed to engage in sheep farming, but he found the winter too severe and sought the warmer clime of Australia, where the rest of his life was spent. For some time he was engaged in fruit farming in Queensland, but natural history always had a strong attraction for him, and in 1889 he became attached to the Queensland Museum, Brisbane. Shortly afterwards he accompanied Sir William Macgregor on an expedition to British New Guinea, during which he made important zoological collections and observations.

In 1891 Hedley removed to Sydney and entered the service of the Trustees of the Australian Museum as assistant in charge of land shells. In 1896 he became conchologist, and in 1908 assistant curator. In 1920, on the death of R. Etheridge, jun., he became acting curator, and, later, principal keeper of collections. He resigned in 1925 to become scientific director of the Great Barrier Reef Investigation Committee, and was in that service at the time of his death. He had returned from Queensland, where he had been superintending the operation of boring the Barrier Reef at Michaelmas Cay, and was happily preparing to go to Japan as one of the Australian delegates to the Pan-Pacific Science Congress, when he contracted a cold, which was followed by more serious illness, and resulted in his death from heart failure.

Hedley was a seasoned and intrepid explorer both by sea and land, and had made many trips to New Guinea, Torres Strait, and various Pacific islands; his knowledge of the South Pacific and its natural history and ethnography was very extensive, perhaps unsurpassed. In 1896 he accompanied the expedition organised by the Royal Society of London to bore the atoll of Funafuti, Ellice Group. He remained on the island for two and a half months, and made extensive collections, which were afterwards described in "The Atoll of Funafuti" (Australian Museum Memoirs, 3, 1896–1900), to which Hedley contributed the "General Account," and the sections on ethnology and Mollusca.

Hedley was recognised as one of the world's leading conchologists, and much of his published work dealt with the Mollusca, but there were few branches of zoology of which he did not have an extensive knowledge, and he was also an accomplished botanist and ethnographer. He was greatly interested in zoogeography, and had made valuable contributions to our knowledge of that subject, particularly as regards the Pacific area and the faunal relations of southern lands. He was a firm believer in the former extension northwards of the Antarctic Continent, which had resulted in a faunal community between South America, South Africa, and Australia, and his conception of the vicissitudes of this land bridge (*Jour. Royal Soc N.S. Wales*, 29, 1895, pp. 278-286; *Proc. Linn. Soc.* London, Session 124, 1911-1912, pp. 80-90) is generally accepted by those who believe in the former connexion of South America and Australia.

Hedley was an indefatigable worker and a voluminous-writer, his published papers and articles totalling more than 160, and he was joint author of about twenty more. Most of these dealt with his special subjects, molluscs and zoogeography, but they also include botanical, ethnographical, and geological contributions. His earliest papers were mainly descriptive of the land shells of Queensland, but after his transfer to Sydney he devoted himself to general conchology, though he was always greatly interested in terrestrial molluscs, particularly in regard to their distribution and the evidence they offer as to the former relations of land and water. Some of his most useful contributions are various faunal lists such as "The Marine Fauna of Queensland" (*Rept. Austr. Ass. Adv. Sci.*, 1909, pp. 329-371); "A Check List of the Marine Fauna of New South Wales, Part 1, Mollusca" (Suppl. to *Jour. Roy. Soc N.S. Wales*, 51, pp. M. 1-M 120, 1917). He was a contributor to the Reports of the Shackleton British Antarctic Expedition of 1907–1909, writing on the molluscs of the 'raised beaches' of McMurdo Sound, and he described the molluscs of Mawson's Australasian Antarctic Expedition of 1911–1914. He was the author of a delightful sketch of the ecology of the Sydney beaches (*Jour. Roy. Soc. N.S. Wales*, 69, pp. 15-77, 1915). One of his longest conchological papers was his masterly "Revision of the Australian Turridæ" (*Rec. Austr. Mus.*, 13, pp. 213-359, 1922, 15 plates). He was skilled in pen-and-ink drawing, and many of his papers were illustrated by himself.

Hedley was a fellow of the Linnean and Malacological Societies of London; honorary member of the New Zealand Institute and of the Royal Societies of Victoria, Queensland, and Western Australia; corresponding member of the Zoological Society of London and of the Academy of Natural Sciences of Philadelphia. He was a past president of the Royal, the Linnean, and Royal Zoological Societies of New South Wales. In 1916 he gained the David Syme prize for scientific research, and in 1925 the Royal Society of New South Wales awarded him the Clarke Memorial Medal, the highest honour in its gift.

Hedley was completely absorbed in his work, which was also his hobby, and he was always ready to make sacrifices in the interests of scientific advancement. He was a most generous donor to the Australian Museum, both of specimens and works of reference, and many of his collecting trips, which invariably yielded a rich harvest of results, were financed by himself.

His body was cremated and the ashes scattered on the waters of the Great Barrier Reef, which he knew and loved so well.

C. ANDERSON.

News and Views.

DR. JEANS's article, which forms our supplement this week, may be regarded as a summing up of the hypothesis of stellar evolution and contributions which he has adumbrated in various publications for several years past. Even those who share neither his view-point nor his conclusions will be unable to withhold their admiration for the extreme ingenuity of the hypothesis and the masterly manner of its presentation. Indeed, it may even, somewhat paradoxically, arouse suspicion by its very perfection it is so rarely that a complex phenomenon reveals its secret through so small a fragment of itself as is our actual, compared with our possible knowledge of the stars. We could scarcely have complained if more uncertainties had been left over for further observation to remove The picture which Dr. Jeans unveils, of a vastly extended field for physics and chemistry, is an arresting one, but it is also very tantalising The field, he tells us, is there, but we are never to enter it, being possibly merely a disease infesting the rubbish-heap in the corner.

As men of science, we must be prepared—to change the metaphor—for truth to be unpalatable, but we do not like to be debarred from the possibility of testing it. For that reason we may be permitted to hope that Dr. Jeans has not yet said the last word on the subject. The alternative views of Russell and Eddington likewise include phenomena unknown on the earth—namely, a transformation of matter into radiation which is a function of temperature and pressure—but such a transformation is not necessarily unknowable; if it takes place in the stars we may in time reproduce it terrestrially. Dr. Jeans, however, does not admit extra-terrestrial processes, but believes in extra-terrestrial matter. One possible objection to his postulates which occurs to us is that it is not easy to conceive how such highly unstable material as his primitive atoms could have come into existence. Evolution from simple to complex implies an infinitely simple origin, which is intelligible, but the reverse process seems to require an infinitely complex origin, which appears to be absurd. We know, of course, that the radio-active elements exist, but a minute fraction of the total matter in the universe might plausibly be attributed to an evolutionary process (from simple to complex) overstepping itself in special circumstances. It is a different matter when the whole universe is regarded as radio-active.

ON November 27, the authorities of the city and cathedral of St. Albans joined in a commemoration of a distinguished man of science belonging to St. Albans, Richard of Wallingford, Abbot 1326–35. Ecclesiastically, the observance took the form of a "Solemn Evensong" in the cathedral. This was attended by the Mayor and Council, by representatives of the University of Oxford, particularly of Wallingford's own College of Merton, and by representatives of the Honourable Company of Clockmakers. At the end of the anthem a procession was formed up the aisle to the altar, where the Astronomer Royal presented a wreath to the Dean, who placed it on Wallingford's tomb within the sanctuary. Later, there was a well-attended meeting in the Town Hall, which was addressed by Profs. H. H. Turner and H. W. Garrod, Dr Gunther, and Mr. Howgrave-Graham, of the Honourable Company of Clockmakers, on various aspects of Wallingford's work. Dr. Gunther also showed a small collection of medieval scientific instruments, which included a reproduction of "Wallingford's Rectangulus," made according to the working-drawings and descriptions which that most practical of medieval savants left behind him. The instrument was intended merely to supersede rather clumsy astrological instruments of the day, such as the 'armillary sphere' and the 'Torquetur,' but actually, as was pointed out, it opened the way to much that the inventor may not have foreseen. It was by far the handiest surveying instrument of its day for things on the earth as well as those in the heaven.

By his combined use of the 'rectangulus' and the plumb-line, Wallingford was led to see the usefulness of the right angle for purposes of measurement, and thus, as one of his treatises shows, was led to grasp for the first time the principles of trigonometry. By introducing the system of measuring the chord instead of the arc, he made such improvements as Mercator's projection a possibility, and gave men of scientific bent a handy tool to work with and on, instead of a cumbrous one. It was hoped that another instrument, Wallingford's 'Albion,' would be on view, but here the visitors were disappointed Tradition had asserted that this instrument was in the possession of a local family of very long standing, acquired by their ancestor from the Abbey at the time of dissolution Unfortunately, they had themselves been under a misapprehension about the heirloom, having confused Wallingford's Albion (an astrological instrument) with the clock that he is also recorded as having made, which was probably a large 'turret clock.' Thus they had considered a most exquisite clock in their possession as 'Wallingford's,' and thought this the Albion. Actually, the clock that was on view, though an excellent specimen, was considered by experts to be of later date, and probably not earlier than the end of the sixteenth century. If Wallingford's Albion could not be seen, the authorities of Oriel College made amends to those who had come to see it, by the loan of 'Bredon's astrolabe,' an instrument left to that society by Bredon in 1340. As Bredon was himself a pupil of Wallingford, it is by no means impossible that the astrolabe was Wallingford's work and his gift to the man who bequeathed it to its present owners.

No names are more worthy to be held in honour by all who are interested in scientific collections than those of the two Tradescants, father and son, "Both gardeners to the Rose and Lily Queen," *i.e.* Queen Henrietta Maria The elder Tradescant it was who by the specimens of plants, animals, coins, arms and other objects of science and art accumulated by him in his travels to various parts of Europe and of northern Africa, and stored by him at his garden in West Lambeth, gave the first impulse to the formation of public museums, and so started a movement which has been of incalculable benefit to the advancement of knowledge and education. The younger Tradescant continued the work begun by his father; and, like him, travelled abroad in search of specimens to add to the collection known as "Tradescant's Ark." His visits to Virginia (1642 and 1654) resulted in the importation of many interesting plants, amongst others, of the Commelinaceous genus named Tradescantia in his honour. The gift of an armorial window by the Garden Clubs of Virginia was therefore a graceful and appropriate recognition of the merits of their seventeenth-century visitor, and no more suitable position for the window could have been found than the Old Ashmolean Museum at Oxford. This building was opened in 1683 to hold the famous collection; which had been bestowed by John Tradescant the younger on his friend Elias Ashmole, and by the latter presented to the University. On November 26 the window was duly unveiled by Lord Fairfax, whose ancestor during the civil war fought on the opposite side to his friend Ashmole, and was at once the successful besieger and protector of Oxford. An inscription on the window in elegant Latin verse by Mr. J. U Powell, of St. John's College, may be freely (and inadequately) translated as follows: "John Tradescant: Virginia's kindred spirits own his fame, and flowers in English gardens bear his name."

Three hundred years ago, on December 10, 1626, there died the Rev Edmund Gunter, one of the first school of English mathematicians, the friend of Briggs, Oughtred and Gellibrand, and for the last seven years of his life, professor of astronomy in Gresham College, London. Of Welsh descent, Gunter was born in Herefordshire, but was educated at Westminster and Christ Church, Oxford, taking the degree of B A. in 1603, and that of M.A in 1606 He entered the Church, and from 1615 onwards held the living of St. George's, Southwark. To the astronomer he is known for his invention of a portable quadrant, to the mathematician, for his *Canon Triangulorum*, the first printed table of artificial sines and tangents, to the physicist, for his discovery of the alteration in the variation of the compass; and to the surveyor, for the invention of the 'Gunter's chain,' which is 22 yards long with 100 links, an instrument which superseded the old measuring rods for land surveying and has remained in use until the present time During the latter part of his life he had chambers in Gresham College, Sir Thomas Gresham's famous old mansion in Bishopsgate Street, where forty years later the Royal Society held its first meetings. He died in the College, and was buried, like his contemporaries Gellibrand and Foster, in St. Peter le Poor, a city church which has long since vanished.

Sir Isaac Newton died on March 20, 1727, so that Sunday, March 20, 1927, will be the two-hundredth anniversary of his death A meeting to celebrate this bicentenary will be held under the auspices of the Yorkshire Branch of the Mathematical Association at Grantham, near which Newton was born, and in which he went to school. The programme includes a scientific meeting on Saturday morning, March 19, to be addressed by Sir J. J. Thomson, Master of Trinity College, Cambridge; Sir Frank Dyson, Astronomer Royal; Dr. J. H. Jeans, Prof. G H. Hardy, and Dr. Horace Lamb; who will speak about

Newton's work in physics, astronomy, mathematics, and mechanics. On the same day there will be a pilgrimage to the house at Woolsthorpe where Newton was born, and a visit to Stoke Rochford. In the evening there will be a dinner at the George Hotel, Grantham, among the speakers at which will be Prof. E. T. Whittaker, Prof. H. H. Turner, and other distinguished men of science. A bicentenary sermon will be preached at the Parish Church, Grantham, on Sunday, March 20, by the Bishop of Birmingham. Detailed programmes will be issued in due course. Any one interested and desiring to take part in the meeting should write to Mr. A. B. Oldfield, Rydal Villas, Crawshaw Avenue, Pudsey, near Leeds, or to Prof. S. Brodetsky, The University, Leeds. As the accommodation is very limited, application should be made as early as possible.

THE British Science Guild recently instituted an annual lecture in commemoration of its founder, Sir Norman Lockyer, and the second of the series was delivered at the Goldsmiths' Hall on November 22 by Prof. Julian Huxley, who took as his subject "Biology and Human Life." The lecture, which was delivered in the afternoon, attracted a crowded audience. Prof. Huxley prefaced his sketch of some industrial and social applications of biology by a reminder that such applications do not constitute the primary motive of research in pure science, but must be regarded as a fortunate by-product of the thirst for new knowledge After describing some of the more recent contributions of biology to the prevention of disease and to the art of healthy living, and some of its applications to the extirpation of agricultural pests, Prof. Huxley made a strong plea for the fearless application of biological knowledge to human population problems. The relative rates of increase of the more and the less desirable groups within the species is so unfavourable to the former that every one acquainted with the facts must agree as to the disastrous consequences of permitting prejudice to obstruct practicable eugenic reforms. Such lectures do a valuable service to the community in bringing home to the educated layman the gravity of the issues at stake.

THE Council of the Royal Anthropological Institute has decided that two Rivers Memorial Medals shall be granted for the year 1926. Of these one has been awarded to Prof. Edward Westermarck in recognition of his researches on the customs and beliefs of the natives of Morocco. The other has been awarded to Dr. Alfred P. Maudslay in recognition of his work of archæological exploration in Central America, which laid the foundations of our knowledge of the art and culture of the early inhabitants of that region and provided the nucleus of the collections of Central American antiquities, small but in certain respects unrivalled, which are exhibited in our national museums. The Rivers Medal was founded in memory of the late Dr. W. H. R. Rivers, who was president of the Royal Anthropological Institute at the time of his death, and is awarded for specially meritorious anthropological work in the field.

THE new coal-treatment laboratory of the Mining Department of the University of Birmingham was opened on November 25 by Lord Chelmsford, chairman of the Central Committee of the Miners' Welfare Fund (which has contributed 9400*l*. to the cost). In this laboratory the whole subject of cleaning and grading of coal will be dealt with; but the main problem, the solution of which is to be sought, is the economic use of very small coal (of size ⅜ inch and less). The plant consists of screening devices, capable of dealing with twelve tons per hour, together with washing and pneumatic separating machines for separating the coal from shale and other dirt. There are also crushing and briquetting plants for producing pulverised fuel and briquettes. A furnace, in which pulverised fuel is used for raising steam, is fitted with means for studying the processes and products of combustion (serving in effect as a large-scale calorimeter for pulverised fuel). There is, in addition, a special laboratory for the testing and analysis of the coal. The establishment of this coal-treatment laboratory is an important step in the application of scientific methods to the reduction of waste in the utilisation of coal.

IT will be noted with regret that Prof. Garstang's resignation of the directorship of the Department of Antiquities at Jerusalem has been accepted by the High Commissioner. According to an announcement which appeared in the *Times* of November 29, the resignation will take effect in December. As head of the British School of Archæology in Palestine and director of the Department of Antiquities during the last seven years, Prof. Garstang has done a valuable work in placing archæological studies in Palestine on a satisfactory footing. He was largely responsible for the formation of the Department of which he was the first director, he drafted the model Antiquities Ordinance, and organised the national and local museums. Prof. Garstang will now return to the University of Liverpool, of which he is Rankine professor of archæology.

AT a meeting of the Newcomen Society held at the Science Museum on November 24, Mr. J. W. Hull was elected president in succession to Mr. Rhys Jenkins. The annual report was read, and showed a satisfactory increase in membership, the Society claiming more than sixty members in America, where considerable interest is being taken in engineering history. After the passing of the report, a paper was read on "High-Pressure Steam and the Work of the Perkins Family." Jacob Perkins, the founder of the well-known London firm, came from Massachusetts about a century ago. He made improvements in engraving machines for bank notes, etc., but is principally known as a pioneer in the use of steam at very high pressures and of compound engines, and as the original inventor of the Uniflow engine, a type which has become popular during recent years. His work was carried on by his son Angier March Perkins, and grandson Loftus Perkins, and it was the latter who, forty-five years ago, fitted the little yacht *Anthracite* with triple expansion engines supplied with steam at 350 lb. pressure, and drove her across the Atlantic.

THE twenty-fourth annual meeting of the Imperial Cancer Research Fund was held on November 23, the Duke of Bedford presiding. The yearly report showed a satisfactory financial position and gave an account of sound progress in the scientific work both in the laboratories at Queen Square, London, and at the farm at Mill Hill. The investigations in hand arise mostly either from the discovery of Yamagiwa and Ichikawa that cancer can be easily produced experimentally by tar, or from the analysis by Gye of the factors concerned in its propagation. Under the former heading Dr. Cramer has shown that the systemic disturbance accompanying the absorption of autolysed normal tissues favours a cancerous response to irritation. In the second field Dr. Begg has worked extensively with the Rous sarcoma and another foul tumour and has obtained results which are, on the whole, concordant with Gye's experiments. Dr. Findlay is engaged with the inoculable warts of man and the dog and the somewhat similar growths of fowl-pox and pigeon-pox. Taking the work all round, it is evident that the Fund continues to consolidate our knowledge of the nature of cancer, and that the admirable foundation of good work laid by Dr. E. F. Bashford is being carried on in the same tradition by Dr. J. A. Murray. One suspects that the relatively small size of the organisation has had a good deal to do with its success: it admits of a degree of co-operation which would be impossible in a larger establishment.

THE paper on rural electrification in Sweden read to the Institution of Electrical Engineers on November 18 was both interesting and instructive. The population of Sweden which earns its livelihood by industry is now at least three times greater than it was in 1920. One reason for this is the rapid development of technical engineering. Smiths and wood carvers, having experienced the benefits which accrue from electric power, have extended their small handicraft workshops into prosperous factories employing many workmen. The agricultural industry has failed to attract the best man power. This has had grave financial consequences. Cheap electrical power is now almost a necessity in the rural districts. An attempt was recently made to connect all the important hydro-electric stations in Sweden into a State-controlled system. Dr. Ekstrom stated that he is glad that this scheme never materialised. At present the northern area is being developed under a State scheme, whilst the southern portion of Sweden is in the hands of a private company. The large power stations are all planned for ultimate interconnexion by means of 220,000 volt mains. At present the southern company transmits from its power stations at 50,000 volts. This is stepped down to 20,000 volts for country lines and to 6000 volts for town supplies. By means of a 50,000 volt submarine cable across the Sound, the company also co-operates with Copenhagen in supplying electric power in Denmark. The importance of standardising the systems of wiring used on farms and the necessity of only using good insulating material were insisted on. Electric cooking is popular, and attempts are being made to standardise the sizes of the electric motors used in farming operations.

IT was appropriate that the first annual Malcolm Morris Memorial Lecture, which was delivered by Prof. H. J. Fleure in the hall of the Royal Society of Medicine on November 15, should have dealt with racial characters of the human skin and racial types in relation to disease, in view of the interest of that great physician in health problems connected with the skin. Prof. Fleure pointed out the importance of the investigation by both medical men and anthropologists of the diversities of human skin, and suggested that it might give clues to many other racial characters as well as to health problems. In dealing with his own thesis, Prof. Fleure sought to show in an ably developed argument that, while the fact that physiological efficiency is greatest under cool temperate conditions suggested that modern types of man originated in a zone with that type of climate, dispersions from this zone toward the southern desert fringe of Africa or the cold northern areas have brought about variations of skin character in pigmentation and growth of hair, and vascularity—specialisations affecting heat loss. The high metabolism and the fair skin of northern Europeans limit the possibilities of their adaptation to tropical climates. In the cold plateau of central Asia, man developed specialisations to meet the long period of severe dry cold. America received the bulk of its aboriginal population in drafts from north-east Asia. Consequently the American Indians have the modifications of the type of skin which were developed in central Asia. Bates noted that the Amazonians were ill adapted to the conditions of steamy heat in which they lived.

AT the fifth annual general meeting of the fellows of the National Institute of Agricultural Botany at Cambridge on November 25, the chairman of the Council, Mr. W. Hasler, presented the seventh annual report and accounts. Papers were read by Dr. E. S. Beaven and Mr. F. L. Engledow. Dr Beaven, speaking on "Field Trials of Cereals," stated that operations have been extended to field trials of varieties already in cultivation. The merits of the many 'new' varieties of cereals cannot be adequately tested by individual growers. The difference in value between two races of the same cereal, taking both yield and quality into account, often amounts to more than 20 per cent. One per cent. only added to the value of the cereal crops of Great Britain is equal to more than half a million of money per annum, and the cost of field trials is a negligible fraction of this amount. It is comparatively easy to sort out the distinctly inferior varieties. A variety which gives both low yield and inferior quality compared with others at four widely separated stations in two successive years is set down as of less than average value; if nothing more than this resulted from the trials they would be justified. Mr. F. L. Engledow spoke on "The Problem of the Adaptation of Varieties." He said that a great advance would attend the elimination of the worst varieties and the concentration of the best in localities most suited to them. The Institute's trials now offer a means of identifying the worst and the best; progress is, however, only possible when the best varieties only are grown. Quality helps to determine monetary value per acre and constitutes a separate problem of adaptation. English wheats are used for bread, biscuits, poultry, pudding and cake flours, and prepared breakfast foods. The exact adaptation of the separate varieties to those several purposes needs more careful study.

DR. F. A. PICKWORTH has been appointed to succeed the late Sir Frederick Mott as honorary director of the Joint Board of Research for Mental Disease, Birmingham. Dr. Pickworth was laboratory director at the Hollymoor Mental Institution under Sir Frederick, and has also had experience in research in biochemistry

MR. NEVILLE CHAMBERLAIN, Minister of Health, will preside at the re-opening on December 8 at 3.15 P.M. of the Wellcome Bureau of Scientific Research and the Museum of Medical Science at 25-28 Endsleigh Gardens, London, W.C.1. Sir Walter Fletcher, Secretary of the Medical Research Council, will deliver an address on "Research and Citizenship" after the opening ceremony has been performed, and the Bureau and Museum will then be open for inspection.

AT the annual general meeting of the Royal Geological Society of Cornwall at Penzance, held on November 25, the William Bolitho Gold Medal was presented to Dr. R. H. Rastall for his researches in the geology of ore deposits. The presentation was made by Mr. J. C. Williams, Lord-Lieutenant of Cornwall, who is president of the Society for the period 1926–28. Among the papers read at the meeting was one by Dr. Rastall on "The Zonary Structure of the Earth." The retiring president, Mr. F. J. Stephens, gave an address on the geotectonics of Cornwall.

THE Philadelphia meeting of the American Association for the Advancement of Science will be held on December 27–January 1 This will be the fifth occasion when the Association has met in Philadelphia. Meetings will be held in the University of Pennsylvania, and a general science exhibition is being arranged in the Weightman Hall, which is the gymnasium of the University. Reduced passenger rates will be available from all parts of the United States and from the eastern parts of Canada. The general chairman of the local committee for the meeting is Dr. C. E. M'Clung, Zoological Buildings, University of Pennsylvania, Philadelphia.

THE annual report of the Raffles Museum, Singapore, for 1925, by the director, C. Boden Kloss, reports satisfactory progress and an increased number of visitors. The accessions include a Malayan cow elephant, an example of the squirrel *Glyphotes simus* Thomas, hitherto known only from the type-specimen, and the rare flying squirrel *Petinomys vordermanni*. Eighteen papers on material in the Museum were published, and there is a list of 28 specialists co-operating in this work.

THE Ministry of Agriculture and Fisheries has published a leaflet (No. 149) on bacillary white diarrhœa of chicks. The disease, which is caused by a micro-organism *Bacillus pullorum*, is essentially one of artificial incubation and may cause considerable mortality within a few days of hatching. Full particulars are given respecting the disease and its prevention. The Ministry is prepared to undertake post-mortem examinations and agglutination tests for moderate fees if the carcase or a specimen of blood is sent to its laboratory, New Haw, Weybridge.

THE Survey of India has published its General Report and its Report on Map Publication and Office Work for 1924–25. A summary of the progress of topographical surveys shows that 44,317 square miles were surveyed during the year, leaving a balance of about one million square miles still to be done. About half of this balance will probably be surveyed on the half-inch or smaller scales. Of the modern topographical maps of India, about one-third each of the total number of one-inch and half-inch sheets are now published. Practically the whole of India, much of Burma, and most of Baluchistan, Afghanistan, and Persia are now completed on the scale of 1 to 1,000,000 In the International Map on the one million scale good progress is being made. The output of general and special maps for various purposes was considerable. The Map Publication Report contains index sheets for the various issues.

THE International Health Board of the Rockefeller Foundation has recently issued its annual report for 1925. Assistance was given to public health enterprises of various types in ninety-seven States and countries. It participated in infection and sanitation surveys, operations for the control of yellow fever, hookworm disease, and malaria, county and rural health work, the development of special divisions of public health services, and the establishment and maintenance of schools and institutions of hygiene and public health. It also provided 197 fellowships for training in public health, and contributed funds to the Health Section of the League of Nations. The report contains illustrated articles on the campaigns against hookworm disease, malaria, and yellow fever, and on other subjects. The expenditure for the year amounted to about 630,000*l*.

WE have received from Messrs. Ogilvy and Co. (20 Mortimer Street, W.1) the second edition of their catalogue of microscopical illuminating apparatus. Many types of lamps are listed, ranging from a simple electric lamp with shade for ordinary laboratory routine work to an elaborate research model; and a quartz mercury vapour lamp illuminator on a new principle, not exhausted of air, both of which are expensive items. Several ingenious and new illuminators are included.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A senior chemist under the Northern Coke Research Committee at Armstrong College—Prof. H. V. A.

Briscoe, Armstrong College, Newcastle-upon-Tyne (December 6). A full-time secretary of the Institute of Physics—The President, Institute of Physics, c/o Royal Institution, Albemarle Street, W.1 (December 14). A junior assistant in the engineering department of the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (December 15). A live-stock officer and 7 assistant inspectors under the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (December 20). A professor of pathology and a professor of bacteriology in the University of Cairo—Sir H. J. Waring, 37 Wimpole Street, W 1 (December 23). A physicist to the Dominion Laboratory, Wellington, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (December 24). An organiser of agricultural education for the county of Wilts—The Clerk of he County Council, County Offices, Trowbridge December 28). A director of tubercular research in the University of Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (February 1). A senior lecturer in natural philosophy in the University of Melbourne—The Registrar, University of Melbourne, Melbourne, Victoria (February 14). A head of the electrical engineering department of the St. Helens Municipal Technical School—The Secretary for Education, Education Office, St. Helens. A lecturer in pharmacy and chemistry at the Portsmouth Municipal College—The Secretary, Offices for Higher Education, Municipal College, Portsmouth. An assistant dairy bacteriologist at the University of Bristol—The Registrar, The University, Bristol. An assistant instructor and lecturer in dairying at the British Dairy Institute, Reading—The Registrar, The University, Reading. A junior assistant chemist under the Directorate of Explosives Research of the Research Department, Woolwich — The Chief Superintendent, Research Department, Woolwich, S.E 18.

Our Astronomical Column.

COMETS.—The following ephemeris for 0^h of comet Comas Sola is from Mr. G. Merton's elements:

	R A	N Decl	log r	log Δ
Dec. 7	$2^h\ 28^m\ 41^s$	9° 32′	0·2931	0·0351
,, 11	2 26 36	10 4	0·2909	0·0411
,, 15	2 25 17	10 41	0·2886	0·0484
,, 19	2 24 36	11 20	0·2864	0·0564

The comet crosses the meridian at about 9 P.M. at a considerable altitude.

Mr. G. Neujmin gives the following ephemeris for 0^h of his comet in *B Z*. No 41:

	R A	Decl	log r	log Δ
Dec. 7	$11^h\ 44{\cdot}8^m$	5° 40′ N.	0·159	0·078
,, 11	11 56·5	3 48		
,, 15	12 8·2	1 53 N.	0·141	0·056
,, 19	12 19·8	0 4 S.		
,, 23	12 31·4	2 3 S.	0·135	0·017

Prof. G. van Biesbroeck, assisted by Mr O. Struve, has made a fine series of cometary observations at he Yerkes Observatory. Comets Orkisz, Borrelly, Faye, and van Biesbroeck were all observed for several months in 1926. The prolonged observation of Orkisz will settle the question of its deviation from a parabolic orbit (*Astr. Jour*, No 872).

SPIRAL NEBULÆ —Dr. G. E. Hale contributes an nteresting article to the September number of *Scribner's Magazine*, entitled "Beyond the Milky Way," in which the character of spiral nebulæ is discussed. The conflict between the distances of hese objects suggested, on one hand by van Maanen's measurements of internal motion, and on the other by Hubble's observations of Cepheid variables, is described, but no final conclusion is drawn The distances indicated are respectively of the order of 4000 to 30,000 light years and 1,000,000 light years. With regard to the possibility of systematic error in van Maanen's measurements, Dr. Hale says: "As van Maanen is unsurpassed in his skill in measurement, here can be no doubt of the existence of some form of displacement. It is difficult to conceive of ystematic photographic or instrumental differences between the old and new plates which would always give an outward motion along the arms of a spiral, and the question remains whether the displacements an be accounted for by some other obscure source of error. As matters stand, van Maanen's conclusions s to the distance and dimensions of the spirals are radically different from those of Curtis and Hubble, nd much work may be needed to clear up the discrepancy." In the concluding paragraphs of the article, reference is made to the suggestion of Millikan and Jeans that the recently discovered penetrating cosmic rays may originate in spiral nebulæ.

SOLAR RADIATION AND WEATHER FORECASTING.—An article bearing this title is contributed by C F Marvin and H. H. Kimball, of the U.S. Weather Bureau, in the September number of the *Journal of the Franklin Institute*. Methods of observing the solar constant are first given, and the various forms of pyrheliometers are described, including the pyranometer, an instrument developed by the Smithsonian Institution in 1920, which, in combination with the bolometer, has proved most successful. The observed values of the solar constant are then discussed, especially from the point of view of the probable errors of observation. Two graphs are given to show that the probable variation of the determinations has decreased from ±1·3 per cent (earliest efforts ±3·0 per cent) to ±0·5 per cent. after the introduction of the pyranometer From the nature of the scatter of Calama observations, it is concluded that it is impossible to determine whether solar variability, atmospheric variability, or errors of observing are the predominating cause, in fact that "such solar variability as exists is submerged in the errors of determination." As regards forecasting, the important question is whether an apparent fluctuation in the sun's total thermal energy of less than 0·5 per cent. can constitute a scientific basis for short- or long-range weather forecasting The authors give their reasons for believing that the weight assignable to solar variability as a factor in the making of the weather is almost vanishingly small. H. H. Clayton's forecasts made with the help of solar constant values do not, they claim, show a marked increase in prevision in the forecasting of temperatures for New York, as compared with those made at the Weather Bureau from a superficial examination of weather maps alone While at variance with the conclusions drawn by Dr. Abbot from the Smithsonian observations, the authors comment upon the great importance of his contributions to the subject of solar radiation and atmospheric absorption.

It may be recalled that a recent paper of Dr. Abbot's, dealing with the observations of the solar constant and their correlation with sunspot data, appeared in the *Monthly Weather Review* for May 1926 (see also NATURE, August 21, p. 280).

Research Items.

THE GHOST DANCE RELIGION AMONG THE POMO OF CALIFORNIA.—In the course of a study entitled "Pomo Folkways," by Edwin M. Loeb, which is published as vol. 19, No. 2, of the *University of California Publications in American Archæology and Ethnology*, reference is made to the effect of the introduction of the modern ghost dance among the Pomo on their own religious esoteric cult and ghost dance. The Pomo are a typical central Californian Indian people, sedentary, living in small villages in a coastal and an inland group, among whom the arts, excepting basketry, were slightly developed. They depended on the chase and fruits and roots for food. It may be noted in passing as an interesting fact that the greater part of the information concerning them has been obtained from a Pomo who had devoted himself to ethnographical studies and made a living by passing on the information thus obtained. The native Pomo ghost dance had as its essentials the use of the bull-roarer, the impersonation of ghosts and clowns, the use of semi-masks, the "death and resurrection" initiation, and mutilation by cutting. The modern ghost dance religion arose among the northern Pai Ute of Nevada about 1870, travelled west and entered California from the north. It reached the Pomo from the Patwin in 1872, when it extinguished the Pomo ghost dance and Kuksu religion, though both supplied material for the new cult. The desire for the return of the dead which underlay Pomo culture now became an essential of the new cult. The new religion supplied a "big head" dance and a pole ceremony. The old secret society also died away. The priests of the new cult, instead of acquiring office by inheritance or long instruction, as in the old, were summoned by some unknown person or some one recently deceased, who appeared to them in a dream and instructed them in the ceremonial. All the ceremonial was supposed to have been received in this way instead of having been installed in the beginning of the world, as was held in the old ghost dance ceremony.

THE AURIGNACIAN HUMAN FIGURE FROM THE CAVERNE DAVID, CABRARET.—An interesting example of the application of technical knowledge to the interpretation of a palæolithic engraving is furnished by a criticism of M. H. Breuil's description of the male human figure of Aurignacian Age found in the Caverne David at Cabraret (Lot) which is contributed by Prof. R. Anthony of Paris to the *Bull. Société d'Anthropologie de Paris*, 7^e Sér. T., 5, Fasc. 1-3. The figure in question lies on its back and, as described by M. Breuil, apart from certain adjuncts which need not be mentioned, the chief characteristics are the indefinite character of the head, the extraordinary outline of chest and abdomen, which are abnormally expanded, although in the case of the latter a second outline is shown which is nearly flat and terminates in the genitalia, and a sharply defined slender waistline between chest and abdomen. Three women are shown near as if approaching the body. M. Boule interprets the drawing either as a representation of a man who has been killed, and the women approaching as mourners, or an initiation scene. Prof. Anthony, regarding the engraving from the point of view of a medical man, offers a different interpretation. The most important element is the phallus, but so far from being the representation of the complete genitalia, the drawing represents three successive morphological states. Viewed in the light of this conclusion, it is suggested that the drawing is a representation of a coitus in which the abnormal curves are feminine. The peculiar and apparently ill-drawn lines of the man's haunch and leg are due to muscular contraction natural in such conditions. If Prof. Anthony's interpretation be correct, it is an addition to a type not without importance for the interpretation of representation of the human figure in palæolithic art, and serves further to emphasise the artist's accurate representation of detail in the attention given to the muscular curves.

SCOTTISH MARINE BIOLOGY.—The annual report for the Scottish Marine Biological Association gives a short account of its activities for the year 1925-26. It opens with a note of regret on the death of Prof. J. F. Gemmill, and we welcome the suggestion that some useful form of memorial should be raised to facilitate the carrying out of research in the laboratory to which he was so attached. The lines of research followed by the Association during 1925-26 are noteworthy for the co-operation between the two permanent workers, Mr. A. P. Orr, who has worked on the seasonal chemical and physical changes of the water in the Clyde sea area, and Miss S. Marshall, who has studied the seasonal variations in the phytoplankton in the same region. The changes in the amounts of phosphate in solution in the sea-water of Loch Striven, which has been visited at weekly and fortnightly intervals this year, show striking correlations with the seasonal fluctuations in the abundance of phytoplankton in the different water layers. Their work has, in fact, produced a confirmation of the generalised theories put forward by Atkins as a result of his researches at Plymouth, direct correlative evidence of phytoplankton changes not having been obtained in that locality. The Millport Station has accommodated seventeen research workers from other parts of Great Britain in the period under review, as a result of which two important papers by Mr. G. S. Carter on "The Control of the Velar Cilia of the Nudibranch Veliger" and by Mr. J. Gray on the mechanism of cell division, have already been published. Mr. R. Macdonald has worked for a year at the laboratory on the life-history of *Meganyctiphanes norvegica*, an important constituent of the food of many fish. The superintendent, Mr. R. Elmhirst, is to be congratulated on a successful year.

ORGANIC MATTER IN LAKE WATER.—For a number of years investigations have been prosecuted by Prof. Birge and several co-workers concerning both the organic life and the physical and chemical conditions in American Lakes. Among the most interesting studies have been the various reports dealing with annual variations in the amount of organic matter, including that organised into plants and animals or existing as organic debris, and the substances in solution. Observations concerning the latter are dealt with in the latest report on these investigations ("The Organic Matter in Lake Water." By E. A. Birge and C. Juday. *Proc. U. S. Nat. Acad. Sci.*, vol. 12, pp. 515-519, August 1926). The water of Lake Mendota contains a standing crop of nearly 15 milligrams per litre of organic matter in solution, an amount considerably in excess of that found in the plankton and higher aquatic plants. Besides carbohydrates and fats, it consists of nitrogenous compounds which yield the amino acids indispensable in food, such as tryptophane, cystine, tyrosine, histidene, and arginine. The dissolved organic matter of lake water, if it is to be judged by amount and chemical composition, constitutes a potential food supply for aquatic animal life several times as large as that offered by the plankton. Whether such food substances in solution can be utilised directly by aquatic animals is controversial and awaits further nvestigation. Indirectly, it doubtless nourishes bacteria which are the food of protozoa, and these, n turn, nourish higher animals.

BRITISH BARK-BEETLES.—*Forestry Commission Bulletin* No 8 deals with British bark-beetles, which orm a group of insects closely associated with forestry practice It is the outcome of several years' work and first-hand study of these insects by Dr J. W. Munro, the author of this bulletin. Much that is known concerning bark-beetles is to be found in German periodicals and text-books and for this reason is not readily accessible to those concerned with forestry problems in Great Britain Dr. Munro has made copious use of this information and, by adding personal observations of his own, has produced an illustrated brochure of great value to foresters and also to the general entomologist In addition to providing an account of the chief facts of the biology of bark-beetles, he also gives useful keys to their identification and accounts of each individual species. n Britain, all the bark-beetles prefer suppressed, less vigorous, and felled trees to healthy trees for breeding. The majority of such insects are secondary enemies the attacks of which are associated with adverse influences The inter-relations between the bark-beetles and influences inimical to the proper growth of trees is the prime feature of bark-beetle economy. In modern forestry practice the most important factors contributing to the increase of bark-beetles are the systems of pure, that is, unmixed, orest planting and of clear-felling In forests omposed of several species of conifers, or of conifers and broad-leaved trees intermixed, such beetle outbreaks seldom become severe. Under the shelterwood systems the danger of increase of these beetles s rare, but in clear-felling of pure woods in large areas, bark-beetle attacks supervene unless adequate preautions are taken.

SEX-LINKED INHERITANCE IN FOWLS.—The fact of ex-linked inheritance in poultry is being put to practical use in the determination of the sex of young hicks. A recent bulletin by Prof. Punnett (Miscellaneous Publications, No. 55, Ministry of Agriulture and Fisheries) explains the method in simple anguage. Three pairs of easily distinguishable sex-nked characters may be used: (1) silver or gold ground colour of plumage; (2) barred or unbarred lumage; (3) light or dark yellow shank colour. A hen, for example, of any silver breed, such as Light Sussex, transmits silver (which is dominant) o her sons and gold to her daughters, whereas a ilver cock transmits silver to all his offspring Hence n a cross between a Light Sussex hen and a Red ussex cock the sex of the chicks can be determined y the down colour at the time of hatching. The same applies to all crosses between a hen of silver reed such as Silver Campines, Wyandottes, and Hamburghs as well as Dorkings and Salmon Faverolles nd a cock of any gold breed such as Brown Leghorn, Indian Game, Buff Orpington, etc. But when a reed, *e g* Campines, with heavy dark markings is sed, the down colour of the chicks is more difficult o distinguish. Similarly when a Plymouth Rock en is mated with a Minorca cock, the male chicks ill be barred and the females black When a White Leghorn hen is mated with a dark-shanked breed he cockerels have light shanks and the pullets dark, ut this distinction is not always clear in other crosses.

FACTORS OF THE SEX CHROMOSOMES IN FOWLS.—recent paper by Serebrovsky and Wassina (*Journ. of Genetics*, vol 17, No. 2) carries further the knowledge of sex-linked characters in fowls. Crossing-over between sex-linked factors has been observed in various cases, and the various percentages of cross-overs between the different pairs of sex-linked factors are used to construct a chromosome map of the sex chromosomes In addition to the three pairs of factors mentioned in the note above on sex-linked inheritance in fowls, a fourth has been studied which inhibits the rate of feathering in chicks, and a fifth—spangling—is receiving attention It is suggested that the order of the genes in the sex chromosome is barring yellow legs, silver and late feathering, but the percentages of cross-overs are not all consistent with this conclusion, and other sex-linked characters are being sought to test these results.

EFFECT OF X-RAYS ON *VICIA FABA*.—H Komuro, in *Jour. Coll. Agric. Imp. Univ Tokyo*, vol 8, No. 2, gives a historical résumé of earlier work with X-rays on plant growth, and details his own experiments on *Vicia faba* He concludes that irradiation is harmful in all circumstances, the degree of injury being correlated with the water content of the seeds, checking of growth being caused by the dose of rays in inverse proportion to the water content With high doses, development is not stopped immediately but germination occurs and the growth below ground reaches the same stage as with seeds of the same initial water content exposed to lower irradiation. It was noticeable that when the dose of X-rays exceeds a certain limit, varying with the water content of the seed at the time of irradiation, it does not induce a visible difference in the degree of injury proportional to the dose No acceleration of germination was obtained by treating air-dried seeds with rays of $7H$-$15H$, and retardation occurred with increasing doses both with air-dried (14 per cent. water content) and steeped seeds (57 per cent. water content). Germination is not affected if the seed coat is removed, the plumule and radicle being equally influenced by the rays whether the seed coat is present or not. The sprouting of air-dried irradiated seeds is delayed more than that of steeped irradiated ones for the same doses, probably because the latter, with a large water content, are more stimulated than the former containing less water. No anatomical differences were observed in the mesophyll of leaves of plants with different treatments of rays, but there was less chlorophyll in the plant treated with high doses ($80H$ and $120H$), so that they appeared yellowish in comparison with the controls.

PLEISTOCENE AND TERTIARY MOLLUSCA OF JAPAN.—A few months ago we had the pleasure of recording the publication by Prof. Matajiro Yokoyama of six papers on the Tertiary mollusca of Japan (NATURE, Sept. 11, 1926, pp. 389-90). Six further papers by the same eminent palæontologist are now before us (*Jour. Coll. Sci Univ. Tokyo*, vols 44 and 45). These treat of the Pleistocene "Mollusca from the Coral-bed of Awa", "On some [Upper Pliocene] fossil Shells from the Island of Saishū in the Strait of Tsusima"; "Tertiary [Pliocene] Mollusca from Dainichi in Tōtōmi", and three papers on the "Molluscan remains [Pliocene and Miocene] from the . . . Jō-Ban Coal-field." Each paper is preceded by a brief but very clear introduction discussing the topography and geology of the area in question, with a list of the fossils, while the main part contains the descriptions of the species, very many of which are regarded as new, followed by plates of figures.

FLOW PAST A ROTATING CYLINDER.—The Flettner rotor ship has brought before the public one practical method of utilising the special properties of a rotating cylinder in a wind. The aerodynamic efficiency of the cylinder has been studied in various laboratories In a short paper by Relf and Lavender (Aeronautical Research Committee: R. and M 1009 London: H M. Stationery Office, 9*d* net) a visual study of the flow of water past a rotating cylinder is made. While the results are purely qualitative, the photographs bring out clearly the extent to which the circulation of the fluid increases with rotational speed of the cylinder. While the proximity of the water channel walls interfere with the free flow of the liquid, the photographs make it appear that at high rotational speeds an unsteady state of flow maintains.

SOFT X-RAYS —Various improvements in the technique of the measurement of soft X-rays are described in a paper by K T Compton and C. H. Thomas (*Phys. Rev.*, October 1926). The soft X-rays generated were detected by their photoelectric action. A system of gauges was used to prevent ions from reaching the detecting plate, and the range of voltage applied to these gauges was carefully studied. The thermionic and photoelectric currents, *I* and *E*, were measured by balanced methods in which the full scales of the instruments were employed to determine the current increments resulting from small changes in the voltage applied to the tube The latter changes were also measured by a similar balanced method The experimental observations thus made were so precise that the critical potentials were determined from curves in which the second differences in the ratio E/I were plotted against the voltage In this manner any discontinuities were rendered much more marked than in previous methods The operation of the tube was tested by examining the critical potentials for an iron target which had been used in previous experiments. The new methods of plotting were used in the examination of the critical potentials of carbon and copper, 62 critical potentials being found for carbon in the range 0 to 160 volts, and 31 critical potentials for copper in the range from 65 to 280 volts, which had not been previously investigated for fine structure. The authors indicate the need for direct spectroscopic work on the spectra from solid targets in this low voltage region.

RATING INCANDESCENT LAMPS —Much attention has recently been given to methods of photo-electric colour matching, as greater sensitivity and higher accuracy are obtained in this way than by the ordinary visual methods In the November number of the *Journal of Scientific Instruments*, N. R Campbell and C. G Eden, of the G E C Research Laboratories at Wembley, describe a machine based on a photoelectric method for determining the voltage at which incandescent lamps will burn with a prescribed efficiency. In practice it is rarely necessary to determine this voltage with the highest accuracy, but it is of great commercial importance to be able to determine it rapidly with a maximum inaccuracy of about 2 per cent The speed is limited by three factors the period required to make an estimate of the photoelectric balance, the period required to introduce the lamp into the photometer, and the period required for the lamp to take up a steady state This last period depends on whether the lamp has been aged or not previous to the test. If the lamp is burnt for the first time it may be so long as 3 minutes The electrometer used is a Lindemann quartz needle instrument made by the Cambridge Instrument Co., Ltd , which reads very quickly and has a very stable zero. The machine is calibrated by the use of standard lamps of which the rated voltage is known It was found that the machine enabled lamps to be rated with a mean error in volts of about 0·1 pe cent at the rate of about 200 lamps per hour. If the machine were modified so as to make certain of the motions automatic, so that all the operator had to do was to insert and remove the lamps and watch the deflexions of the electrometer, nearly double the speed could be obtained.

DIRECT READING WAVE-LENGTH SPECTROMETERS —Messrs. Bellingham and Stanley, Ltd , have recently added to their catalogue of spectroscopic apparatu a description of two instruments exhibiting nove features. A direct reading wave-length spectrometer is now available, mounted on a stand in such a way that it can be used in the horizontal or vertica position or tilted to any convenient angle The prism is of the usual constant deviation form, and is rotated by a micrometer screw to which is attached a large divided drum-head on which the wave-lengths o the spectrum lines can be read. The second piece of apparatus is a visual wave-length spectrometer fo ultra-violet light. The light enters by a slit, is sen by a quartz reflecting prism to a quartz mirror, and thence in a parallel beam to a reflecting quartz half prism where the dispersion takes place The issuing beam is then reflected by another quartz mirror to a fluorescent screen adjacent to a wave-length scale where it is viewed by an eyepiece. The instrumen is very compact, and a large screen is attached to shield the observer from the ultra-violet radiation It is said to be of considerable use for the examination of the lamps used in actino-therapy. The Universa spectroscope constructed by this firm has recently been improved and the price considerably reduced.

IONISATION POTENTIAL AND THE PERIODIC SYSTEM —The *Gazzetta Chimica Italiana* for August contains a paper by Rolla and Piccardi in which some relation between the ionisation potential of elements and their position in the Periodic System are discussed. It is shown that non-metals have high ionisation potentials metals low ionisation potentials, and metalloids potentials of medium value. The ionisation potential is periodic function of the atomic number; it is function of the atomic structure in general and of the peripheral structure in particular, and is in quantitative relation to the chemical character of the elemen A curve showing the periodic character of the ionisation potential is given, which resembles the well-know Lothar Meyer atomic volume curve.

ISOLATION OF ILLINIUM.—Since the appearance o a paper by Harris, Hopkins, and Yntema in the June issue of the *Journal of the American Chemical Societ* on the isolation of illinium, a new element with atomi number 61, a preliminary note describing some independent research on this element has been publishe in the *Gazzetta Chimica Italiana* for July by L. Roll and L. Fernandes Starting in 1922, by June 192 they had obtained strong evidence for its separatio from a specimen of didymium earth from Brazilia monazite sand, but they refrained from publishin their results because of the small quantity of substanc at their disposal. With a larger amount of material and using an improved method of fractionation, afte about 3000 complete crystallisations they arrived a a residue rich in samarium possessing an absorption spectrum in which the peculiarities observed in 192 were greatly accentuated. A thorough examination of the emission and absorption spectra of this fraction was in progress when the work of the American chemists appeared.

Anniversary Meeting of the Royal Society.

IN his presidential address to the Royal Society delivered on November 30, Sir Ernest Rutherford referred to the deaths of sixteen fellows and one foreign member of the Society, several of whom were distinguished workers in the field of general biology and pathology. Sir Ernest then remarked on the improvement in international scientific co-operation which is marked by the unanimous resolution passed at the recent Brussels meeting of the International Research Council inviting the Central European Powers to full membership of the Council. Another event of importance during the past year was the gift, by Mr. A. A. Campbell Swinton, of 1000*l.* for a fund for other than directly scientific purposes The donor expressed the hope that others may be induced to subscribe to this fund so that the income may in time become sufficient for general purposes.

Continuing, Sir Ernest gave a brief account of recent striking advances in radio communication, and referred to the many avenues of research which are being opened up by the study of the propagation of electric waves over the earth (see p. 809).

Presentation of Medals.

THE COPLEY MEDAL, AWARDED TO SIR FREDERICK GOWLAND HOPKINS.

For twenty years Sir Frederick Hopkins has been a foremost leader in biochemistry, a branch of science that has grown rapidly in importance and influence during this period. The guide and director of a great Research Laboratory in Cambridge, he is everywhere recognised as one of the great pioneers of his science In his active life he has made a series of fundamental discoveries, each of which has led to the opening up of new fields of work. The isolation and identification of tryptophane twenty-five years ago, at a time when but few of the amino-acids that enter into the composition of proteins were recognised, marked an epoch in the pure chemistry of these substances The importance of this discovery was enhanced by Hopkins' later work on this substance, which led to a revolution in the physiology of proteins in nutrition, the end of which is not yet in sight. Some of the most fruitful work in recent physiology has been upon the nature of muscular contraction The work of A. V. Hill and Meyerhof, of Embden, and many others, turns upon the fundamental earlier discoveries by which Hopkins, in collaboration with W. M. Fletcher, defined the conditions governing the appearance of lactic acid in muscle during activity, and its disappearance during recovery. One of the most important discoveries of this century is summed up in the word 'vitamins' Fifteen years ago, Hopkins had carried out experiments which not only showed that appropriate mixtures of proteins, carbohydrates, fats and salts, might, for lack of traces of unknown substances, be inadequate for the nutrition of animals, but also at the same time established the general lines of the methods used ever since in the investigation of these substances, by important groups of biochemists in all parts of the world. The discovery of the dipeptide glutathione, coming at a time when the nature of the processes underlying biochemical oxidations was the subject of significant work in many laboratories, has again brought Hopkins into the van as a leader in yet another part of the field of biochemistry and given the signal for intense renewed activity there. Hopkins' work throughout has shown a genius for discovery. It has inspired a very large part of the best work in biochemistry in this century.

THE RUMFORD MEDAL, AWARDED TO SIR ARTHUR SCHUSTER.

Sir Arthur Schuster began his work on optics in the early days of spectrum analysis, and, indeed, was the first to employ in 1881 the word 'spectroscopy' to designate this branch of science He has made numerous original contributions to optics in many directions. We may refer particularly to his work in the group velocity of waves and the pulse theory of white light The breadth and penetration of his knowledge is clearly shown in his book on "Optics," a standard work which has served as a guide for generations of students. Schuster has made valuable contributions to many branches of experimental and mathematical physics. When professor in the University of Manchester, he made with Gannon a well-known determination of Joule's equivalent, and did valuable work in that connexion by calibrating the thermometer originally used by Joule in his fundamental experiments He was a pioneer in the study of the discharge of electricity through gases, and has taken a deep interest in the problems of geophysics, particularly in connexion with the magnetism of the earth and the state of the upper atmosphere, and is responsible for valuable additions to knowledge in these fields. Besides this original work, Schuster has always shown an active and keen interest in the progress and organisation of science. He was a member of the General Board of the National Physical Laboratory from its inauguration and for six years acted as chairman of its Executive Committee. He was Secretary of the Royal Society 1912–19 in the difficult War period, and Foreign Secretary 1920–24. He took an active part in the formation of the International Research Council, and since its inception has acted as its secretary.

A ROYAL MEDAL, AWARDED TO SIR WILLIAM BATE HARDY.

The scientific investigations of Sir William Hardy in physical chemistry and physics are of outstanding importance in many different fields of work, and are characterised by the highest degree of originality. In colloid chemistry his name is known for the fundamental and pioneer work which he has accomplished in that field The stability of colloid sols in relation to the electric charge, the theory of flocculation, the nature and importance of the iso-electric point, the theory of protein ampholytes, and the electric charges of the positive and negative colloid ions, represent some of the important discoveries with which his name will be for ever associated. The modern theory of protein solutions, which is of such great importance in biochemistry and physiology, is very largely due to his pioneer work in that field. Sir William Hardy has also been a pioneer in the elucidation of the nature of surface forces and surface films and the orientation of molecules at surfaces. This work has been of the highest importance for the development of a new and extremely important branch of physico-chemical science. As a natural outcome of this work, Sir William Hardy has turned his attention in recent years to the friction between surfaces and the nature of lubrication, and in a series of important investigations has thrown a flood of light on a subject which had long been neglected by both physicists and chemists. For the first time in the history of science the dependence of friction and lubrication on the structure and molecular orientation of surface films and the force-fields of molecules in relation to their structure and polarity have been elucidated in a series of beautiful and highly important researches.

A ROYAL MEDAL, AWARDED TO PROF. ARCHIBALD VIVIAN HILL.

Prof. A. V. Hill has made important contributions to knowledge of muscle and nerve. As to the former, his inquiries, begun some sixteen years since, were taken up at a time when, owing to the emergence of new facts, views of general acceptance stood in essential need of re-examination. In the past seven years Hill has accomplished this with a success beyond expectation He has related to the mechanical the thermal aspects of muscular activity with a precision hitherto unattained, and obtained data as valuable for the chemical as they are fundamental for the physical study of the problem. The technique developed by him enabled for the first time the discrimination, in the heat production of muscle, of successive quantities and rates characterising successive stages of that activity, in spite of the closely consecutive and in part evanescent character of those phases. 'Initial heat,' uninfluenced by oxygen, the immediate accompaniment of the mechanical changes in the muscle, was thus distinguished from a 'delayed heat' associated with functional recovery of the muscle; and in this latter there were recognised two portions which evaluate the relative shares of aerobic and anaerobic disappearance of lactic acid in the processes of restoration of the muscle. In association with this recovery process the molecular ratio between removed and oxidised lactic acid has thus been estimated. Besides furnishing this essential analysis of the functional reactions of isolated muscle, Hill has prosecuted notable inquiries into the factors conditioning the performance and maintenance of muscular effort in the human body, measured its chemical cost, and traced to their causes certain of the limits set to the speed and endurance of the athlete. Further, he has succeeded not only in detecting but also in measuring heat-production accompanying the conductive activity of nerve. The scale of energy-change involved in this has required the devising of a refined technique, here again he with his pupils has obtained and measured the heat not only in block but also in its separate phases of production. Whenever the intimate mechanism of the activity of muscle and nerve may finally be elucidated, it is certain that the contributions of Professor Hill will remain fundamental for the explanation of the mechanism of them both.

THE DAVY MEDAL, AWARDED TO SIR JAMES WALKER.

The investigations of Sir James Walker in the field of physical chemistry have been of great importance in the advance of that science. His work on the electro-synthesis of organic compounds, carried out originally in conjunction with the late Prof. Crum Brown and continued up to the present time, has thrown much light on the phenomena of electrolysis and has led to the synthesis of a large number of new and interesting substances. One of the pioneer investigators of ionic equilibria, he has developed the theory of Arrhenius in many directions. His discovery of the nature and equilibria of amphoteric electrolytes constitutes a fundamental advance which has been of the greatest fruitfulness not only for the general theory of electrolytic solutions, but also for the development of the chemistry of the proteins. The work of Sir James Walker on the theory of amphoteric electrolytes represents one of the greatest advances in the elucidation of the nature of solutions. His investigations on the adsorption of dissolved substances by solids—for example, the adsorption of picric acid by silk fibres—were of cardinal importance in the recognition of the true nature of a class of phenomena the occurrence of which has been established in many branches of science. In the theory of reaction-velocity and chemical reactivity, and in many other parts of physical chemistry, the work of Sir James Walker is of high value and importance.

THE DARWIN MEDAL, AWARDED TO DR. DUKINFIELD HENRY SCOTT.

At a moment when there seemed some danger that the brilliant advances in palæophytology made by Prof. Williamson might slacken owing to advancing years, Dr. Scott entered upon a fruitful co-operation with the veteran. Several joint memoirs were the result of this happy coalition; but later Scott established a quite independent position of his own. Among the numerous memoirs published by him during the last forty years, none stands out more prominently as a model of presentation of complex structure than that on Cheirostrobus, a new type from the Calciferous Sandstone. Not only was its elaborate structure fully described, but also the comparative treatment showed a master hand. This quality came out with even greater effect in the study of the new class of the Pteridosperms, or primitive seed-plants with fern-like habit. The extensive knowledge of these early land-plants which we now possess has been mainly based upon the work of Scott, Oliver and Kidston. Such work, of which these examples do nothing more than suggest the nature and the scope, has been gathered up by Scott into his "Studies in Fossil Botany," now in its third edition. It deals primarily with early vascular plants, placing them in natural relation to their living correlatives, and giving a picture of early land-vegetation that has never been surpassed in clarity of presentment, combined with accuracy of detail and of reference. It supplies not only a great mass of fact that is positive and new; but it also subjects those facts to a detailed criticism and a philosophical treatment such as Darwin himself would have been among the first to appreciate.

THE HUGHES MEDAL, AWARDED TO ADMIRAL OF THE FLEET SIR HENRY BRAWARDINE JACKSON.

Sir Henry Jackson's experiments date from 1899, and in the following year apparatus of his design was fitted to certain of H.M. ships, and some of the problems connected with the screening effects of high land were investigated by him. At a later date he was responsible for the erection of one of the earliest continuous wave stations, in which an arc of 100 kilowatts was used. In 1915, at his suggestion, work on directional wireless was begun at the National Physical Laboratory. As chairman of the Radio Research Board, his wise guidance and his enthusiasm for his subject have in no small measure contributed to the success of the important investigations on the fundamental problems of radio transmission carried out under the auspices of that Board.

The Copley Medal.

In connexion with Sir W. B. Hardy's discourse at the Royal Institution on lubricating films of oil, and of other forms of matter in thin films (NATURE, November 13, p. 700), the following extracts from a letter written by Benjamin Franklin contain many points of interest. It may be recalled that Franklin was a Copley medallist, and that Sir W. B. Hardy is this year a Royal medallist whose work has dealt with the theory of lubrication. The Copley medallist for 1926 is Sir Frederick Gowland Hopkins.

Writing to Pringle from Philadelphia, on December 1, 1762, Franklin says:

"During our passage to Madeira, the weather being warm, and the cabin windows constantly open for the benefit of the air, the candles at night flared and ran very much At Madeira we got oil to burn, and with a common glass tumbler or beaker, slung in wire and suspended to the ceiling of the cabin and a little wire hoop for the wick, furnished with corks to float on the oil, I made an Italian lamp, that gave us very good light all over the table. The glass at bottom contained water to about one-third of its height Another third was taken up with oil, the rest was left empty, that the sides of the glass might protect the flame from the wind There is nothing remarkable in all this, but what follows is particular. At supper, looking on the lamp, I remarked that though the surface of the oil was perfectly tranquil, and duly preserved its position and distance with regard to the brim of the glass, the water under the oil was in great commotion, rising and falling in irregular waves, which continued during the whole evening. The lamp was kept burning as a watch-light all night, till the oil was spent and the water only remained In the morning I observed that though the motion of the ship continued the same, the water was now quiet, and its surface as tranquil as that of the oil had been the evening before At night again, when oil was put upon it, the water resumed its irregular motions, rising in high waves almost to the surface of the oil, but without disturbing the smooth level of that surface. And this was reported every day during the voyage

"Since my arrival in America, I have repeated the experiment frequently thus: I have put a pack-thread round a tumbler, with strings of the same from each side, meeting above it in a knot at about a foot distance from the top of the tumbler. Then putting in as much water as would fill about one-third part of the tumbler, I lifted it up by the knot, and swung it to and fro in the air; when the water appeared to keep its place in the tumbler as steadily as if it had been ice. But pouring in upon the water about as much oil, and then again swinging it in the air as before, the tranquility before possessed by the water was transferred to the surface of the oil, and the water under it was agitated with the same commotions as at sea

"I have shown this experiment to a number of ingenious persons. . . . And I think it is worth considering . for a new appearance, if it cannot be explained by our old principles, may afford us new ones, of use perhaps in explaining some other obscure parts of natural knowledge."

In 1753 the Royal Society awarded Franklin the Copley medal This was the first time the award was made by the president and council of the Society, previous awards having been by nomination of trustees under the will of Sir Godfrey Copley. To mark the significance of the gift, the *Gentleman's Magazine* published a special plate of the medal (Fig 1), and it is interesting to recall the comments of that old-time chronicle of social and general events. The account states that at the anniversary meeting of the Society, held on November 30, 1753, the annual benefaction of Sir Godfrey Copley, Bart. (the gift of which on the death of Sir Hans Sloane devolved upon the president and council), was adjudged to Benjamin Franklin, Esq, of Philadelphia, for his useful discoveries in electricity, and delivered to be transmitted to him by the care of P Collinson, Esq, fellow of the said society. "On this occasion," we read, "the Earl of Macclesfield, their president, delivered a speech, which greatly enhances the value of the prize, and does honour to the judgment, candour, and strict impartiality of the Society. It gave assurance that in conferring this prize constant regard would be had to the advancement of useful knowledge, it declared that, overlooking their own circle, they would always, with the spirit of true philosophers, esteem ingenious men of all countries, and that they would accordingly distinguish the most deserving." The writer, in conclusion, remarks that the successful experiments of Franklin have given hopes of our being one day able to secure ourselves against the effects of lightning.

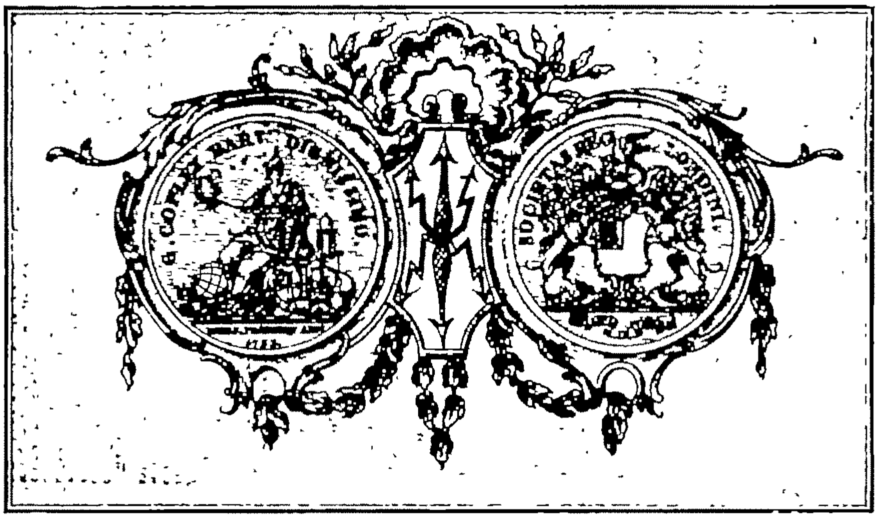


FIG. 1.—Copley Medal of the Royal Society, awarded to Benjamin Franklin in 1753. From the *Gentleman's Magazine*.

Folk Dances as a Survival of Primitive Ritual.

AT a joint meeting of the Royal Anthropological Institute, the English Folk Dance Society, and the Folk Lore Society, held on Tuesday, November 23, in the Parry Theatre of the Royal College of Music, Miss Violet Alford read a paper on "The Ritual Dance," which was illustrated by a number of English and other folk dances performed by members of the English Folk Dance Society. As the author dealt with the anthropological side of the dances, the illustrations were classified according to the function in primitive ritual which they were intended to fulfil, so far as this could be deduced from the character of the form in which they have survived.

The dances were therefore divided into three divisions. First, magical dances to procure food or, sometimes, the power of the animal hunted. Such a dance is "The Abbots Bromley Horn Dance," which is the only example of its kind in England and, it is believed, in Europe. This is a dance of an extremely primitive character, in which the men are dressed as deer and wear long branching antlers on their heads. The horns are kept in the church. The men, bearing these immense antlers, visit the whole parish. This is probably done as an imitative dance to ensure a supply of venison, and the dance may be compared with the well-known "Hobby Horses" and "Danse de l'Ours." A second example, the "Bean Setting" dance, is a morris dance from Headington, Oxon, which shows magical qualities, though not so ancient in spirit as the "Horn Dance." It imitates the planting of beans, beginning with a sun circle.

In the second class were dances belonging to spring festivals, processionals and maypole dances—the Whitsun morris. Such were the "Castleton Garland Procession," in which the leaf-clad king is the spirit of vegetation in person, and his spring bride and the morris dancers carry oak boughs, and "Sellenger's Round" and "Gathering Peascods," two maypole dances which date from long before plaiting ribbons was heard of, and show evidence of touching the pole to obtain power or 'luck' from it. "The Rose" is a morris dance always danced round the maypole at Leafield, Gloucester, and "The Sherborne Jig," a solo morris dance showing an elaborate kneeling posture The "Newcastle," which was also shown, is a round country dance and shows the development of simple rounds into a beautiful and elaborate country dance. "The Whitsun Morris" is the most highly developed type of ritual dance in England. The morris men must leap for increase like the Kouretes of ancient Crete. They appear at Whitsuntide to fetch in the spring. They have a long and interesting history and were patronised by the Church. The parish even provided the morris bells and dresses. Each dance contains sun circles and heys—a representation of the form of the sacred serpent. A group of country dances was interpolated here showing the development into ballroom dances. This is the type of dance spoken of when it was said "none but country dances were done at Court." Examples of these were "Mr. Beveridge's Maggot," meaning 'notion'; "Picking up Sticks," containing a remarkable hey; and "Nonesuch," probably named from Nonesuch House.

In the third division were dances to illustrate a later confusion of ideas of sacrifice founded on the primitive rite of killing the year god. This yearly death is seen in mummers' plays, sword dances, and occasionally in the allied morris. The ritual is known from Bulgaria to south west Spain. "The Eynsham Morris" shows the raising of the captain as Visigothic chiefs were raised on shields. A similar dance from Spain was shown in the "Finale of the Viscaya Sword Dance" danced to its own tune, showing the raising of the captain in a lying position like a dead man. The "Askham Richard Long Sword Dance" showed the killing of the captain, and the "Winlaton Rapper Dance" gives the 'calling on song,' the ritual of the 'captain's sword,' and the display of the 'lock of swords' as a symbol of the death.

University and Educational Intelligence.

CAMBRIDGE.—G. Bateson, St. John's College, has been appointed to the Anthony Wilkin studentship in anthropology

THE Educational Settlement Association publishes in the October number of its magazine, *The Common Room*, its annual report for 1925-26. Prominence is given both in the report and in several of the magazine articles to the place of science in adult education. Science is stated to have figured in the programmes of seven of the thirteen educational settlements affiliated to the Association, the object being, in four cases, "to gain some insight into the meaning of scientific method and the change in other realms of thought which the study of science is bringing about"; in the other cases "to obtain some first-hand knowledge of every-day phenomena." Keen interest in science was shown by the Aberdeen branch of the Workers Educational Association, which asked to be "instructed in the ways of life that are exhibited by plants and animals, the idea being that these might afford useful suggestions to thoughtful men." Some account is given of the Second International Conference of Social Settlements which was held in Paris on June 30-July 5, and was attended by representatives from England, the United States, Belgium, Germany, Scandinavia, Italy, Switzerland, India, and Japan. It culminated in the setting up of a committee to bring into being an International Association of Settlements, and to arrange for a third conference to take place in two years' time.

FROM the statement for the academic year 1925–26 recently issued by the Rhodes Trust, it appears that the number of Rhodes scholars in residence during that year was 188, of which 97 were from the British Empire and the remainder from the United States. Of the total, 42 were taking natural science and medicine, 3 mathematics, 3 education, 2 forestry or agriculture, and 4 miscellaneous subjects. The present year started with 183 Rhodes scholars and 10 ex-scholars in residence, and three more will come into residence in January. Examination successes include four D.Phil. degrees (three in natural science and one in medicine) and three B.Sc. degrees in natural science. Notices were received during the year of forty-five publications, including translations, by Rhodes scholars; these were mostly literary productions. As usual, many Rhodes scholars represented Oxford against Cambridge in sports. A Rhodes Memorial Lectureship, to be awarded to any person who has attained eminence in science, arts, business or public life, has been founded, and the first lecturer will be Sir Robert Borden, Prime Minister of Canada from 1911 until 1920. The first Rhodes Travelling Fellowships, to enable resident fellows and tutors to undertake study, especially in territories from which Rhodes scholars are derived, will be awarded in 1927. Particulars of the benefactions available under the Rhodes Trust can be obtained from the offices of the Trust, Seymour House, Waterloo Place, London, S.W.1.

Contemporary Birthdays.

December 4, 1875. Prof. George William O. Howe.
December 6, 1858. Prof Hans Schinz
December 7, 1865. Sir John Otto Beit, Bart, K.C M G., F.R.S.
December 9, 1855. Mr. W. H Dines, F.R.S.
December 9, 1855. Dr. F. A. Dixey, F.R.S.
December 10, 1855. Mr. H. N. Ridley, C M.G., F R.S.
December 11, 1860. Dr. Leonard Huxley.
December 11, 1863. Sir Frank Heath, K.C B.

After an apprenticeship with Messrs. Siemens Bros, Woolwich, Prof. HOWE was appointed lecturer at the Technical College, Hull; he then became assistant professor of electrical engineering, Imperial College of Science and Technology, South Kensington, and afterwards chief assistant, Department of Electrical Standards and Measurements, National Physical Laboratory. In 1921 he was appointed James Watt professor of electrical engineering in the University of Glasgow.

Prof. SCHINZ, born in Zürich, was educated there at the Polytechnic, and at the University of Berlin. Professor of botany in the University of Zürich, and director of its famous botanical gardens and museum, he is a foreign member of the Linnean Society of London. Prof. Schinz has conducted valuable botanical surveys in South Africa; with M. Théophile Durand, he issued the "Conspectus Floræ Africæ."

Sir OTTO BEIT's name is associated with the foundation of the Beit Fellowships for Scientific Research tenable at the Imperial College of Science and Technology, and the Beit Memorial Fellowships for Medical Research. The former fund has recently received, through Sir Otto's munificence, a further capital sum of 15,000*l.*, enabling the trustees to make awards for two years instead of one year as hitherto.

Mr. DINES, the distinguished meteorologist, was educated at Woodcote House School, Windlesham' graduating afterwards at Corpus Christi College, Cambridge. He is the author of many valuable papers in meteorological and aeronautical science.

Dr. DIXEY is a Londoner. Educated at Highgate, he graduated at Wadham College, Oxford; he is subwarden, bursar, and lecturer there. An authority on insect bionomics, and a past president of the Entomological Society, he is curator of the Hope Collections, Oxford.

Mr. H. N. RIDLEY, who was educated at Haileybury, graduated at Exeter College, Oxford. A member of the botanical staff, British Museum, he became Director of Gardens and Forests, Straits Settlements, retiring in 1911 after twenty-three years' service Whilst in the tropics Mr Ridley conducted numerous scientific expeditions. Last year he published the final volume of his "Flora of the Malay Peninsula."

Dr. LEONARD HUXLEY, eldest son of Thomas Henry Huxley, is the author of the well-known biography of his father, published in 1900, this was supplemented in 1918 by a biography of Sir J. D. Hooker, both works of classic interest.

Sir FRANK HEATH is a Londoner. Educated at Westminster, he graduated at the University of London, from University College. He was assistant registrar and librarian of the University from 1895 until 1901, and in 1916 became Secretary to the Department of Scientific and Industrial Research. He has recently completed a tour in Australia and New Zealand and has put forward valuable schemes, which have been adopted, for State aid in research in these countries.

Societies and Academies.

LONDON.

Geological Society, November 3 —Sydney S. **Buckman**: Jurassic chronology (iii.): Some faunal horizons in Cornbrash. Faunal dissimilarity within strata of a supposedly synchronous time-unit, the Cornbrash, were observed about seventy years ago, but were not understood. Series of faunal analyses of the brachiopod species south of the Humber disclose a series of synclines, anticlines, and various non-sequences in the strata of the South Humbrian Cornbrash. The divisions of Cornbrash time on the basis of brachiopods and of ammonoids are compared and also the Cornbrash and the inferior oolite. If the time-value of brachiopod species be the same in the Cornbrash as in the inferior oolite—and there is every reason that it should be—then the Cornbrash must have taken in deposition a time far in excess of that of the middle and upper inferior oolite, with all its numerous ammonoid hemeræ

The Physical Society, November 12 —H. **Dewhurst**: A rapid bolometer made by sputtering on thin films. Thin films of collodion are made by drying weak solutions in ether and alcohol on the surface of clean mercury Flexible films which withstand great distortion, and can be punctured without fracture, are made in the same way. Both types can be produced rapidly and cheaply down to a thickness of one wave-length of light. Two novel types of sputtering apparatus are described, and a table is given containing sputtering data for 25 metals, nine of which appear for the first time. The method of making the bolometers, together with holders of various types, and apparatus for blackening, are detailed. Rings were moulded for supporting the thin collodion films and providing a reliable contact for overlying sputtered metallic films. The comparative sensitivity of these new bolometers is discussed, and curves and an empirical formula given from which an estimate of the speed of the instruments can be determined. The new type of instrument is roughly 400 per cent. faster than a representative bolometer of the Lummer and Kurlbaum type.—**Ezer Griffiths** and J. H. **Awbery**: A hygrometer employing glycerine The variation of refractive index of glycerine solutions in equilibrium with air of various humidities has been studied; the time for equilibrium to be reached, when thin films of glycerine are used, has been investigated, and this property may be used very conveniently in a hygrometer.—J. W. **Avery** and C. J **Smithells**: The effect of working on the physical properties of tungsten Measurements of the densities of specimens cleaned in successive stages by etching reveal the presence of low density surface layers. Variations of heat treatment likely to occur in practice have no appreciable effect upon the density of worked tungsten. The density rises rapidly during swaging to a maximum value within 0·5 per cent. of the density of the perfect tungsten crystal. Further working produces a steady fall in density, which becomes more marked in the finest sizes The resistivity falls rapidly in the early stages of working and reaches a minimum when the density is a maximum. It then increases at a uniform rate, which is approximately an exponential function of the diameter.

Royal Meteorological Society, November 17 — E W. **Bliss**: The Nile flood and world weather. Correlation coefficients are given with pressure, temperature, rain, ice and wind, and it is shown (*a*) that the Nile takes part in the southern oscillation as a member of the first group; (*b*) that equatorial temperatures are in inverse relation to the Nile; and (*c*) that the winter North Atlantic circulation varies inversely with the preceding Nile. St Helena pressure has no contemporary relationship with the Nile. A formula is derived for prediction on June 1 with a joint coefficient of 0.72.—D. **Brunt**. (1) An investigation of periodicities in rainfall, pressure, and temperature at certain European stations. A discussion is given of twelve periodograms: those of rainfall at Milan, Padua, London, and Edinburgh; of pressure at Edinburgh, Stockholm, London, Paris, Berlin, and Vienna. Their use for forecasting future weather is not recommended. (2) A simple period of vertical oscillation in the atmosphere. When an element of air is displaced vertically, it oscillates harmonically about its equilibrium position, with a period of the same order as those found in microbarograph records.

EDINBURGH.

Royal Society, November 8.—A. P. **Laurie** and John **Milne**. The evaporation of water and salt solutions from surfaces of stone, brick, and mortar. Sulphate of lime sometimes crystallises out in bricks and stones, and in other cases it does not do so. Prof. Guye's work on the conditions of evaporation where capillary tubes open on surfaces over which water can creep, shows that the flow of liquid under these conditions is governed by the rate of thinning of the liquid layer by evaporation. Experiments made on the surface of a wall soaked by the rain and then drying out indicate that the surface which is evaporating more rapidly draws water from the more slowly evaporating surfaces. Thus if the brick or stone is evaporating more rapidly than the mortar, water will be drawn from the mortar containing salts in solution which will crystallise out and break up the stone or brick; if, however, the mortar is evaporating more rapidly than a stone or brick, water will be drawn from the stone or brick to the mortar, causing the concentration of salts to take place principally in the mortar instead of in the stone or brick. Hence in repointing old buildings, the decay of the brick or stone will be stimulated if the mortar is too dense. Mortar joints should be raked out; a suitable preservative should then be used so as to reduce the rate of evaporation from the stone or brick surface, and then repointed.—J. H. **Ashworth** and Janet C. W. **Bannerman**: A tetracotyle (*T. phoxini*) in the brain of the minnow. Specimens were collected near Edinburgh, near Loch Lubnaig, and in the Thames Valley. The parasite appears to be identical with *T. phoxini*, a species originally described in 1910 from minnows collected in Switzerland and in Germany, but has apparently not been recorded since. The tetracotyle are 0.33 mm. to 0.42 mm. long and very immature. The minnow is the second intermediate host of this trematode; the first intermediate host, and also the host in which it reaches maturity, have still to be ascertained. In heavily infected minnows about 250 or more tetracotyles were present, chiefly in the cavities of the optic lobes, in the Sylvian aqueduct, and in the fourth ventricle. The epithelial lining of these cavities has undergone extensive proliferation, and forms a vacuolated tissue in which most of the worms lie.—David **Waterston**: Development of the hypophysis cerebri in man, with a note upon its structure in the human adult. A series of specimens from embryos 3 mm. in length, and over, and from a Tarsius embryo, are discussed. Evidence is shown of the division of the anterior lobe into central and lateral portions, and of the absence of a distinctive pars intermedia in the adult human pituitary.—Ekendranath **Ghosh**. On the anatomy of the Mastacembelidæ of Bengal, with notes on their habits.—Sir Thomas **Muir**. The theory of persymmetric determinants from 1894 to 1919.—Satish Chandra **Chakrabarti**. A factorable continuant.

PARIS.

Academy of Sciences, November 3.—Emile **Picard**: Certain partial differential equations connected with problems of calorific equilibrium.—**Charcot** and P. **Idrac**. A phenomenon of atmospheric depression produced by a lofty obstacle in the wind. Entrance of the ship *Pourquoi Pas* into the shelter afforded by the high volcanic mountain Beerenberg on Jan Mayen Island (2300 metres), caused a sudden drop of the barometer of 1·8 mm. on one occasion and 2.5 mm. on another.—V. **Grignard** and P. **Murat**. Pyrosulphuryl chloride. With water in excess the reaction is given by the equation

$$S_2O_5Cl_2 + 3H_2O = 2H_2SO_4 + 2HCl$$

With the chloride in excess, the primary reaction appears to be

$$S_2O_5Cl_2 + H_2O = 2HClO + 2SO_2,$$

followed by the reaction

$$SO_2 + 2HClO = H_2SO_4 + Cl_2.$$

From this reaction and from measurements of the magnetic susceptibility and molecular refraction, the constitution of sulphuryl chloride is considered to be best represented as

$$Cl.O.SO-O-SO.O.Cl.$$

—Léon **Guillet** and Albert **Roux**. The influence of gases on the properties of steels. Steels from which the gases have been extracted by heating in a vacuum at 750°-850° C., show changes in mechanical and chemical properties when compared with samples of the same steels heated to the same temperature in air.—A. **Recoura**. Acetylated chromium sulphate.—Paul **Alexandroff**: Cantorian multiplicities and the generalised theorem of Phragmén-Brouwer.—Paul **Montré**: The reciprocity of two complexes with double inflectional foci.—I. **Raramata**: Relation between the distribution functions of two series dependent on each other.—G. **Valiron**: The theorems of Bloch, Landau, Montel, and Schottky.—S. **Stoïlow**. Remarks on some properties of continuous transformations of *n* variables.—A. **Kovanko**. The necessary and sufficient conditions for the capability of summation of some functions.—R. **Mazet**: Flow through a jet.—B. **Polland**: The limit of absorption of the *K* series of the element of atomic number 75.—R. **Forrer**: The structure of the atomic magnet and the mechanical effects of magnetisation.—Edmond **Vellinger**: The rotatory dispersion of tartaric acid. The author concludes that in aqueous solutions of tartaric acid there exist two fundamental forms. Of these, one is dextrorotatory corresponding to the molecular structure of the tartrate, the other lævorotatory corresponding to a structure as yet undetermined, that of the molecules in the crystals of tartaric acid.—Charles **Prévost**. The catalytic dehydration of the α-ethylenic alcohols.—Charles **Dufraisse** and Alfred **Gillet**: Stereochemical researches in the benzalacetophenone series. Ethylenic isomerism and polymorphism.—Georges **Darzens**: A new general method for the synthesis of the tetrahydronaphthalene and naphthalene hydrocarbons. Benzylallylacetic acid, treated with 78 per cent. sulphuric acid, undergoes internal condensation, giving tetrahydromethylnaphthalene carboxylic acid. The method is generalised by starting with homologues of benzylallylacetic acid.—Pierre **Bedos**. The stereochemical isomerism of the ortho-cyclohexanediols

nd on the structure of the oxide of cyclohexene.—
. **Weil**: The influence of impurities on the temperaure of the paramorphic transformation of cristobalite
–L. **Petitjean**: The thermodynamics of the surfaces f atmospheric discontinuity.—Marcel **Lefèvre**: A ariation of tabulation in certain fresh-water species f Peridinium.—Pierre **Georgévitch**: *Ceratostomella uerci.*—**Raymond-Hamet**: The action of ergotamine n the respiration.—Raoul **Bayeux**: The transussion of erythroclasia, produced by change of altiude, by the serum of animals which have lived in rarefied atmosphere.

SYDNEY.

Linnean Society of New South Wales, September 29.
–A. J. **Turner**: Revision of Australian Lepidoptera: repanidae, Limacodidae, Zygaenidae. Nine genera nd twenty species are described as new. Keys are ven for the identification of the genera in each of the ree families, and for the species of many of the enera.—H. J. **Carter**: Revision of Athemistus and icrotragus (Cerambycidae) with notes, and descripons of other Australian Coleoptera.—T. C. **Roughley**: n investigation of the cause of an oyster mortality n the George's River, New South Wales, 1924–5. uring the winters of the past eight or nine years there ave been mortalities of oysters of varying intensity the shores of the George's River and other rivers the southern half of New South Wales. Where the ortality was greatest large numbers of the oysters maining alive were affected with abscesses and cerations, commonest on the palps, gills, and inner rfaces of the mantles, but also found in the stomach, ver, gonad, and adductor muscle. A fairly definite tio of this affection to the severity of the mortality as found, and the appearance of microscopic sections ggests a bacterial origin. The theory is advanced at the low winter temperatures lower the vitality d therefore the resistance of the oysters and induce fection by bacteria in the water.

VIENNA.

Academy of Sciences, October 14.—A. **Dadieu**: he electromotive behaviour of aluminium. The tential was measured of aluminium and aluminium nalgam in molten aluminium bromide plus potassium omide and in the solution aluminium bromide, hyl bromide. The oxide skin theory is preferred.—
. **Rollett**: β-amyrin from elemi resin from Manila.—
. **Rollett** and L. **Bayer**: The constitution of furorylen.—O. **Dischendorfer** and H. **Grillmayer**: etulin.—K. **Przibram**: An artificial blue colouration rock salt at room temperature. Kahlbaum's pure dium chloride or rock salt from Wieliczka was ushed to powder and then exposed to weak daylight r some days. Reference is made to former exriments with radium radiation.—K. **Singer**: Physiogical and pathological chemistry of the brain (I.) he nitrogen and sugar apportionment in the brain the horse. Total amino nitrogen was determined, so cholin nitrogen, galactosid nitrogen and residual trogen.—N. **Alders**, H. **Chiari**, and D. **Laszlo**: The ycolytic power of cell-free extracts from tumours d other tissues.—R. **Weiss** and K. **Woldich**: The ndensation of ethoxymethylene-β-ketoneacidester ith resacetophenone and its relation to xanthophanic id.—J. **Pollak** and E. **Gebauer-Fulnegg**: The action chlorosulphonic acid on phenols.—M. **Holly**: (1) ew fish forms from the Sanaga River, Cameroons. (2) Two new silurids and a new characinid from e Cameroons.—L. **Lammermayr**: New contributions serpentine flora with special relation to Styria.

Official Publications Received.

BRITISH AND COLONIAL.

London County Council. Annual Report of the Council, 1925. Vol. 4: Education: Elementary Education; Children's Care; Special Schools, Industrial and Reformatory Schools and Places of Detention; Accommodation and Attendance in Elementary Schools, and Employment of Children; Higher Education; Technical, Trade and Evening Education, Day Continuation Schools, and Juvenile Employment Centres; General. (No. 2471.) (Published by the London County Council.) Pp. 40+8 plates. (London: P. S. King and Son, Ltd.) 1s.

Society for the Provision of Birth Control Clinics. Annual Report, 1925–1926. Pp. 16. (London: Walworth Women's Welfare Centre.)

Department of Agriculture, Jamaica. Entomological Bulletin No. 4, Parts 1 and 2: Catalogus Insectorum Jamaicensis. By C. C. Gowdey. Pp. ii+114+10+2. (Jamaica: Government Printing Office, Kingston.) 2s.

Union of South Africa: Department of Agriculture. Division of Chemistry Series No. 68. The Solubility of Copper in Basic Copper Carbonate. By Thos. D. Hall. Pp. 8. (Pretoria: Government Printing and Stationery Office.)

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 29, Part 3, Session 1925–26. Pp. xvii-xxiv+210-310. (Edinburgh.) 7s. 6d.

The Journal of the Institution of Electrical Engineers. Vol. 64, No. 359, November. Pp. 1093-1212+xxx. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Diary of Societies.

SATURDAY, DECEMBER 4.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—G. Wilkinson: Have we a Resonance Theory of Hearing, or only a Resonance Hypothesis?—Sir James Dundas-Grant: Remarks on the Use of Weber-Liel's Intra-tympanic Tube in Chronic Eustachian Catarrh.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Midland District) (at Shire Hall, Hertford), at 10.45 A.M.—S. M. Senior: Hertford Sewage Disposal Works and Housing.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. G. C. Simpson: Atmospheric Electricity (2).

MONDAY, DECEMBER 6.

CAMBRIDGE PHILOSOPHICAL SOCIETY (at the Museums, Cambridge), at 4.30.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. A. G. Cannon and Miss S. M. Manton: On the Feeding Mechanism of a Mysid Crustacean, *Hemimysis Lamornae*.—J. H. Awbery and Dr. E. Griffiths: Further Experiments with the Ewing Ball and Tube Flowmeter.—H. A. Baker: The Law of Blackening of the Photographic Plate at Low Densities (second paper). IV. Results for Isochromatic and Blue-Sensitive Plates and Filtered Light.—Dr. F. Walker: The Igneous Geology of Ardsheal Hill.

VICTORIA INSTITUTE (at Central Hall, Westminster), at 4.30.—Prof. J. A. Fleming: Evolution and Revelation.

BIOCHEMICAL SOCIETY (at Imperial College of Science), at 5.—D. Krestin and J. R. Marrack: The Calcium in Body Fluids in Nephritis.—D. J. Lloyd: The Mutual Influence of pH and Salt Concentration on Protein Swelling.—C. R. Harington and Prof. G. Barger: Chemistry of Thyroxin. III. Constitution and Synthesis of Thyroxin.—H. W. Buston and Dr. S. B. Schryver: The Basic Hydrolysis Products of Gelatine.—Prof. I. M. Heilbron, E. D. Kamm, and R. A. Morton: Absorption Spectra of Cholesterol and its Possible Biological Significance with reference to Vitamin D.—O. Rosenheim and T. A. Webster: Further Observations on the Photochemical Formation of Vitamin D.—Demonstration of Methods Employed for Purifying and Investigating the Proteins (Electro-dialysis, etc.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 5.30.—Annual General Meeting at 5.45.—At 6.—M. M. Lewis: Personality and Verbal Expression.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institution of Mechanical Engineers) (at Engineers' Institute, Cardiff), at 6.—Dr. J. H. Paul: Water, and its Action in Steam Boilers.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—G. Rushton: The L.G.O.C. Methods of Repairing Motor Buses.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—Ll. B. Atkinson and others: Discussion on Notes on the Trend of Electrical Development in America and Canada.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Dr. R. H. Pickard: Some Scientific Problems confronting the Leather Industry.

INSTITUTION OF THE RUBBER INDUSTRY (London and District Section) (at Engineers' Club, Coventry Street), at 8.—A. Fraser: British and American Machine Practice.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Earl Cawdor: The People of the Tsangpo Gorge.

INSTITUTE OF CHEMISTRY (Leeds Area Local Section).—F. Scholefield: Registration of Chemists.

INSTITUTE OF CHEMISTRY (Manchester and District Section) (at Manchester).—Dr. H. Levinstein: Address.

TUESDAY, DECEMBER 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: The Imperfect Crystallisation of Common Things (3).

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Loughborough College), at 6.45.—Col. J. F. Lister: Address.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.—Prof. W. Morgan: The Use of the Optical Indicator as a Means of Examining Combustion in Internal Combustion Engines.

Royal Photographic Society of Great Britain, at 7.—H. Venn: Bromoil (Lecture).

Institution of Automobile Engineers (Coventry Graduates' Meeting) (at Coventry), at 7.15.

Institute of Chemistry and Society of Chemical Industry (Edinburgh and East of Scotland Sections) (at 36 York Place, Edinburgh), at 7.30.—F. H. Carr: Vitamins in their relation to Industry.

Institution of Electrical Engineers (Scottish Centre) (at Royal Technical College, Glasgow) (Informal Meeting), at 7.30.—R. B. Mitchell: Home Lighting.

Institute of Metals (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—A. Logan: Foundry Work.

Rontgen Society (at British Institute of Radiology), at 8.15.—W. V. Mayneord: An X-ray Study of the Crystal Structure of some Biological Objects.—C. Andrews: Demonstration of The Seriascope, a New Instrument for Serial Radiography.

Royal Anthropological Institute, at 8.30.—Miss M. A. Murray: Recent Excavations in Malta.

Royal Society of Medicine (Orthopædics Section), at 8.30.—S. L. Higgs, Prof. Noordenbos, Sir Charters Symonds, Mr. Openshaw, H. Groves, Mr. Elmslie, M. Redding, E. M. Cowell, Mr. Bristow, Mr. Fairbank, Mr. Todd, and others: Discussion on The Treatment and Results of Fracture of the Upper End of the Femur in Adults (Excluding the Shaft).

WEDNESDAY, December 8.

Society of Chemical Industry (Glasgow Section) (at Royal Technical College, Glasgow), at 5.—F. H. Carr: Insulin.

Royal Institute of Public Health, at 4.—Lt.-Col. F. E. Fremantle: The Rôle of Parliament in regard to Health Legislation.

Institution of Civil Engineers (Informal Meeting), at 6.—A. H. Dykes: The Circumstances in which Small Private Electric Generating Stations may have Advantages over Public Stations.

Society of Chemical Industry (South Wales Section, jointly with Institute of Chemistry, South Wales Section) (at Swansea Technical College), at 7.30.—E. Le Q. Herbert: Lubricating Oils: their Manufacture, Properties, and Examination.

Royal Society of Arts, at 8.30.—Rev. Père De Clayn: The Port of Antwerp.

Eugenics Society (at Royal Society), at 8.30.—Prof. Carr Saunders: Migration in relation to Racial Problems.

Society of Chemical Industry (Newcastle-upon-Tyne Section) (at Newcastle-upon-Tyne).—Discussion on The Possibility of the Introduction of New Chemical Industries into the District.

THURSDAY, December 9.

London Mathematical Society (at Royal Astronomical Society), at 5.—T. Estermann: On Certain Functions represented by Dirichlet Series.—R. M. Gabriel: Some Theorems for Integrals of Moduli of Regular Functions.—U. S. Haslam Jones: An Extension of Hadamard's Multiplication Theorem.—Prof. H. Hilton and Sybil D. Jervis: On the Real Foci of Plane Algebraic Curves.—S. Pollard: On Plane Curves.—E. C. Titchmarsh: A Consequence of the Riemann Hypothesis.—Prof. H. W. Turnbull: Double Binary Perpetuants.

Royal Institution of Great Britain, at 5.15.—Sir Squire Sprigge: Early Medical Literature.

British Psychological Society (Industrial Section) (jointly with the National Institute of Industrial Psychology) (at Royal Society of Arts), at 5.30.—Discussion on The Attitude of Management to Industrial Psychology.

South London Entomological and Natural History Society, at 7.—Dr. H. B. Williams: Rumicia phlœas: Random Notes on Breeding and Collecting.

Institution of Electrical Engineers (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—Prof. A. R. Fulton: Tidal Power from the Tay.

Institute of Metals (London Local Section, jointly with Institute of British Foundrymen) (at 83 Pall Mall), at 7.30.—H. C. Dews: Contraction and Alloy Casting.

Royal Society of Tropical Medicine and Hygiene (at 11 Chandos Street, W.), at 7.45.—Demonstration on Some Tropical Liver Infections.—At 8.15.—Dr. H. S. Stannus: Tropical Neurasthenia.

Oil and Colour Chemists' Association.

Institution of the Rubber Industry (Manchester Section) (jointly with Society of Dyers and Colourists, Manchester Section) (at Manchester).—H. L. Hockney and C. W. Bancroft: Cloth Dyeing suitable for Rubber Proofing.

FRIDAY, December 10.

Institution of Water Engineers (at Geological Society), at 10.30 A.M.—A. W. Kenyon: Water Supply Finance.—J. P. Hallam: Recent Developments in the Design and Application of Centrifugal Pumps.—J. K. Swales: Repair Works in Connexion with the Belmont Reservoir of the Bolton Corporation.—E. J. Silcock: The History of an Artesian Bore-hole.

Royal Society of Arts (Indian Section), at 4.30.—C. H. Bompas: The Calcutta Improvement Trust.

Royal Astronomical Society, at 5.—A. Stanley Williams: A New Variable Star in Taurus.—R. H. Fowler: On Dense Matter.—W. M. Smart: The Constants of the Star Streams from Photographic Proper Motions.

Royal Society of Medicine (Ophthalmology Section) (at Central London Ophthalmic Hospital), at 5.—Clinical Meeting.

Physical Society of London (at Imperial College of Science), at 5.—Dr. F. Wenner: The Principle Governing the Distribution of Current in a System of Linear Conductors.—A. Campbell: A Capacitance Bridge of Wide Range, and a New Inductometer.

Malacological Society (at Linnean Society), at 6.

Institution of Mechanical Engineers, at 6.—Marine Oil Engine Trials Committee: Report No. 5.

North-East Coast Institution of Engineers and Shipbuilder (at Newcastle-upon-Tyne), at 6.—H. L. Brackenbury: Worksho Methods in Heavy Engineering.

Institution of Electrical Engineers (London Students' Section) (Automatic Training School, G.P.O., E.C.), at 6.30.—F. I. Ray Automatic Telephony.

Institute of Metals (Swansea Local Section) (at Swansea Universit College), at 7.15.—C. A. Seyler: The Application of Metallograph Methods to Coal.

Junior Institution of Engineers, at 7.30.—C. H. Foster: A Method Measuring Temperatures in the Cylinders of Internal Combustio Engines.

Institute of Metals (Sheffield Local Section) (at Sheffield University at 7.30.—A. H. Nicol: The Conductivity of Silver Plating Solutions.

Institution of Mechanical Engineers (Liverpool Branch) (jointl with Liverpool Engineering Society) (at Liverpool).—Marine Oil Engir Trials Committee: Report No. 5.

SATURDAY, December 11.

Institution of Municipal and County Engineers (South-Wester District Meeting) (at Vestry Hall, Dawlish), at 2.15.—S. F. C. Church Twenty Years in an Urban District.

Royal Institution of Great Britain, at 8.—Dr. C. Rootham: Hen Purcell and his Contemporaries (1).

British Psychological Society (Annual General Meeting) (at Universit College), at 2.30.—J. C. Flugel: Practice, Fatigue, and Oscillation.

North-East Coast Institution of Engineers and Shipbuilde (Graduate Section) (jointly with Institution of Mining Engineers) (Newcastle-upon-Tyne), at 7.15.—Discussion on The Production ar Transport of Coal by Machinery.

Mining Institute of Scotland (at Glasgow).

Oil and Colour Chemists' Association (Manchester Section) (Manchester).—R. S. Horsfall: Modern Industrial Chemistry.

Physiological Society (at London Hospital Medical College).

PUBLIC LECTURES.

SATURDAY, December 4.

Horniman Museum (Forest Hill), at 3.30.—Miss M. A. Murra Egyptian Hieroglyphs.

SUNDAY, December 5.

Guildhouse (Eccleston Square), at 3.30.—Sir George Newman: T Contribution of Medical Science to Human Life.

MONDAY, December 6.

Royal College of Surgeons, at 4.—F. W. Twort: Influence Environment on Bacteria. (Succeeding Lectures on December 7, 13, and 14.)

WEDNESDAY, December 8.

Institution of Civil Engineers, at 5.30.—F. E. Smith: Physics Navigation (Public Lectures of the Institute of Physics on Physics Industry).

London School of Economics and Political Science, at 6.— Hutchinson: Office Machinery in the United States (2).

THURSDAY, December 9.

Imperial College of Science and Technology, at 5.30.—Air Vi Marshall H. R. M. Brooke-Popham: Air Warfare.

King's College, at 5.30.—M. Beza: Sacred Marriage in Roumani Folklore.

Fulham Central Public Library, at 8.—Dr. D. Ward Cutler: Charl Darwin and Human Progress.

FRIDAY, December 10.

University College, at 5.30.—L. S. Jast: The Planning of a Libr Building.

SATURDAY, December 11.

Horniman Museum (Forest Hill), at 3.30.—M. A. Phillips: The Nurs Life of Animals.

SUNDAY, December 12.

Guildhouse (Eccleston Square), at 3.30.—Viscount Grey: The Natio Genius of England.

CONFERENCES.

December 8, 9, and 10.

Institution of Chemical Engineers (at Science Museum, Sou Kensington).

Wednesday, December 8, at 5.30.—R. G. Parker and D. N. Jackman: T Measurement of Mechanical Power absorbed by Driven Machines. Recording Torsion Dynamometer.

Thursday, December 9, at 3 and 5.30.—Symposium on Statistical Meth in relation to Industrial Efficiency:—D. Rider and T. C. Finlayson: T Control of Chemical Plant Operation by Statistical Methods.—H. Marris: Statistics in Industry—Some Uses and Limitations.— Cooke: Statistical Methods in Connexion with Plant Construction.

Friday, December 10, at 3 and 5.30.—Dr. G. Martin: Researches on Laws of Air Elutriation.—H. M. Dunkerley: Refrigeration in Chem Manufacturing Processes.

December 10.

Rothamsted Experimental Station, Harpenden, at 11.30 A.M.—Gr Manuring: its Possibilities and Limitations in Practice:—H. J. P and others: Green Manuring.—H. Upcher, H. Drewitt, and oth Practical Experiences of Green Manuring.

SATURDAY, DECEMBER 11, 1926.

CONTENTS.

PAGE
The China Indemnity 829
The Training of a Sociologist. By Prof. T. D. A. Cockerell 831
The Diphtheria Bacillus and Related Organisms. By M. M. B. 832
British Late Palæolithic Industries. By M. C. Burkitt 833
Vinegar 834
Our Bookshelf 835
Letters to the Editor:
The Supposed Law of Flame Speeds.—Prof. William A. Bone, F.R.S. 837
Rainfall Interception by Plants.—John Phillips . 837
The Occurrence of Helium and Neon in Vacuum Tubes.—Dr. Robert W. Lawson 838
A Possible Connexion between the Wave-Theory of Matter and Electro-Magnetism.—H. Bateman . 839
Patent Law and Unemployment.—E. Wyndham Hulme; The Writer of the Article . . . 840
The Oogenesis of Lumbricus.—Prof. J. Brontë Gatenby 840
Chromosome Complements in Grasses.—Gwilym Evans 841
The Planet Mars.—E. M. Antoniadi 841
The "H and K" Bands of Carbon.—A. S. Ganesan 842
The Anomalous Dilatation of Invar.—Prof. Carl Benedicks and Per Sederholm 842
Science and the Press.—Dr. W. M. Cumming . 842
Critical Potentials of the Vapours of Mercuric Halides.—Prof. V. I. Pavlov and A. I. Leipunsky 843
Optical Excitation of the Vapours of Mercuric Halides.—Dr. A. Terenin 843
Sir William Crookes and Spiritualism.—The Right Hon. Lord Rayleigh, F.R.S. 843
Behaviour of Silicic Acid Gel during the Drying-up Process.—K. Krishnamurti 843
The Reaction to Flea Bites.—Ernest I. Robson . 843
Biology and Human Life. By Prof. J. S. Huxley . 844
Developments in the Use of Echo-Sounding Apparatus. By J. B. 846
Tectonic Features of New Guinea. By Prof. Arthur Holmes 848
Obituary 849
News and Views 850
Our Astronomical Column 854
Research Items 855
Rectal Alimentation 858
The Russian Geographical Society. 859
Peat Investigation in Canada. By Dr. Hugh Ryan 859
University and Educational Intelligence . . . 860
Contemporary Birthdays 861
Societies and Academies 861
Official Publications Received 863
Diary of Societies and Public Lectures . . . 863

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

The China Indemnity.

ALTHOUGH the situation in China is now such that the present would scarcely seem an opportune occasion for the discussion of methods of educational development, a note of optimism and reassurance is not absent from the Report of the Advisory Committee established under the China Indemnity (Application) Act 1925, which was presented to Parliament last week.[1] This Committee, it will be remembered, was constituted to advise the Secretary of State for Foreign Affairs on the methods of applying the so-called Boxer Indemnity to purposes "beneficial to the mutual interests of His Majesty and of the Republic of China." When the Committee took up its duties at the beginning of 1926, it decided to send a delegation of six of its own members—three English and three Chinese—to investigate conditions on the spot. The report of this delegation occupies four-fifths of the report of the Committee.

The report of the delegation is in many respects an illuminating document. While it does not, indeed, deal with matters not strictly germane to the inquiry, it serves to throw light on many of the political, social, and economic difficulties of the moment. Although it bears witness to the courtesy and assistance the delegation received at the hands of the Chinese, official and other, not the least of the difficulties encountered arose from the suspicion prevalent among the Chinese that the motives of Great Britain were not disinterested. This attitude was undoubtedly due to a misunderstanding, and the delegation thought it expedient to publish an explanatory memorandum with the object of removing it. So strong, however, was the impression made on the members that they recommend that the future management of the fund should be in the hands of a board of trustees established in China, who will supersede the advisory committee. In this way, it is considered, it will be possible best to fulfil the desire to administer the fund according to Chinese ideas. The board will consist of eleven members, of whom six will be British and five Chinese. After 1945, British members may be replaced by Chinese as vacancies occur.

Before the delegation left England, a memorandum had been drawn up by the chairman of the Committee, Lord Buxton, for the guidance of the members. This had received the approval of the Chinese members. In this memorandum it was assumed that the purposes for which the indemnity was to be used were entirely educational. There was, however, a reference to the fact that an influential body of opinion had urged that a considerable portion of the fund should be used for railways, or public works. The members of the delegation themselves were, indeed, much impressed by what they saw of the importance of agriculture and the peasant in the social and economic conditions of China, as well as by the need for improved methods of cultivation.

---

[1] Report of the Advisory Committee, together with other Documents respecting the China Indemnity. (London: H.M. Stationery Office, 1926) Price 3s. 6d. net.

It is essential that these facts should be kept in mind in judging the weight of the considerations which have guided the delegation in framing its recommendations. It must be remembered that while education was the primary consideration, the needs of China as a whole, and not a section of it, as well as the desires of the Chinese themselves, had to be taken into consideration. The delegation wisely decided that provision should be made for carrying on the work now to be initiated after 1945 when the annual payments come to an end. The total fund, amounting to about 11,000,000*l.*, accruing between 1922 and 1945, is to be divided into two parts: (*a*) an annual sum of about 350,000*l.* (out of an annual average amount of about 500,000*l.*) for immediate expenditure, and (*b*) capital for the formation of an investment fund, for which provision is to be made by raising a sum not less than 3,500,000*l.* and not exceeding 5,200,000*l.* for permanent investment. It is suggested that this be applied for some useful national reproductive undertaking, such as railways or river conservation, or if they do not provide adequate security, gilt-edge securities. This first course would ensure the desire of the Chinese that advantage should accrue from the fund to objects of national importance other than education. On the amortisation of the indemnity fund, the proceeds from the investment fund are to be applied to the continuation of the educational and other work. These proposals are endorsed by the Committee so far as the twofold allocation of the indemnity fund is concerned; but caution is recommended in dealing with the investment fund. It is calculated that the latter will produce rather more than five millions.

Turning to the proposals for immediate expenditure, it is recommended that the annual sum be applied in the following proportions:

Agricultural Education and Improvement (including 5 per cent. for famine relief and rural credit) .	30 per cent.
Scientific Research . . .	23 per cent.
Medicine and Public Health . . .	17 per cent.
Other Educational Purposes . .	30 per cent.

While a number of interesting suggestions are made under each of these heads, they are in no way mandatory, and considerable discretion is to be left to the trustees in allocating the fund. These suggestions, when examined in the light of the detailed information given in the body of the report, can only be regarded as the outcome of a very clear view of the needs and possibilities of the situation. In agriculture, for example, agricultural colleges are to be established, scientific study of the culture of the silk-worm is suggested, and an Institute of Rural Economics is proposed. Under the heading of scientific research is suggested the establishment of a National Research Institute. It is generally acknowledged that provision for research is one of the greatest needs of China in higher education, and it may be noted that provision for research is also suggested as one of the objects of the subsidy for university education.

In considering the claims of what is here called "direct educational purposes," the delegation had before it a serious problem in relation to elementary education. The funds at the disposal of the trustees will be far too small to admit of any subsidy on a large scale. Further, it was felt that it was not expedient that they should assist elementary education, which is a national duty. Secondary education, however, and particularly secondary education for girls, is recognised as of importance and is to be encouraged so far as possible in the matter of staff and equipment. In university education, the provision of professorships, equipment for library, laboratory, and research are among the objects mentioned. It is interesting to note that an endowment for a chair in Chinese at the School of Oriental Studies, London, and similar provision at Oxford, Cambridge, and elsewhere, are recommended.

Some stress has been laid from time to time on the advantage in increased understanding which would accrue from the education of selected students in England. This, however, the delegation does not recommend, at least on any large scale, and the experience of the Japanese and American schemes leaves little room for doubt that this decision is sound.

Taken as a whole, the report is a document which summarises the present educational situation in China with a remarkably clear view of essentials. The work has been well done. The claims of the more urgent needs of the country have been carefully weighed and the various interests nicely adjusted. Some disappointment may be felt by those who hold that so small a sum relatively might have been better employed in an existing or new institution of university rank. Possibly, however, its wider dispersion through more numerous channels may serve the greater good in the long run by stimulating public effort in a larger number of directions when China once more becomes an organised State.

The Training of a Sociologist.

My Apprenticeship. By Beatrice Webb. Pp. xiv + 459 + 12 plates. (London: Longmans, Green and Co., Ltd., 1926.) 21*s*. net.

AMONG the various kinds of people in the world, certainly the most interesting are those who have tried to understand the meaning and purpose of human life, and express their conclusions in word and deed. It is rather astonishing to reflect how few these are, and how diverse their results. The complexities of human behaviour are such that most investigators appear to belong in some measure to the kingdom of the blind, finding only the tail or trunk of their elephant instead of the whole beast. Mrs Webb is not without limitations, but the extent of her knowledge and the breadth of her comprehension place her among the foremost living sociologists, the more to be admired on account of the practical results of her activities. Becoming a sociologist, she also became a socialist, but of a plastic opportunist type rather than a rigid Marxian.

How all this happened to a young woman of good social standing, intended to grace the halls of conventional society, is told at length in "My Apprenticeship." In the very dawn of life and during the years of development Herbert Spencer was a significant factor. When only twenty-four, Spencer had made the acquaintance of Mr. and Mrs. Potter—Mrs. Webb's parents. They made an extraordinary impression on him, and he recorded that they appeared to him the most admirable pair he had ever seen. Spencer said of Mr. Potter: "He is, I think, the most lovable being I have yet seen. . . . I must say I felt so strongly the beauty of his disposition as contrasted with my own, that I felt more dissatisfied with myself than I have done for a long time past." The friendship thus begun lasted as long as life, and Spencer was "the philosopher on the hearth" at the Potters', in spite of the fact that Mr. Potter never could interest himself in the synthetic philosophy. When Spencer died, it was Beatrice Potter, already married to Sidney Webb, and holding opinions strongly opposed to those of the philosopher, who ministered to his broken spirit. She records in her diary of December 1903: "My old friend passed away peacefully this morning. . . . 'My oldest and dearest friend,' he has called me these last visits. 'Let us break bread together,' he said on Monday, and insisted on a plate of grapes being set on the bed and both of us eating them. 'You and I have had the same ends,' he repeated again; 'it is only in methods we have differed.'"

The contact with Spencer, and with other intellectual men who came to the house, could not fail to have potent influence. The diary of 1881 records: "Mr. Spencer's visits always interest me and leave me with new ideas and the clearing up of old ones." Growing up in such circumstances, endowed with a keen mind and a warm heart, it is not surprising that Beatrice Potter came to question the accepted views of conventional society and orthodox religion, and was much perplexed about her duty and conduct. In this state of mind she might have been converted to some religious or political faith, and have gone through life a fanatical advocate of a particular brand of salvation. Instead of this, she sought relief in contact with realities, in experiences which might reveal to her the hidden meaning of the maladjustments which she could clearly perceive.

That Miss Potter took the scientific rather than the emotional path may well have been due to her early scientific contacts; but the revelation of the workings of her adolescent mind, given with the utmost frankness, should interest any psychologist. There were certain notable limitations; thus she says: "Owing to a mental defect, which I believe is not so uncommon as it is unrecognised and unrecorded, the whole realm of poetry was closed to me: I was poetry blind, as some persons are colour blind." Yet she was not at all devoid of feeling; indeed her diaries indicate rather an excess of sensitiveness with regard to her own personality and affairs. The abandonment of orthodox religion left her with "not even an affirmation by the intellect of the existence of a spiritual power with whom man could enter into communion, but an intuitive use of prayer as, for one of my temperament, essential to the right conduct of life . . . by prayer, by communion with an all-pervading spiritual force, the soul of man discovers the purpose or goal of human endeavour, as distinguished from the means or process by which human beings may attain their ends."

Gravitating toward the field of practical sociology, Miss Potter in 1883 conceived the plan of what she now calls "a sentimental journey." Her mother's family, the Heyworths, had come from among the working classes of Lancashire and Yorkshire. The old nurse, affectionately called 'Da,' used to visit at Bacup, where some of the variously remote cousins still lived and belonged to the 'working classes.' Why not go to visit them? But, said the nurse, they are not accustomed to such grand folk. "'Oh,' cried I, jumping up with the delightful consciousness of an original idea, 'I wouldn't be Miss Potter, I would be Miss Jones, farmer's daughter, near Monmouth.'" It was so arranged, though it was difficult to break the nurse of the habit of calling her 'm'am.'

The visit was very successful, and was repeated in following years. Miss Potter was attracted by the earnest simplicity of the people. She says:

> "In living amongst mill-hands of East Lancashire, I was impressed with the depth and realism of their religious faith. It seemed to absorb the entire nature, to claim as its own all the energy unused in the actual struggle for existence. Once the simple animal instincts were satisfied, the surplus power, whether physical, intellectual, or moral, was devoted to religion. Even the social intercourse was based on religious sympathy and common religious efforts. It was just this one-idea'd-ness and 'transparentness of life which attracted my interest and admiration. For a time it contrasted favourably with the extraordinarily complex mental activity arising in the cosmopolitan life of London—an activity which in some natures tends to paralyse action and dissipate thought."

The great opportunity and experience came to her when Charles Booth, at his own expense, undertook his investigation of the conditions of life and labour of the London people. This extended over seventeen years, and the results were published in a series of volumes which have ever since been recognised as of classic importance. Through participating in this inquiry, Miss Potter came to understand the practical problems of urban life in all its details, and also to appreciate the importance of intensive work in this field. The opinions she formed, like those developed by Booth himself, were gradually matured in the presence of an ever-increasing mastery of the facts. Charles Booth was a wealthy captain of industry, "conservative in politics and strongly anti-socialist in temper and economic views," yet he emerged from his long study with "proposals the very reverse of individualist." He conceived that it was the duty of the State to take over the control of the lives of the very poor, under a socialistic type of administration, while leaving the more capable section of society to its own devices, with individualism dominant.

Beatrice Potter had now become a well-known social investigator, and thought of this work as her chosen calling. She studied the 'sweating' problem, deciding that the real sweater is not some malevolent Jew, but the nation itself. She took up the history and results of the co-operative movement, and in the course of these studies found herself in need of certain information. "'Sidney Webb, one of the Fabian essayists, is your man,' casually remarked a friendly woman journalist. 'He knows everything; when you go out for a walk with him he literally pours out information.'" In February 1890, the diary records: "Sidney Webb, the socialist, dined here to meet the Booths. A remarkable little man with a huge head and a tiny body, a breadth of forehead quite sufficient to account for the encyclopædic character of his knowledge. A Jewish nose, prominent eyes and mouth, black hair, somewhat unkempt, spectacles, and a most bourgeois black coat shiny with wear. But I like the man. There is a directness of speech, an open-mindedness, an imaginative warm-heartedness which will carry him far."

So it came about that the apprenticeship of Beatrice Potter came to an end, and her long and happy partnership with 'the other one' began. Concerning that we may hope to hear full particulars at some later date.

T. D. A. COCKERELL.

The Diphtheria Bacillus and Related Organisms.

Annals of the Pickett-Thomson Research Laboratory. Vol. 2, No. 2, July 1926. Pp. iv+29-203+50 plates. (London: Baillière, Tindall and Cox; Baltimore, Md.: Williams and Wilkins Co., 1926.) 42*s*. net.

THIS volume is almost entirely devoted to a study of Corynebacteria (diphtheria bacillus and 'diphtheroids'), with special reference to the importance of microphotography as an aid to their classification and identification. The writers are the Director and Pathologist of the Pickett-Thomson Research Laboratory, Drs. David Thomson and Robert Thomson.

The greater part of the letterpress is given up to a comprehensive review of the literature of the genus. Much of this of necessity covers ground very adequately dealt with in the monograph on diphtheria published by the Medical Research Council (1923), to which acknowledgment is made. A feature of the present survey which will be found very useful for reference is an alphabetically arranged list of probably all the named diphtheroids to be found in the literature, together with a short account of each and the authors' comments on the records. Chapters are also devoted to the distribution of the genus, to the pathogenicity, and to previous attempts at classification. The latter show the great complexity of the subject, the confusion resulting from the unavoidable inadequacy of the earlier attempts, and the difficulties still encountered in the present state of bacteriological knowledge.

In the system of classification advocated in this memoir, the importance of photographic records of the organism in both microscopic preparations and cultures is emphasised, though other cultural and biochemical characters are detailed. Seventy-two varieties of diphtheroids are described, with plates of each, but the total number of strains examined is not stated, and in some of the varieties the fermentation reactions are not recorded.

The routine recommended by the authors in examining a diphtheroid is as follows: The macro- and microscopic characters of the growth are observed on standard solid and liquid media. These cultures and stained microscopic preparations are compared with photographs of diphtheroids previously examined If the organism under investigation does not correspond with any of the existing records, it is itself photographed and added to the collection. Afterwards the fermentation reactions are examined, and in most cases the pathogenicity of the strain for the guinea-pig is tested.

From the character of the growth on testicular agar a preliminary division into five groups is made:

Group I. Non-chromogenic, profuse growers, aerobic or facultative (22 varieties).

Group II. Non-chromogenic, profuse growers, anaerobic (4 varieties).

Group III. Non-chromogenic, delicate growers, aerobic or facultative (25 varieties).

Group IV. Non-chromogenic, delicate growers, anaerobic (5 varieties).

Group V. Chromogenic, profuse growers, aerobic or facultative (16 varieties).

The variety is determined by ancillary cultural characters and morphology. The fermentation reactions give the type.

The authors agree with the writers of the diphtheria monograph in deprecating the naming of individual members of the genus and suggest that individual strains be designated by a Roman numeral indicating the group, a fermentation formula showing the type, and a number giving the variety.

Whilst a study of the authors' plates and accompanying descriptions shows that much time and labour have been expended on the work, the mass of detail is so great that the general impression given is one of great complexity. Indeed, the authors themselves at times seem to have some difficulty in deciding the position of a strain. They appear to desire to emphasise the great variety of diphtheroids encountered in routine examinations. Few, if any, modern bacteriologists will dispute this point, but what those who have had most experience of the genus will feel is that, owing to the variations, especially in morphology, to which the genus is liable, any method of identification in which morphology and minor cultural characters play an important part must hold the possibility, nay, the certainty, of many errors, especially if, as the authors seem to contemplate, the organism is 'placed' on the evidence of a single examination.

It is claimed by the authors that this difficulty can be overcome by the use of a satisfactory medium, but this we are inclined to doubt. Whilst the more obvious cultural characters, such as thickness or thinness of growth, on which the authors base their primary grouping, will, as a rule, remain constant on any given medium properly prepared, variation in the finer points may occur even on the same batch of medium, and morphology is notoriously variable A sentence in the Medical Research Council's monograph would seem to be conclusive on the latter point. "When different portions of the same serum slope are examined, very great differences may be detected in the proportion of the different (morphological) types" The reference is to the diphtheria bacillus and not to diphtheroids, but though it is true that in many diphtheroids the number of morphological types present is smaller than in *C. diphtheriæ*, in others considerable pleomorphism exists. Indeed, many such are shown in the authors' plates.

The book is well printed and the great majority of the photographs well reproduced. The latter, with the accompanying notes, are of considerable value in demonstrating the great variety of morphological and cultural characters to be found among Corynebacteria.

The volume also contains a further note by Dr. David Thomson on the pleomorphic Gram-negative bacillus associated with measles, and a paper on the etiology of tuberculosis in relation to satisfactory immunisation in cattle by Dr. J. J. Thomson.

M. M B.

British Late Palæolithic Industries.

The Upper Palæolithic Age in Britain. By D. A. E. Garrod. Pp. 211+3 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 10*s*. 6*d*. net.

THIS book indeed fills a gap. Not since 1897, when the second edition of Evans's "Ancient Stone Implements . . ." appeared, has there been any attempt to study systematically the palæolithic history of Britain. The present volume only deals with a small portion of the story, but it is to be hoped that the author will not stop short and that further work on the other periods will appear later to complete the picture.

Miss Garrod has learnt her subject in France under the Abbé Breuil and others, and her terminology and indeed her whole thought is French. The reader who is not familiar with the French classifications may find himself now and then at sea, but clearly the present volume is intended rather as a book of reference for the student of the subject than as arm-chair reading for the casual inquirer. As such it amply fulfils its purpose. There are numerous illustrations.

Britain is divided into geographical areas, each of which is dealt with in a chapter, but Miss Garrod is careful to point out that this method is only employed for convenience' sake and that no idea that each area shows a different culture is implied.

After a charming little preface in French by Breuil and a short introduction, Devonshire finds are discussed, and, as will be expected, Kent's Cavern is given a foremost place and occupies the lion's share of the chapter. This is the first time that the most important British cave site has ever been systematically described. Except for a note on Bench Cavern, Brixham, other palæolithic finds of the county are omitted. Neither the Tor Bryan Caves situated near Denbury, nor the Happaway Cave, Torquay, nor the cave at Cattedown near Plymouth, where human remains were found, appear, though they are all mentioned by Evans. Would it not have been well at least to have catalogued them, even if unimportant?

The next area discussed is South Wales. Here comes an excellent condensed account of Paviland. Some notes on several other small caves in the district follow. A few pages (with figure) on King Arthur's Cave in the Wye Valley form the third chapter, but as this district is at present being investigated by the Spelæological Society of the University of Bristol, it is probable that a second edition will show a considerable amplification here.

An account of the Mendip region follows, including Aveline's Hole, Gough's Cave, Wookey Hole, Hyena Den, etc. Although the first of these has been published by the Spelæological Society of the University of Bristol in its *Proceedings*, it has not attracted hitherto all the attention it deserves.

The North Welsh caves are next passed under review, and this chapter is all too short; the district calls for further investigation in the field.

After a note on the Victoria Cave, Settle, Yorkshire, the Derbyshire caves are described. Creswell Crags take naturally chief place. Mr. L. Armstrong's recent and still unfinished work there has revolutionised our ideas on the industries found. To a certain extent, therefore, Miss Garrod's account is necessarily an epitome of that published in the *Journal of the Royal Anthropological Institute* for January 1925, but none the less, here as elsewhere, she has carefully studied the finds in person.

The book concludes with a second part containing notes on a few open-air finds that are possibly Palæolithic in culture, followed by a short sketch on some transitional industries, and finally a general summary and conclusions, bibliography, etc.

The treatment of the earlier part of this section is perhaps too slight. Surely any account of the open-air sites in eastern England should form part of a much larger discussion on the whole problem of the surface finds of East Anglia, some of which may be quite possibly Upper Palæolithic in age. Lastly, may one dissent from the use of the term 'Creswellian' for those late Palæolithic cultures occurring on the edge of the Magdalenian world, which, though derived from the same basal Neanthropic stock, did not actually develop into the Magdalenian culture. Late developments of the Aurignacian culture are found all round the periphery of the Magdalenian world, and show more or less influence from the splendid Magdalenian culture of France. There is a danger that the name of a species would be given to the genus and that the term 'Creswellian culture' would become on a par with the term 'Cromagnon race'—that unfortunate use of the name of a site where one modification of the Neanthropic race was found, for the race itself.

One can only conclude by hearty congratulations to Miss Garrod. Her book is the first systematic account of the Upper Palæolithic cave cultures in Britain that has appeared in the light of modern knowledge, and she may justly be proud of the result.

M. C. Burkitt.

Vinegar.

Vinegar: its Manufacture and Examination. By C. Ainsworth Mitchell. Second edition, thoroughly revised. Pp. xvi+211+5 plates. (London: Charles Griffin and Co., Ltd., 1926.) 10*s.* 6*d.* net.

VINEGAR or 'Alegar,' as the body when derived from beer was originally called, has been in household use from early times; it has been the subject of organised manufacture for generations; and for 250 years in Great Britain was an object of taxation for revenue purposes—a policy which still exists in some other countries. There is therefore a wealth of interesting historical material from which Mr. Mitchell has been able to draw in this manual on vinegar.

The early story of vinegar and its manufacture, the legislation affecting it, the theories advanced to account for acetic fermentation, as well as illustrations of the apparatus in use a century ago, some of it surviving in a few cases to-day, form a considerable part of the book. But modern processes of manufacture have not been overlooked, and on this portion the author speaks with the authority of an experienced worker.

The manufacturing details and the treatment of the crude vinegar show how the factors used by chemists a quarter of a century ago for determining the purity of a vinegar, as well as the definition of what is understood by vinegar, need revision. An effort has, indeed, recently been made in a Bill before Parliament to lay down a definition of vinegar, but the author does not refer to this although he gives the proposals on the same point put forward by the Vinegar Brewers' Association in 1908.

The methods for the examination of vinegar are on the whole fairly complete, although reference has to be made to the appendix for some of these. A full description of the method for the determination of arsenic by the Marsh zinc and acid method described in a report to the Royal Arsenical Commission in 1901, is included, but it would have been as well to record that the Commission had also before it the electrolytic method which is now very largely used.

It is unfortunate that the appendix has been used to describe several pieces of modern work, instead of their inclusion in the text in this 'revised' edition. Thus, in reading the account of the manufacture of acetic acid in Chap. v., there is a sense of loss that no reference is made to the synthesis from acetylene. This, however, is given in the appendix, together with other matters such as the modern classification of acetic bacteria suggested by the American Society of Bacteriologists in 1920. The book would have been more clearly up-to-date if these had been included in their relevant places in the text.

The appendix also gives a list of the import duties of different countries on vinegar and acetic acid, presumably as a guide to intending exporters. It would have been of advantage to give also the definitions for the various types of vinegar which have been adopted by some of these countries with which imported vinegar must conform.

The book is, however, a very useful addition to technical literature.

Our Bookshelf.

Zoologie im Grundriss. Von W. Stempell. Dritte Lieferung. Pp. 337-512. 6·90 gold marks. Vierte Lieferung. Pp. 513-688. 6·90 gold marks. Funfte Lieferung (Schluss des Werkes). Pp. xx + 689-900. 10·50 gold marks. (Berlin: Gebrüder Borntraeger, 1926.)

THE early portion of the third part of this text-book contains the remainder of the general account of the structure of the Vertebrata. The few pages on development might have been extended with advantage, and the systematic accounts of the classes of vertebrates also suffer from undue compression—the elasmobranchs are dealt with in 40 lines, the Dipnoi in 20 lines, and the Rhynchocephalia in 10 lines.

The succeeding section is devoted to physiology and development. A brief account of the principal inorganic and organic substances met with in animals is followed by a consideration of the various aspects of metabolism, and (continuing into the fourth part) excretion, with short accounts of pigments and animal coloration. The transformation of food into energy and the production of electricity and light are considered, and an account is given of the sense organs—especially eyes and statocysts, which are concerned in directing movement, and of the general relationships of the neurones in the central nervous system concerned in reflexes. The last section of the part deals with reproduction and development and here again the difficulties due to compression are apparent.

The fifth part opens with a brief account of heredity, followed by a section on the relation of animals to their environment and on evolution, concluding with a short chapter (9 pp.) on the descent of man. A list of books and of journals is given for the use of those who wish to pursue their studies further.

A concise summary is provided so that the student can review, by reading some fifteen pages, many of the important matters which have been dealt with in the volume.

The diagrammatic figures are for the most part good and helpful, but some of the others scarcely fulfil their functions, *e.g.* the figure of Archæopteryx would have been of much more use to the reader had its parts been lettered. At the end of the volume are one hundred reproductions of photographs made chiefly by the author, and there is an excellent index.

The book as a whole is very condensed, but the student who works through it and grasps the facts and principles set forth, if he is at the same time developing his knowledge of comparative anatomy, embryology, and microscopical structure by sound work in the laboratory, will have received an all-round introduction to the study of animal life.

Business Economics. By Sir William Ashley. Pp viii + 71. (London: Longmans, Green and Co., Ltd., 1926.) 2*s.* 6*d.* net.

NOTWITHSTANDING the growing attention which is being paid to-day to the importance of the study of economics, there is as yet no real assurance that its teachings are having any deep effect upon the minds of the great mass of business men. It may be that it is yet too early to look for this result. While economics is slowly winning its rightful place in the syllabuses of many professional examinations, it is doubtful whether either the younger or the older practical business man ever has its claims brought before him in a manner which both attracts and ensures his attention. If this end is to be achieved, it can only be through the influence of books specially written with this purpose in view, and it is within this sphere that Sir William Ashley's little book on "Business Economics" has a particular claim. It consists of a reprint of three lectures delivered by him this year at the Commercial College at Copenhagen. Its main purport is to emphasise the importance of overhead charges or expenses in the determination of business policy.

Much of the dislike and the distrust that a practical man of affairs shows towards economics spring from the difficulty he has of finding within the written page any immediate help towards the solution of the practical problems with which from time to time he is faced. Such a man seeks a definite answer to a definite question, and all he can find in the text-book is a broad answer to a broad question. His interest in economic literature is therefore never likely to develop until some practical link is established between general theories on one hand and particular problems on the other. By analysing the influence of overhead costs, Sir William Ashley makes an important contribution towards forging this essential link. He shows how and why 'dumping' arises. He considers its reaction on the wage policy. He discusses the advantages and disadvantages of integration and vertical combinations, and also of the policy of broadening the basis of business. The relation of dividends to profits, with the corollary of reserves, also receives attention, and a few words are devoted to the question of publicity.

The field of business economics calls, as Sir William Ashley notes in his concluding lines, for much further investigation, and we venture to hope that he will pursue his studies and so develop this side of knowledge that it will, in his own words, "contribute to the training of efficient men of business . . . form in itself an interesting body of knowledge and . . . be a genuine mental discipline."

W. H. C.

Handbuch der Pflanzenanatomie. Herausgegeben von Prof. K. Linsbauer. Lief. 15. Abteilung 2, Teil 2: Pteridophyten und Anthophyten. Band 9: Das abnorme Dickenwachstum. Von Dr. H. Pfeiffer. Pp. xii+273. 19·50 gold marks. Lief. 14. Abteilung 2, Teil 2: Pteridophyten und Anthophyten. Band 10: Anatomie der Angiospermen-Samen. Von Prof. Dr. Fritz Netolitzky. Pp. v+364. 27 gold marks. (Berlin: Gebrüder Borntraeger, 1926.)

THESE two volumes, forming part of a comprehensive series dealing with all aspects of plant anatomy, contain a wealth of detail useful to the specialist and, expecially in the case of Pfeiffer's book, not without considerable interest to the general botanist. Pfeiffer deals essentially with the various types of anomalous secondary thickening found in lianes and perennial storage organs, the detailed consideration of which, arranged under numerous headings, occupies the greater part of the book. The introductory section includes a brief summary of the present views as to the causal interpretation of the phenomena concerned and a useful oversight in tabular form of the occurrence of the different types of anomalies in the various Phanerogamous families. The treatment of a large mass of (in part) rather unconnected facts has been successfully accomplished, but a rather fuller consideration of fleshy roots might have been useful. The illustrations are somewhat scanty—in particular figures showing successive stages in development of anomalous structure might have been more freely included.

Netolitzky's treatise on the anatomy of Angiospermous seeds, which traverses a very large body of literature, deals with the subject-matter essentially from the systematic point of view. Seed structure is considered family by family and the data are summarised in a table at the end of the book. One misses, however, anything of the nature of a synopsis giving the distribution of the various seed characters in families and genera, such as would facilitate identification of a seed of unknown affinity. The numerous illustrations may help to some extent to remedy this defect.

Le pH intérieur cellulaire. Par Dr. Paul Reiss. Pp. 135. (Paris: Les Presses universitaires de France, n.d.) n.p.

THIS monograph provides an excellent summary of the literature in a field of experimental biology which is beginning to attract great attention. After a very summary statement of the theoretical physico-chemical basis from which conclusions may be drawn as to the significance of hydrogen ion concentration to the behaviour of protoplasm, a brief chronological summary is given of the main investigations in which an attempt has been made to determine a *p*H of biological interest. As the author says, when placed chronologically, these investigations do not show a growing improvement in the technique of determination of *p*H, the difficulties grappled with in earlier papers often being completely neglected by later workers.

The intention of the author is to avoid this in future by a comprehensive study of the literature of *p*H determinations of significance in biology, and a very valuable section follows in which a critical discussion is given of the use and limitations of both indicator and potentiometric methods when applied to living organisms. A brief but very suggestive discussion of the tentative suggestions as to the significance of *p*H, for example, as an internal regulatory mechanism in the organism, completes a very concise monograph that should be of real value to the experimental biologist.

The bibliography covers English and American work as well as continental, and cites a number of papers published so late as 1926. It is an additional advantage that this little monograph discusses somewhat fully the suggestive work of Prof. Vlès and his pupils, both in the development of methods of determination of *p*H and as to the significance of external *p*H on the behaviour of mixtures of protein ampholytes with different iso-electric points.

Die Tierwelt der Nord- und Ostsee. Herausgegeben von G. Grimpe und E. Wagler. Lieferung 4. Teil 7, c_1: *Bryozoa*, von Ernst Marcus; Teil 12, c.: *Pisces, Allgemeiner Teil*, von H.M. Kyle und E. Ehrenbaum; Teil 12, g_1: *Teleostei Physoclisti*, 1-5, von Georg Duncker und Erna W. Mohr. Pp. 100+104+44. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 18 gold marks.

THE present part of the "Tierwelt der Nord und Ostsee" maintains the useful character of the preceding numbers, the section by Marcus on the Bryozoa being particularly well done, comprehensive, and embodying all recent work. It receives treatment on the lines already laid down, which are to be followed throughout the whole work in dealing with each group. The full account of the habitats of the species, and a detailed key, together with figures elucidating the morphology of a large number of species, will be very valuable to zoological workers.

The general introduction to fishes given here by Kyle and Ehrenbaum comprises a rapid survey of their systematics, morphology, and biology; though necessarily brief, it is good. Systematists will find Kyle's views on classification and the phylogenetic scheme which places the Cyclostomata amongst the Chondrichtyes on a level with the elasmobranchs provocative and stimulating. Of greater service to the naturalist are the artificial keys to the families and to the eggs of North Sea species so far as they are known. Detailed descriptions of the families, species, and of their life histories are to be given in the systematic portions as they appear; the scombresociformes, syngnathiformes, Plectognathi, atheriniformes, and ammodytiformes occurring in the present volume.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Supposed Law of Flame Speeds.

AT the general discussion upon explosive reactions in gaseous media, held in London on June 14 under the auspices of the Faraday Society, Prof. R. V. Wheeler and Dr. W. Payman presented a paper on the uniform movement during the propagation of flame, in which they emphasised their supposed 'Law of Flame Speeds,' claiming it to be applicable to all conditions of flame propagation. They added that "there is a considerable amount of evidence available that the relative speeds of the uniform movement of flame obtained under the specified experimental conditions are directly proportional to the speeds under other conditions, except during the detonation wave"; also, that the law of speeds applies to the rate of development of pressure in complex mixtures of gas with air (*Trans. Faraday Soc.*, **22**, pp. 301-306).

In a written contribution to the general discussion (*ibid.* pp. 314-320) I expressed doubts as to the general validity of this supposed 'law,' and stated that for some time past experiments had been in progress in my laboratories to test it from the point of view of the behaviour of complex mixtures of certain hydrocarbons with hydrogen and oxygen, containing an excess of combustible gases, and that we hoped to be able to publish a detailed account of the results of these experiments before the end of the year, when we would discuss further their bearing upon the 'law.'

The basis of the experimental test to which we have subjected the 'law' is one which the authors of it themselves have accepted. For in their recent paper at the Faraday Society (*loc. cit.* pp. 304-305) they said: (1) "that if a complex mixture is made by blending a number of mixtures of air with simple combustible gases all of which have the same speed of uniform movement of flame, then this complex mixture will also have the same speed of flame provided that all the mixtures are of the same type, all containing excess of oxygen or all containing excess of inflammable gas," and that (2) "an important deduction from the law of speeds is that during the propagation of flame in a complex mixture of combustible gas and air mixtures of the type we have just considered (all with the same speed of uniform movement of flame), the combustion can be regarded as involving the simultaneous but independent burning of a number of simple mixtures of the individual gases with air, in which the proportions of inflammable gas and air are such that each mixture, if burning alone, would propagate flame with the same speed as does the complex mixture." They also reported having found experimentally that complex mixtures of methane-hydrogen-and-air, containing insufficient oxygen for complete combustion, fulfil such conditions.

The experiments which have been in progress in my laboratories during the past two years upon the behaviour at atmospheric temperature and pressure of such complex mixtures as those of acetylene-hydrogen-and-oxygen, and of ethylene-hydrogen-and-oxygen, containing an excess of combustible constituents, are now completed, and the results thereof will in due course be communicated to the Royal Society. Meanwhile, I desire it to be known that in neither case have the observed flame speeds fulfilled the requirements of the 'law.' In the case of the acetylene-hydrogen-oxygen mixtures they diverged from it considerably; and for the ethylene-hydrogen-oxygen mixtures they were entirely inconsistent with it. Indeed, we have arranged an experiment, which can be shown to any one who will come to see it, affording visual evidence that the behaviour of such complex mixtures of ethylene-hydrogen-and-oxygen are irreconcilable with the requirements of the 'law.'

I am, therefore, convinced from my own experiments that, whatever degree of validity there may be in the conclusions which Prof. Wheeler and Dr. Payman have drawn from theirs, they are not universally applicable to all explosive mixtures, and therefore they cannot be vested with the authority of a natural law.

WILLIAM A. BONE.

Imperial College of Science and Technology,
South Kensington, London, S.W.7,
November 29.

Rainfall Interception by Plants.

THE work of Marloth ("Results of Experiments on Table Mountain for ascertaining the Amount of Moisture deposited from the South-east Clouds": *Trans. S. A. Phil. Soc.*, 14, 403-408, 1903, and "Results of Further Experiments on Table Mountain for ascertaining the Amount of Moisture deposited from the South-east Clouds": *ibid.*, 16, 97-105, 1905) on the subject of deposition of moisture from the south-east clouds on Table Mountain, has attracted much interest in meteorological circles.

Marloth used two 5-in. gauges, one bearing a 12-in.-high frame of mesh wire and 4 vertical wire supports, through which seventeen Restionaceous stems were drawn, the other being an ordinary open gauge. In 56 days the control catch totalled nearly 4 in., the vegetation-screened catching nearly 80 in., representing an *interception gain* of about 1500 per cent. During ordinary precipitation the *interception gains* were 300-400 per cent., but during misty weather they rose to 1000-1200 per cent.

de Forest ("Rainfall Interception by Plants: An Experimental Note": *Ecology* 4 (4), 417-419, 1923), working in Maryland, employed three 3-in. gauges: the first bore a wire-mesh frame 12 in. high; the second bore a similar frame and in addition ten 12-in.-long imitation (tin) reeds, standing about 1·5-3 mm. apart, bent lengthwise to form interior angles of about 135°; the third served as a control. In four months (26 days measurable rainfall) the reed-clad gauge registered an *interception gain* of nearly 30 per cent.

The writer, working at Deepwalls, Knysna, South Africa (1725 feet elevation; Lat. 33·9 S., Long. 23·16 E.), has employed two 5-in. gauges 4 ft. high, standing within three yards of one another on the level ridge of an exposed hill. The first gauge bore a 12-in.-high frame of wire mesh identical with that used by Marloth; through the mesh four single branchlets of the broad-leafed conifer, *Podocarpus Thunbergii* Hook., were drawn, about thirty leaves (of 2-3 in. × ½ in.) being borne by each branchlet. The branchlets were arranged so that the foliage was held firmly in position, and the apex of each branchlet was placed ½ in. below the top rim of the frame, thus an evenly spread mosaic of leaves was exposed round the gauge. Care was taken to preserve the spread and density of the foliage-screen, the leathery, persistent nature of the latter necessitating very slight adjustment during the twelve months of the experiment.

The rainfall registered by the two gauges was as follows:

Month	Control Gauge.	Vegetation-screened Gauge.
June 1925	3·96 in.	7·95 in.
July	2·66	2·73
August	3·59	6·81
September	9·04	19·49
October	6·03	12·46
November	3·91	7·20
December	4·88	7·95
January 1926	3·37	6·34
February	*3·41*	*3·32*
March	5·62	10·54
April	3·43	6·60
May	2·12	3·17
Total	52·02	94·56
Percentage	100	181·7

Summarising: (1) In one year the control registered 52 in. only, the vegetation-screened, 94 in. (2) For every month except February 1926, the vegetation-screened gauge registered the higher catch—the reason for the higher catch by the control in February being that few hydrometeors occurred, the precipitation taking the form of normal and of heavy showers. (3) A classification of rain types for the period June 1925–May 1926, shows—

79 per cent. of the rains to have been of fine, misty nature (*Nebelreissen*).

13 per cent. of the rains to have been normal showers.

8 per cent. of the rains to have been heavy downpours.

(4) Detailed readings indicate that the greater catches registered by the vegetation-screened gauge occurred as the result of the *Nebelreissen*.

The *Nebelreissen* are responsible for the deposition of large amounts of moisture upon the exposed crowns of the Knysna Forest trees, and to a lesser but still appreciable extent upon the foliage of the two 15-ft.-high Macchia or *Fijnbosch*; the forests are usually dripping wet during *Nebelreissen*, while the ground immediately beyond their margins is comparatively dry.

The subject of *interception loss* due to vegetation has been studied by Horton ("Rainfall Interception": *Mon. Weath. Rev.*, 47, 603-623, 1919), and by de Forest (*loc. cit.*). Horton working in Albany, N.Y., with trees and field crops, concludes that rainfall interception represents a loss of rainfall which would otherwise be available to the soil, and shows that the interception loss is greater in forests than in fields. In the summer of 1918 he found the *mean interception loss* under eleven species of trees to be about 40 per cent of the total rainfall.

The writer has studied the interception loss in the Knysna forests as the result of the taking up of moisture by the foliage, branchlets, branches, and boles of the trees, and as the result of evaporation of thin films of moisture occurring on these parts. In one experiment two 5-in. gauges 4 ft. high were employed—the first being placed under canopy of climax high forest (*Podocarpus elongata* L'Herit. and *Olea Laurifolia* Lamk. being the dominants), the second being set under full exposure, about 200 yards distant. The elevation was 1500 feet, and the aspect southern. The results of the experiment may be summarised as follows:

(1) For the period February 1, 1923–January 31, 1925 the total catches by the gauge under canopy and by the control were 65·98 in. and 85·0 in. respectively; that is, there was an interception loss of about 22·4 per cent.

(2) The total number of days on which 0·01 in. or more was registered, was 58 days less under canopy than in the open.

(3) Interception losses were greater during Nebelreissen or fine rains, owing to the foliage, branches, and boles taking up so much of the moisture; heavy downpours lowered the interception loss considerably.

Observations are showing that while there is this well-marked interception loss below the trees, within their crowns the actual total catch of moisture is far greater (30-80 per cent) than at equivalent heights in fully exposed sites.

It is hoped that those interested in the fascinating subject of rainfall interception by plants will place on record any information they may have accumulated concerning the relative importance of interception losses and interception gains. JOHN PHILLIPS.

Forest Research Station,
Deepwalls, near Knysna,
South Africa, September 26.

The Occurrence of Helium and Neon in Vacuum Tubes.

IN a letter recently published in NATURE of October 30, 118, p. 625, Prof. Baly and Dr. Riding gave an account of their more recent experiments on the appearance of the rare gases in electric discharge tubes. Under certain conditions they found both neon and helium in the residual gas, and they record one instance in which pure helium was obtained. These results confirm their earlier observations, as well as those of Collie, Patterson, and Masson (1915). The authors incline to interpret their results as due to a disintegration by the electric discharge of the nitrogen atom, the experiments having been performed in mixtures of oxygen and nitrogen, or with nitride electrodes.

Whatever may be the true interpretation of these experiments, their importance cannot be denied, for they undoubtedly reveal a phenomenon in electric discharge work the significance of which has not hitherto been adequately appreciated. There can be no doubt that the results can not be interpreted as arising from a simple air-leak, for positive results have been obtained under a great variety of conditions, and elaborate precautions have been taken to avoid contamination from outside. Nevertheless, the possibility of the diffusion of atmospheric helium and neon through the walls of the apparatus, first suggested by Lo Surdo (*Atti Linc.* (5), 30, I. p 85, 1921), does not seem to have received the attention it deserves in the interpretation of such experiments, and it is the purpose of this note to indicate that the effect is by no means negligible.

That helium and neon diffuse through heated quartz and glass is a well-established fact, though most of the experiments on the phenomenon have been performed with these gases in a state of comparative purity, and at appreciable pressures. The effect is much greater with helium than with neon. According to experiments of Williams and Ferguson (*Am. Jour. Sci.*, 44, p. 2160, 1922), the permeability of fused silica glass to helium is proportional to the pressure and increases exponentially with the temperature, and with Pyrex glass at 610° C. the effect is about 5 per cent. of that with fused silica at the same temperature. Furthermore, O. W. Richardson and R. C. Ditto (*Phil. Mag.* (6), 22, p. 704, 1911) have shown that at 1000° C. helium diffuses from the air through fused silica more rapidly than neon.

In their remarkable work on the transformation of hydrogen into helium, F. Paneth and K. Peters (*Ber. d. D. Chem Ges.*, 59, p. 2039, 1926) have also directed attention to the passage of helium and to a lesser extent of neon through heated glass. Even at normal temperature they were able to detect the presence of helium in their apparatus after the lapse of about a week, their arrangement being so sensitive that they could detect about 10^{-8} c.c. of helium. For this reason, in experiments of long duration they immersed their apparatus in water, when the presence of helium was not detected even after a period reckoned in months.

In experiments by Dr. J. S. Hawnt and myself, it has frequently been necessary to test our apparatus for atmospheric contamination, and in the course of this work we have also established the diffusion at room temperature of helium from the air into our apparatus, which is constructed of glass, with an attached quartz discharge tube. Thus, after the apparatus had stood evacuated for a fortnight, during 36 hours of which part of the discharge tube was heated locally by means of a sand bath at 200° C, we found, after removal of hydrogen and absorption by charcoal, that the residual gas was helium, no trace of neon being evident The volume of helium (at N.P.T.) so obtained was greater than 10^{-7} c c, our apparatus being capable of detecting 10^{-8} c c. or less. In the spectrum of the excited residual gas the mercury lines and Hα were feebly developed, but the helium lines were strong, and the colour of the discharge was that characteristic of helium in the capillary of a vacuum tube containing helium at reduced pressure. The following helium lines were well developed: 6678, 5876, 5016, 4922, 4713, and 4471.

It is well known that in heavy unidirectional induction coil discharges in vacuum tubes, particularly at low pressure, the glass walls of the bulb surrounding the cathode become very hot Moreover, in heavy condensed discharges (with spark-gap) the capillary becomes strongly heated, whereas the bulbs remain relatively cool. In the latter case, also, if the pressure of the contained gas be increased, a greater spark-gap is necessary to get the same amount of heating in the capillary. Now these are precisely the conditions under which Baly and Riding have obtained helium and neon in their discharge tubes, and it seems practically certain that in experiments of from 60 to 100 hours duration helium in appreciable quantity, and to a lesser extent neon, will diffuse from the air through the heated parts of their discharge tubes. It would be interesting if the experiments were repeated with the bulb and the capillary respectively immersed in a jacket containing mercury or through which water was continuously flowing during the discharge. The non-appearance of the rare gases in such cases would be proof that these gases had previously diffused from the air into the discharge tubes. It should also be pointed out that by enclosing the discharge tube in an evacuated glass vessel the entrance of helium will not be prevented, for the double walls will probably both be hot at the cathode end in the ordinary discharge, and the diffusion will only be retarded owing to the greater thickness of glass through which the helium (and neon) must now diffuse.

Should the occurrence of the rare gases in electric discharge tubes really be due to their diffusion through the heated glass from the air, it is rather surprising that helium is not always more abundant than neon in the residual gas. It seems not unlikely that some other cause may also be involved in the case of neon, for neon is often present in greater quantity than helium.

Paneth (*l.c.*) has pointed out that glass has the ability of selectively adsorbing helium from a helium-neon mixture, and this may in part explain the occasional relative abundance of neon as compared with helium. A further contributory cause may be adduced from the fact that in a helium-neon mixture subjected to electric discharge, helium disappears more readily than neon, presumably due to absorption by the electrodes, sputtered metal, or the glass walls. Thus Claude (*C.R*, 156, p. 1317, 1913) found that with 1 per cent. helium in neon the helium disappeared by absorption during the passage of the discharge, whereas in a mixture containing 1 per cent. neon in helium the neon did not disappear.

Robert W. Lawson.

The Physics Laboratory,
The University, Sheffield,
November 16.

A Possible Connexion between the Wave-Theory of Matter and Electro-Magnetism.

In de Broglie's theory a particle of matter travelling with velocity v has associated with it a phase-wave travelling with velocity c^2/v. It seems that this theory may have some connexion with Sir J. J Thomson's theory of moving lines of force if we interpret v as a velocity of the electric line and c^2/v as the velocity of the magnetic line.

In this theory, as I understand it, a possible velocity v for a line of electric force satisfies the equation

$$H=\frac{1}{c}[v \times E],$$

where E is the electric and H the magnetic force. A possible velocity w for a line of magnetic force is, on the other hand, given by the equation

$$E=-\frac{1}{c}[w \times H].$$

Eliminating H and making use of the equation $(w\,E)=0$ we find that

$$(v.w)=c^2.$$

When v and w are in the same direction, this equation gives $w=c^2/v$. In the later developments of Thomson's theory (see, for example, H. Bateman, *Phil. Mag.* vol. 34 (1917), p. 405), expressions of type

$$H_x=\frac{\partial(\psi,\tau)}{\partial(y,z)},\ E_x=\frac{1}{c}\frac{\partial(\psi,\tau)}{\partial(x,t)},$$

are adopted for the components of E and H and the equations of a moving line of magnetic force are

$$\psi=\text{constant},\ \tau=\text{constant}.$$

Adopting also expressions of types

$$A_x=\frac{1}{2}\left(\psi\frac{\partial\tau}{\partial x}-\tau\frac{\partial\psi}{\partial x}\right),\ \ldots\ \Phi=-\frac{1}{2c}\left(\psi\frac{\partial\tau}{\partial t}-\tau\frac{\partial\psi}{\partial t}\right)$$

for the potentials, we remark that if ψ and τ both satisfy de Broglie's equation

$$\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}+\frac{\partial^2\psi}{\partial z^2}-\frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2}=\frac{m^2c^2}{h^2}\psi,\ h=\frac{h}{2\pi},$$

then we have the usual relation

$$\frac{\partial A_x}{\partial x}+\frac{\partial A_y}{\partial y}+\frac{\partial A_z}{\partial z}+\frac{1}{c}\frac{\partial\Phi}{\partial t}=0.$$

If we assume simply (P. A. M. Dirac, *Proc. Roy. Soc.*, vol. 112 (1926), p. 670)

$$\psi=e^{i\frac{E}{hc^2}(vx-c^2t)}f_1(y,z),\ \tau=e^{-i\frac{E}{hc^2}(vx-c^2t)}f_2(y,z),$$

$$E=mc^2\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}},$$

the electromagnetic field turns out to be independent of the time,[1] but according to the above rules the lines of magnetic force can be regarded as moving with velocity c^2/v parallel to the axis of x, and the lines of electric force with velocity v in the same direction. If our function ψ can be regarded as a constant multiple of Schrödinger's ψ and τ as its imaginary conjugate, then, whenever we have an expression such as

$$\psi = \Sigma A_n e^{2\pi i \nu_n \left(t - \frac{x}{c}\right)},$$

the only frequencies which appear in the electromagnetic field are the differences $\nu_n - \nu_m$ of the fundamental frequencies.[2] We are not bound, however, to make ψ and τ conjugate complex quantities. If, for example, we put

$$\psi = \frac{hec}{Er} e^{\frac{iEt}{k}}, \quad \tau = ie^{-\frac{iEt}{k}},$$

where r is the distance from the origin, both ψ and τ satisfy de Broglie's equation and we have

$$E_x = -\frac{ex}{r^3}, \quad E_y = -\frac{ey}{r^3}, \quad E_z = -\frac{ez}{r^3},$$

$$H_x = 0, \quad H_y = 0, \quad H_z = 0.$$

The field is thus that of a simple electric pole.

H BATEMAN.

California Institute of Technology,
Pasadena.

Patent Law and Unemployment.

THE writer of the article on the above topic has provided, in NATURE of November 13, p. 695, a very valuable graph of the number of British patents kept in force for the fourteen years' term, and has supplied useful figures of the number of foreign patents granted in Great Britain from 1900 to 1909; but I dissent from his conclusions. The former shows an almost continuous rise in the number of the fourteen-year enduring patents from 1897 onwards. This cannot be due to the retrospective action of the 1902 Act. It supports my contention that the rise is due to external industrial conditions. If the writer of the article compares his graph with the list of the numbers of foreign inventions patented here he will see that the rise or a fall in the latter is reflected in a corresponding rise and fall in the graph.

Hence I again urge that an official inquiry should be made to ascertain whether these foreign patents were taken out for the purpose of fostering or obstructing British industries. This is more material, as it is known that since the year 1900 or thereabouts British capital has gone abroad in increasing quantity (cf. Hobson, "Export of Capital"), and this fact, while it makes for national wealth, accentuates the problem of unemployment. I agree with the writer that foreign inventions patented here represent the cream of foreign inventive talent. I was wholly opposed to the foolish Act of 1919 which for a time acted as a deterrent to the foreign inventor. My contention is that if it is wished to induce the foreigner to introduce his industries here, we must stop threatening him and must offer him such better terms as will induce him to come over and help us.

E. WYNDHAM HULME.

Littlehampton, November 14.

MR. HULME'S contention that there is "an almost continuous rise in the number of fourteen-year enduring patents from 1897 onwards" can be tested numerically. For the period 1885 to 1896 the average number of such survivors was 498 per annum, the mean deviation being 4·9 per cent. and the maximum deviation 9·4 per cent. For 1899 and 1900 the figures are 509 and 508 respectively, and the deviation from the previous average, namely 2 per cent, was thus so well within the previous mean deviation that the rate of survival may be regarded as steady down to 1900 at least. Nor is the rise really great for the next two or three years. Practically the whole transition took place over the period 1904–1906, and by 1907 the figure had become so steady again that for the period 1907–1912 the mean deviation from the new average of 1210 was only 2·3 per cent., and the maximum deviation only 5·4 per cent. It is difficult to think of any cause for such a change other than the enhanced prestige conferred upon patents by the Act of 1902, as a result of increased confidence in their validity.

The rate of survival is no doubt affected by the number of patents granted to foreigners There are other factors, however, which swamp the correlation in question, and it does not seem to be very close.

Mr. Hulme more than any one else can claim credit for having directed attention in recent years to a principle which is in real danger of being forgotten, namely, the principle that the value of a patent system must be measured by its success in fostering the establishment of new manufactures within the realm. But surely if a capitalist is to risk his capital on a manufacture which has been patented, he wishes to feel some assurance that his patent is a valid one. In proportion as his confidence is increased in this respect will he be willing to risk the necessary outlay in experimental work, plant, organisation and publicity. He has to create a new demand; and he needs to be assured that when he has done so he will not be robbed of his reward by the competition which invalidation of his patent would make possible.

THE WRITER OF THE ARTICLE.

The Oogenesis of Lumbricus.

THE letters by Mr. L. A. Harvey and Prof. V. Nath in NATURE of November 27 and December 4 require comment. With regard to Parat's 'Vacuome Theory,' I have little of value to say. Some of my associates have a leaning towards the vacuome theory, and Prof. Nath does not mention Nassonov's Protozoa work, which is certainly in its favour. One of my most valued pupils, Dr. Bhattacharya, of Allahabad, after studying in Paris, embraced Parat's views, and naturally this has had some influence on me. In the oogenesis of Patella, a form investigated by Ludford, Woodger, Rodgers Brambell, and myself, it does seem that it is the sphere-substance and not a vacuole, which forms the fat globules. Reinvestigation of this form, in view of Parat's claims, might yield interesting results. If Mr. Harvey really wants to see Golgi bodies forming yolk and fat, I commend him to Patella, where the phenomenon is very clear.

I think that the evidence for Parat's views is getting stronger, but I do not care to commit myself to any more definite expression of opinion at the present moment. I consider that Prof. Nath's very interesting attempt to co-ordinate Parat's results, and his own valuable investigations on yolk formation, should be weighed carefully by future workers on the cytoplasmic inclusions.

Mr. Harvey is ill advised to reopen a controversy on his paper. I have no intention of repeating here the substance of our reply to Mr. Harvey's paper, which Dr. Nath and I have published in the recent issue of the *Q.J.M.S.* The reader of this letter should refer to that journal.

---

[1] This may be avoided by using the type of solution employed by L. de Broglie, NATURE, Sept. 25, 1926.

[2] This was suggested by the remark at the end of Schrodinger's paper, *Ann. d. Phys.*, Bd. 79 (1926), p. 734.

Now, regarding Mr Harvey's letter, it should be pointed out that my Saccocirrus work, the only paper published on annelid oogenesis before Mr. Harvey's paper, was merely quoted by him in the bibliography It is clear that Mr Harvey had not taken the trouble to read my work before he published his criticisms This was a pity

Mr. Harvey points out that his paper was more in the nature of a critique of the methods of argument used by my school. Years ago, when I had already published several papers in the *Q.J M S.* under Sir Ray Lankester's editorship, that great worker wrote to me a good many letters of advice. In one of these he said, "Collect as many facts as you can, avoid discussion." If Mr. Harvey will take this piece of advice to heart, it will be all to the good.

Mr. Harvey complains that I have called into question his technique and powers of observation. This is true. Mr Harvey quotes Dr. Cowdry. I know Dr. Cowdry's work: it is very fine, but it has no bearing on Lumbricus. Dr Cowdry has worked on vertebrate mitochondria and chondriocontes. I am dealing with the eggs of the common earthworm.

Mr. Harvey says that "Prof. Gatenby and his school are content to accept the view that yolk is a general term covering anything in the cell which cannot otherwise be identified." On the contrary, Prof. Gatenby and his school are *not* prepared to accept everything and anything, as Mr Harvey now realises clearly Mr. Harvey goes on to say, "Is it not time that cytologists made some attempt to bring the observations on oogenesis to as orderly state as are those on spermatogenesis?" Such an attempt has already been made by Rodgers Brambell, Nath, and myself. Mr. Harvey should read these papers *carefully*, and then sit down quietly and try to help by adding facts himself.

I am grateful to the editor of NATURE for an opportunity of seeing the letters of Prof Nath and Mr. Harvey. I have no wish to continue this controversy.

J. BRONTE GATENBY.

Trinity College, Dublin,
November 6.

Chromosome Complements in Grasses.

THE hybridising and genetical study of grasses has reached a stage when information on their nuclear constitution is not only of general interest, but may also give guidance in elucidating problems of inheritance.

So far, we have had no recorded evidence of chromosome counts having been made in grasses, as apart from cereals.

I obtained, through the kindness of Mr. T. J. Jenkin, of the Welsh Plant Breeding Station, Aberystwyth, the use of grasses of known pedigree to carry out cytological investigations. This work was commenced in the summer of 1923 on *Lolium perenne* (Perennial ryegrass), *Lolium perenne* var. *multiflorum* (Italian ryegrass), and the hybrids derived from these two.

Anthers were selected as the organs most likely to yield the best results in the matter of chromosome counts. They were studied partly by means of microtome sections, and partly by means of the iron-aceto-carmine (Belling's) method.

The whole series of events in sporogensis was followed from the initiation of the meiotic divisions in the pollen mother-cell to the end of the homotype division.

Seven univalent chromosomes were so clearly distinguished in several phases of the reduction and homotype divisions that I can state with confidence that this number represents the haploid complement in *Lolium perenne*, *Lolium perenne* var. *multiflorum* and their hybrid progeny. The diagrammatic disposition of the seven bivalents on the nuclear plate, forming a regular hexagon with a chromosome at each angle and one in the centre, is remarkable It is of interest to mention that I found the divisions in the pollen mother-cells of the hybrids to be quite regular, except that 'lagging' chromosomes were occasionally found.

In studying mitoses in the root tips of *Festuca elatior* (probably var. *arundinacea*) (= Tall fescue), I discovered that the exact diploid number of chromosomes was difficult to determine, since the cell is comparatively small and the crowded chromosomes fill it to a great extent However, from my counts the full complement appeared to be in the region of forty.

The anthers of this grass were investigated later, and the reduced number of chromosomes was determined, with a fair degree of certainty, to be twenty-one.

From a preliminary study of *Festuca elatior* var. *pratensis* (Meadow fescue) I have strong evidence that the haploid number in this case is seven.

The iron-aceto-carmine method applied to the anthers of this grass was such a striking success that I was able to make a large number of counts in individual anthers.

It would thus seem that polyploidy obtains in genera of grasses, as in cereals.

GWILYM EVANS.

Agricultural Education Department,
County Offices, Dolgelley,
October 28.

The Planet Mars.

IN NATURE of November 13, p. 709, I notice the following sentence. "An objection frequently brought by M Antoniadi against the objective reality of the canals, based on their being drawn straight when far from the centre of the disc, is answered by a careful observation of the canal Amenthes-Thoth on October 19 and 20, 1924"

This passage scarcely represents the facts, for I have shown in numerous writings since the opposition of Mars in 1909 that, in the place of Schiaparelli's *canali*, the surface of the planet very often shows either (1) complex dusky streaks; or (2) jagged edges of half-tones; or (3) isolated, irregular dark spots. Amenthes-Thoth being a Schiaparellian marking, the probabilities, according to my views, are that, in its position, there exists an irregular streak. The Thoth I saw very broad, strong, and jagged in 1911, and insisted on its abnormal conspicuousness, considered it real, and discovered the fact that its changes are not seasonal—a fact that observation has fully confirmed since (See my Mars Report for 1911–1912, of the British Astronomical Association, pp. 116-117)

As the writer of the note on p. 709 refers to the 1924 appearance of the Amenthes-Thoth, and as I have represented that marking in 1924 as a winding, complex, dusky streak (*Bulletin of the Astronomical Society of France*, 1925, p. 82), it is only natural that it should obey perspective. The suggestion that the marking in question is illusive is thus completely answered.

Furthermore, Prof. Pickering did not mention me in connexion with his above observation, as the text on p 709 seems to suggest.

My position is perfectly clear: there is no geometrical network on Mars, since I have shown (1) that the linear canals vanish in a large glass when much more delicate detail is quite plain; (2) that they disobey the laws of diffraction; and (3) that they often disobey perspective Mr. E. W. Maunder, whose wonderful insight led to the theoretical solution of the canal question fifteen years before my observations of 1909, had already pointed out in 1894 that the linear 'canals' appear sometimes unduly straight near the limb of the planet; and I have further given a graphic demonstration of the illusive character of such appearances by the construction of spherical projections. I must continue therefore to refute any attempt to represent, as real lines, markings disobeying natural law, and I wish to express the view that the 'canal' question, in its present stage, is past serious scientific discussion.

E. M. ANTONIADI.

15 rue Arsène Houssaye,
Paris, 8e, November 15.

The "H and K" Bands of Carbon.

IN discussing the negative bands of carbon, Deslandres mentions (*Comptes rendus*, 137, p. 460, 1903) the two strong bands λ2883·86 and λ2897·11 which "are very intense, are diffuse on both sides, are of a different structure and otherwise very curious," and suggests that they may probably be due to oxygen. These bands have also been noticed by Prof. Fowler while studying the comet-tail bands, but he makes no mention of them in his papers He calls them the "H and K" bands of carbon because of their striking resemblance to the two solar lines H and K. In a recent paper Johnson (*Proc. Roy. Soc.*, A, 108, p. 343, 1925) observes that each of these bands is resolved into two components, and he has allocated two of them to the regular negative band system. This allocation seems to be of a rather doubtful nature, for the structure of these bands is peculiar and they can be obtained alone, unaccompanied by the other members belonging to the same system.

While experimenting on the spectrum of neon under a low pressure, these two bands were prominently obtained on a photograph. The tube contained carbon and oxygen impurities, as was evidenced by the presence of the strong lines belonging to them. The bands were seen only in the uncondensed discharge, and no other bands were to be seen at all The structure of these bands is remarkable. Each consists of three lines, a central sharp line bounded on each side by a diffuse line, the less refrangible diffuse to the red and the more refrangible diffuse towards the violet. The writer had the opportunity of examining the old plates of Prof. Fowler and verifying the wave-lengths. In those plates, however, the resolution was not sufficient to warrant accurate measurements. The following table gives the wave-lengths of the lines measured on a plate taken with a large Hilger quartz spectrograph that gave a dispersion of about 14 Å.U. per mm. in this region.

Deslandres. λ I.A.U.	Johnson. λ I Å.U.	Present Measures. λ I.A.U.	ν (vac.)
2897·00 (10)	2897·15 R (3)	2897·23 d.r.	34505·61
		2896·25	34517·28
	2895·5 V (4)	2895·35 d.v.	34528·00
2883·75 (10)	2883·6 R (2)	2883·74 d.r.	34666·97
		2882·84	34677·79
	2882·25 V (2)	2881·97 d.v.	34688·26

A. S. GANESAN.

University College,
Rangoon.

The Anomalous Dilatation of Invar.

IN NATURE of November 6, p. 662, Prof. F. Zernike describes an experiment claiming to be a repetition of our dilatation measurements of invar. This experiment, however, presents considerable differences regarding the method and thermal circumstances used as well as the state of the metal.

The wire now used being 0·5 mm. in diameter has a section only 0·09 times the one used by us (diameter 1·65 mm.). Consequently, the time—about 3 minutes—during which the intermedial changes were observed by us (before contraction set in on heating) must have been a considerably reduced one. Further, on account of the wire being heated by the passage of an electric current, this time must be shortened still further. Now, such electric heating—in spite of giving necessarily a definite temperature gradient in a radial direction—may be all right for the later observations, at the very beginning, however, when a rather uniform temperature is indispensable, the temperature distribution along the specimen necessarily is a non-uniform one (say parabolic) This must reduce the intermediate dilatation as observed by us, and render the observation more difficult. The comparatively high stress of about 1 kgm. as applied by Prof. Zernike will also act in the direction of lessening the effect observable.

On the other hand, it is well known that the dilatation properties of a 36 per cent. iron-nickel alloy are dependent to a considerable degree of the thermal and mechanical treatment; it can scarcely be considered as invar when not in the original well-seasoned state. On account of this we deemed it necessary to investigate the ('geodetic') wire in its original state, using merely the heating (to 50°) necessary for the experiment. Prof. Zernike, on the contrary, has examined a wire which after the original treatment had been severely cold-worked, in one case "after annealing at a red heat." After such a treatment the alloy is certainly not strictly comparable to the original invar wire, as used by us.

In these circumstances we cannot consider that the experiments made by Prof. Zernike "in order to repeat" our work, really fulfil this purpose, and we await a repetition more nearly equivalent to our method before taking the work up again.

CARL BENEDICKS,
PER SEDERHOLM.

Metallografiska Institutet,
Stockholm, November 13.

Science and the Press.

IN reference to the leading article on "Science and the Press" which appeared in the issue of November 27, it may interest readers of NATURE to know what action has been taken in Glasgow in this connexion. A publicity campaign, under the auspices of the local section of the Institute of Chemistry, has been in operation for the past four years, and during that time 125 articles of column length have been published at regular intervals in the *Glasgow Herald*. These articles deal with the applications of chemistry in a popular fashion, and several have been written at the special request of the editor. The evening papers have also opened their columns, and about 175 short articles have appeared there. The scheme is still in operation and has been eminently successful. The experience of the *Glasgow Herald* may perhaps influence other newspapers to make a special feature of similar popular scientific efforts.

W. M. CUMMING.

The Royal Technical College,
Glasgow, C.1, November 30.

Critical Potentials of the Vapours of Mercuric Halides.

STUDYING the losses of energy suffered by slow electrons in mercury vapour by the methods of Lenard (velocity distribution) and Franck and Hertz, we came across a rather sensitive arrangement for detecting the inelastic collisions of smaller probability (V. I. Pavlov, *Jour. Russ. Phys.-Chem. Soc.*, Phys. Sect., v. 58, p. 369, 1926). Applying this combined method to the investigation of the vapours of mercuric halides, we found for mercuric chloride at least four values for critical potentials: 1·6 v., 2·7 v., 3·9 v., and 6·6 v.; for mercuric bromide: 1·5 v., 2·9 v., 6·6 v., and 8·9 v.; for mercuric iodide: 1·4 v., 2·7 v., 6·2 v., and 7·8 v. The same method for iodine yielded the values. 1·2 v., 2·3 v., 3·8 v., 5·1 v, and 7·5 v. Some of these data seem to be in agreement with the observed absorption by the vapours of light of corresponding quanta.

It may be hoped that the results obtained will lead to the building up of a system of energy levels of the molecules investigated and will give some knowledge of the various possible ways of dissociation with excitation.

V. I PAVLOV.
A. I. LEIPUNSKY.

Physical and Technical Laboratory,
Leningrad, November 18.

Optical Excitation of the Vapours of Mercuric Halides.

IN the course of an investigation on the optical excitation of salt vapours I have found that vapours of mercuric chloride, mercuric bromide, and mercuric iodide of low density, when illuminated by the spark, give a bright visible fluorescence; this is green for mercuric chloride, blue for mercuric bromide, and violet for mercuric iodide. The fluorescence consists of a system of bands with a somewhat abrupt maximum of intensity at respectively 5600 Å.U., 5000 Å.U., and 4400 Å U., and there is a continuous falling of intensity down to about 4000 Å.U.

The lines which stimulate these bands are strictly confined to the following rather narrow limits: 1900-1850 for mercuric chloride, 2100-1900 for mercuric bromide, and 2200-2100 for mercuric iodide. A detailed analysis of the structure of these bands, together with further experimental work, will give, I hope, some information upon the underlying mechanism.

A. TERENIN.

Optical Institute, Leningrad.

Sir William Crookes and Spiritualism.

IN the leading article in NATURE of November 20, it is stated that Sir William Crookes closed the spiritualistic chapter for the rest of his life for reasons which, owing to the deliberate destruction of the necessary documents, it is impossible to gauge.

I am in a position to throw light on this matter, and as what I have to say is purely historical, and does not touch on the marvellous, it will perhaps not be considered to fall under the ban of the editorial closure.

Sir William Crookes, on a visit to my parents in August 1894, engaged in conversation with my grandmother, the second Lady Rayleigh, on this subject. I listened with attention. The conversation was substantially as follows:

Lady R. Have you had any recent spiritualistic experiences?

Crookes. No, unfortunately not. The difficulty is that I have not been able to get into touch with any suitable medium lately.

Lady R. Well, that is unfortunate; but after the wonderful things that you have seen perhaps you may fairly be satisfied.

Crookes. I do not know that. When one has had a good dinner one day, one none the less wants another the next day.

The last sentence is quite clear in my recollection.

RAYLEIGH.

Terling Place, Chelmsford, Essex,
November 26.

Behaviour of Silicic Acid Gel during the Drying-up Process.

IN a note published in the *Proceedings of the Indian Association for the Cultivation of Science* (vol. 9, Part 4, p. 328, June 1926), I described an observation made by me more than two years ago (in April 1924), namely, that when silicic acid gel is treated with a concentrated solution of potassium chloride and is then allowed to dry up, the salt exudes from the surface of the gel in the form of thin white, glistening fibres. I attributed this to the pressure that is exerted upon the capillaries of the gel, as the gel continually loses water and experiences contraction. A photograph of the growth was also published there. It was further pointed out that an X-ray examination of those fibres of potassium chloride might reveal their true nature. As indicated before, this phenomenon seems to be very general, and should therefore be observable with various gels and salts.

The note referred to was written long ago, but its publication was delayed, as I intended to study the phenomenon further.

In a paper on the "Structure of Silicic Acid Gels," communicated by Messrs. Fells and Firth to the *Proc. Roy. Soc.* (112 A, Sept. 1926, p. 468), the authors describe interesting experiments on the same phenomenon. Apparently my previous note was not noticed by them.

K. KRISHNAMURTI.

Ramsay Chemical Laboratories,
University College, London.

The Reaction to Flea Bites.

PROF. E. A. BOYCOTT, in NATURE of October 23, says: "Some persons who are extensively flea bitten seem to become immune." This is, in my case, true of other insect bites. In January 1885 I suffered the most terrible agony from bites of Australian sand-flies (I do not know the specific name). Some seven years afterwards I was again in a sand-fly-infested neighbourhood and was completely immune from effects, and was so ever since.

In January 1906 I spent four or five days fishing in New Zealand, where I suffered misery from the bites of the New Zealand "sand-fly." (This is quite a different insect from its Australian namesake.) Returning again in January 1907 I suffered almost as much. I visited the same spot for four or five years later, and, though attacked as much as before, never felt any effects.

Similarly the mosquito, which was once a terror to me, now does no more than leave a painless mark. It is perhaps curious that the 'gruelling' I had from the Australian species has conferred immunity in Europe.

ERNEST I. ROBSON.

Oxford, November 2.

enable us to modify the processes of our bodies more in accordance with our wishes—to stimulate our faculties when we need high-tension work, but without evil after-effects; to relax them without the use of harmful soporifics. It seems clear that temperament, even more important than pure intellect in achieving success, is largely an affair of the balance of the various glands of internal secretion—thyroid, pituitary, reproductive, adrenal, and the rest. It may well be that the applied physiology of the future will discover how to modify temperament.

But I must close. Let me emphasise that while pure science will make discoveries so long as she exists, while technology will apply those discoveries so long as profit is to be made out of their application, it is in the long run the average man and woman who decide *how* that application shall be made. Whether the discoveries of science will in the ultimate event be beneficial, as those of us trust who believe in progress, or whether they are leading the human race to destruction, as many sincere and many far-sighted men assert—that will be decided by the use to which the human race decides to put them. In themselves, apart from their intense personal value to their discoverers, and to others on the plane of pure intellect, they are, like any other tool, neutral.

Developments in the Use of Echo-Sounding Apparatus.

THE use of compressional waves in water for the measurement of the depth of the sea beneath a vessel now lacks the novelty which it possessed some years ago, when practical schemes for using them in navigation were first put forward. Briefly, all such schemes reduce to three essential parts—the source of the compressional impulse, the receiver of the echo from the ocean bed, and the mechanism for recording the time interval between the emission of the original disturbance and the moment of receipt of the echo, or, in some cases, the direction of the returning wave front. Small explosive charges dropped into the water, automatic hammer-blows on diaphragms, and diaphragms which are caused to vibrate electrically are used as sources of compressional disturbances within the audible range and form parts of actual sounding sets which are obtainable commercially. Microphones attached to diaphragms exposed to the sea are in general use for receiving the echo and for transforming the sound energy into electrical power. Various mechanisms, some of which are simple and ingenious, while others appear, from their descriptions in technical papers, to be unduly complicated and too delicate for continued sea-going use, are favoured by different firms who have embarked on the manufacture of echo-sounding gear. A typical echo-sounding apparatus for use in shallow water was described in NATURE in an article dealing with the use of the method in navigation.[1]

All the systems of sonic echo sounding covered by the remarks in the preceding paragraph involve the creation of an audible disturbance, but there is one system in which the initial disturbance has a frequency which lies above the upper limit of the range of frequencies audible to the normal human ear. The practical form of this apparatus is described in a recent publication issued by the International Hydrographic Bureau,[2] and the principles of its operation have already been described in these columns,[3] where it was observed that this 'supersonic' or 'ultra-sonic' system was of great scientific interest. It is clear that much skill and ingenuity have been expended in the design of the mechanisms embodied in the gear as now manufactured.

For sounding installations from which nothing more is demanded than an accurate measure of the depth of shoaling water beneath a ship, it appears that sonic systems are capable of answering navigational requirements, but the merit of the supersonic system lies in its ability to locate comparatively small objects, such as wrecks or rocks, in shallow water. This advantage is gained by the supersonic system because the energy is transmitted through the water in a beam the direction of which can be altered, whereas the sonic impulses are more nearly in the form of spherical waves spreading through the water without marked directionality. The supersonic gear cannot, however, be relied upon to detect projections which are small in comparison with the breadth of the beam, and at great depths therefore this system cannot be expected to show much greater power than the sonic gear to resolve discontinuities in the depth of water, unless either the size of the oscillator, or the frequency of its oscillation, is increased so as to make the beam sharper. There are limits beyond which both of these courses become impracticable.

Judging from published descriptions of the supersonic gear as manufactured by the Société de Condensation et d'Applications Mécaniques, the equipment must be decidedly costly and must require skilled operators and attention in case of defects. For these reasons it is to be expected that the simpler and less costly forms of sonic gear will be more popular and that the use of the supersonic apparatus will for some time be limited to special purposes where the sonic gear fails. On the other hand, disappointments with the echo-sounding gear must be anticipated and be looked upon as certain to come. The final form of every new thing is reached by stages, and it may be years before the defects which are bound to occur in existing echo-sounders are all eliminated and so great a mass of evidence for the reliablity and usefulness of the gear becomes available that the wholesale adoption of this invention is inevitable. It is scarcely necessary to quote examples in which events have followed a course similar to that which may be anticipated in the case of echo sounders, but the gyro-compass and the use of directional wireless in navigation may be mentioned. Both these aids to navigation 'hung fire' for years and the gyro-compass is only now coming into general use, while the application of directional wireless is still somewhat under a cloud, owing to errors in the readings taken, which are partly due to the effect of the ship's structure on the apparatus and partly to imperfectly understood effects such as the apparent coastwise refraction of the electric waves. One cannot blame the experienced navigator, upon whom the onus of a disaster falls, if he is chary about accepting the claims which well-informed people are making for sonic-sounding gear, but one is fully justified in urging that the method should not be condemned on the evidence of a few initial failures.

---

[1] NATURE, March 29, 1924, pp. 463-65.

[2] Special Publication No. 14 of the International Hydrographic Bureau, Monaco, August 1926.

[3] NATURE, May 9, 1925, pp. 689-90.

Further experiments, of which no detailed description has yet been observed in the English scientific press, have been made in France by the Société de Condensation et d'Applications Mécaniques with a supersonic transmitter for guiding ships along a channel. In these experiments, according to newspaper reports, a supersonic oscillator is fixed at the entrance to a channel and arranged so that its beam may be projected horizontally and rotated in azimuth. In order to obtain the bearing of a vessel, the transmitter may, as in the well-known wireless beacon system, be rotated at a constant rate, or may be made to emit signals corresponding to the bearing of the oscillator. Alternatively, wireless signals might be used to indicate the instantaneous bearing of the beam. A vessel entering the channel would be swept intermittently by the beam and would thereby be informed of its bearing with respect to the transmitting station. The distance of the vessel from the transmitting station could easily be obtained by recording in the ship the difference between the times of arrival of the wireless and sound signals, the principle being the same as that which is used in the radio-acoustic system of position-finding at sea.

The value of such an installation in fog is obvious, for the underwater beam does not suffer from those extraordinary effects of reflection and refraction which make aural observation of the direction of a fog signal or siren station so unreliable in these circumstances. On the other hand, it would be necessary to fit each vessel using the system with a special receiver of high-frequency oscillations, since hydrophones and other instruments which are suitable for use with submarine bells or oscillators of the Fessenden type, are useless as detectors of the ultra-audible vibrations which compose the supersonic beam. The press accounts of the actual system used by the Société de Condensation et d'Applications Mécaniques are not very precise in the description of the manner of obtaining the ship's position relative to the transmitting station, but it is clear that the position might be obtained without the use of any underwater gear in the ship itself. The ship, in fact, acts as reflector of the supersonic beam, so that the operator of the shore station, hearing an echo, would know that a ship was on a certain bearing from him, while the range of the ship can clearly be deduced by the measurement of the 'echo-interval' as in ordinary depth sounding. This information could then be signalled to the ship by wireless telegraphy.

Judging from the cold reception which was given to the leader gear system by shipping companies, it is feared that development of the underwater beam system of guiding ships into harbour is unlikely to be hailed with enthusiasm, and that masters of vessels will prefer to wait for clear weather rather than trust the indications of apparatus of which only a part is under their immediate control. The difficulties which stand in the way of the general adoption of any new schemes such as these are undoubtedly great, and the real trouble is to form a body of opinion in favour of their general use.

Echo-sounding gear of the sonic type has been used also for the determination of the height of an airship above the ground in fog or darkness. The apparatus which was tried for this purpose in the ZR.3 before her journey across the Atlantic in 1924 was almost a replica of that which is used in one of the commercial systems of sonic echo sounding. The source of sound was a small explosive charge, and the time interval was recorded by a spring-driven wheel which was started and stopped by the outgoing shock and the returning echo respectively. It is clear that a machine which is capable of giving the pilot of an aeroplane or airship a continuous record of his height above ground would add greatly to the safety of aerial navigation, and experiments which have already been made indicate the possibility of attaining this end. It is probable that any apparatus which proves suitable for underwater sounding would require to be redesigned before being applied to aircraft, not only because of the necessity for cutting down weight, but also because diaphragm oscillators of the kind used at sea are incapable, when working in air, of delivering enough energy to be effective over any useful distance. The explanation of this is, of course, similar to that given by Stokes, in his classical paper on the communication of vibrations from a vibrating body to a surrounding gas, of Leslie's observation, made in 1837, that the sound of a bell vibrating in hydrogen is exceedingly feeble compared with the sound of the same bell vibrating in air.

Apart from its use as a navigational instrument, sonic-sounding gear has already been found valuable in making rapid hydrographic surveys in deep water. A large number of 'sections' have been made during the past year by vessels of the United States Navy in the course of ordinary voyages, and the results are believed to be in good agreement with charted depths when comparison is possible. The British Admiralty has made a fresh survey of the Challenger Bank using the Admiralty sonic-sounding installation in a survey vessel, and it is understood that a deep-water sounding set has been fitted in a recently built cable-laying vessel for oceanic use.

As an aid to hydrographic, hydrological, and fishery research the sonic sounder has already proved its importance, and it is noted that the German Research Vessel *Meteor* was equipped with no less than four sets of echo-sounding gear. A recently published account[4] of rather less than eight months' work in the Atlantic shows that some twenty thousand soundings were taken, the maximum depth recorded being 6110 metres. In a series of 89 comparisons between echo and wire soundings, the mean depth was 3420 metres and the wire sounding was, on the average, 2·2 per cent. greater than the echo sounding. This discrepancy may be due in part to drift and sag of the sounding wire, or, more probably, to the fact that the echo does not in general return from a point directly beneath the sounding vessel. This point is dealt with in the two paragraphs which follow. Since the echo-sounding gear is really a time-measurer we also require to know, for great accuracy, the velocity of sound in the different layers of water, between the surface and the bottom, through which the sound passes. This velocity will not differ markedly from that at the surface, but it will be affected to a calculable extent by changes in salinity, temperature, and the alteration in compressibility at great depths.

---

[4] Beiheft zu den *Nachrichten für Seefahrer*. Nr. 7, 1926.

News and Views.

FOR the meeting of the British Association which is to be held in Leeds on August 31-September 7 next year, under the presidency of Sir Arthur Keith, the following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Prof E. T. Whittaker; Section B (Chemistry), Dr. N. V. Sidgwick; Section C (Geology), Dr. Herbert H Thomas; Section D (Zoology), Dr. G. P. Bidder; Section E (Geography), Dr. R. N. Rudmose Brown; Section F (Economics), Prof. D. H. Macgregor; Section G (Engineering), Sir J. B. Henderson, Section H (Anthropology), Prof. F. G. Parsons; Section I (Physiology), Dr. C. G Douglas; Section J (Psychology), Dr. W. Brown; Section K (Botany), Prof. F. E. Fritsch; Section L (Education), The Duchess of Atholl, M.P.; Section M (Agriculture), Mr. C. G. T Morison. Notices are being issued for meetings of the organising committees of the sections to take place at King's College, Strand, by kind permission of the Principal, on January 7 at 12 noon, to consider the programme for the Leeds meeting

NOT so long ago, very considerable claims were made for a new treatment for cancer devised by Prof. W Blair Bell, of Liverpool. This claim was the outcome of work done by the Liverpool Cancer Research Organisation, of which Prof. Blair Bell is the Director. Recently a good deal more has been added to our knowledge of the new treatment by a discussion on the subject at the British Medical Association held at Nottingham in the summer and published in the *British Medical Journal* of November 20. While it is too early to make categoric statements of the value of the treatment, Blair Bell and his co-workers seem to have emphasised some facts which, if not altogether new, are at any rate confirmatory of the work of others. It is supposed that cancer or other malignant growths really represent a de-differentiation of the cells with a return to an embryonic type This, of course, is not a new idea, and has indeed been the current teaching for thirty years or more. The embryonic type with which Prof. Blair Bell compares the cancerous tissue is the trophoblastic mass which covers the chorionic villi of the developing embryo. The comparison is valid in that both the syncytium and malignant cells have a destroying effect on the tissues. Prof. Blair Bell suggests a closer analogy, as both have a similar morphological and chemical structure. He conceives malignant new growth to be a state induced by oxygen starvation supervening on injury to the cell itself or the neighbouring blood supply, and that the return to the trophoblastic state is to enable the cell to survive.

As there appears to be an affinity of embryonic cells for certain lead compounds, Prof. Blair Bell was induced to try preparations of the latter in the treatment of cancer. The exact preparation of the lead suspensoid is now published, and it is claimed that the intravenous inoculation of this agent has led to the arrest, disappearance, or cure of some undoubted malignant growths. Many who have seen Prof Blair Bell's cases agree with him that this is true. The treatment is most drastic and the mortality heavy. Apparently the mode of operation of the lead is to induce necrosis or other regressive changes in the tumour tissue, and while this is going on there may be severe or fatal injury even to normal tissues. Dr. L. Cunningham, the Assistant Director of the Liverpool Cancer Research Organisation, has tabulated the results of 227 cases treated by lead. Of these, 50 died before treatment was completed and 106 died after treatment. In 10 the disease was said to be completely arrested and 31 were "believed cured." He says that "lead is undoubtedly of value in the treatment of malignant disease, either alone or in conjunction with other methods; but we feel not only that something better may be found in the near future but that our preparation is imperfect"

AMONG the names of astronomers famous as the discoverers of comets is that of Giovanni Battista Donati, the centenary of whose birth at Pisa falls on December 16 of this year. Entering Florence Observatory at the age of twenty-six years, Donati became assistant to Amici, and in 1864 was appointed Director, a post he held until his death at the early age of forty-six years. During the years 1854–1864 he discovered six comets, that first seen on June 2, 1858, now bearing his name. The period of this comet is 1950 years, and its next appearance will take place in the year 3808. Donati was also well known for his early studies of the spectra of stars He observed the total solar eclipse of July 1860 at Torreblanca, Spain, and the same year began his studies in stellar spectroscopy. He indicated the feasibility of a physical classification of the stars, and in 1864 discovered the gaseous composition of comets. In August 1873 he was seized with cholera while attending the International Meteorological Congress at Vienna, and died on September 20 a few hours after his arrival home at Arcetri.

THE latest news to hand of the Dutch-American Expedition to explore Dutch New Guinea under the auspices of the Smithsonian Expedition furnishes some probable indications of the extent and value of the results which are likely to accrue from this penetration of the unexplored belt of forty miles of jungle which separates the Snow Mountains from the sea. Dr. Matthew W. Sterling, the leader of the expedition, expected to reach the mountains in August. The work accomplished by the expedition, which at the time of writing was considerable, especially in mapping much unknown territory and numerous river routes, was to a great extent due to the use of the aeroplane. This machine acted as the scout of the expedition and saved much time and expenditure of labour by its preliminary reconnaisances of the route. It did much survey work as well. Unfortunately it has been put permanently out of action by the effect of climatic conditions, but not before it had practically ensured the success of the expedition. Large collections of plant and animal life, as well as of ethnographical specimens, have been made. The natives were nervous and not uniformly friendly. Villages were sometimes found to have been deserted on the approach of the expedition. The only implements and weapons in use by the natives are of stone and bone. No metal is known.

IN view of the rising tide of Fundamentalism in the Protestant Churches of America, it is important to note that a certain number of priests in the Roman Catholic Church have conducted important researches in various branches of natural science without interference from the ecclesiastical authorities. In an interesting article in *Truth and Freedom* for October, Dr. J. J. Walsh supplies a number of examples. In the first place, there was the Augustinian monk Mendel, whose researches may be said to have created the new science of genetics. Then there is the German Jesuit, Father Wassmann, one of the most distinguished entomologists of our day. The present head of the Vatican Observatory in Rome, Father Hagen, S J., is the author of an atlas of variable stars, while the seismographs with which many Jesuit colleges are equipped have contributed much to scientific knowledge. Sir Arthur Keith, in a recent article in an American magazine, has told the story of a young priest, Father MacEnery, who was an important pioneer in the science of anthroplogy a hundred years ago, "working like a navvy to reach the things he prized." How the geological records might tally with Genesis did not trouble the chaplain of Tor Abbey Since his time many priests have taken a serious interest in palæontological and archæological anthropology, and in a recent number of the *Forum* (June) Prof. H. F. Osborn has named a dozen French, Belgian, German, and Spanish priests who have done valuable work in this department Prof. Osborn actually dedicated his "Men of the Old Stone Age" to two priests, the Abbé Breuil and Father Obermaier.

THE fact is that between natural science and religion in general there is really no quarrel, in spite of the Fundamentalist panic. Where there does seem to be a certain conflict is between the results of literary and historical criticism and some of the traditional dogmas of Christianity Here it can scarcely be said that the ecclesiastical authorities allow freedom of research to those under their control. When the Abbé Loisy, professor of Hebrew at the Institut catholique of Paris, dealt on scientific lines with the Canon, the religion of Israel, and the Babylonian myths behind the early chapters of Genesis, it cost him his chair In 1907 this scholar was excommunicated, and the same fate befel the English Jesuit Tyrrell Even the great historical scholar Mgr. Duchesne has had to walk warily. His examination of the legends which attached to the great French churches gave offence, while his "Étude sur le Liber Pontificalis" (1877) barely escaped the 'Index.' No doubt an institution has to preserve its integrity, but historical controversies cannot really be settled by disciplinary measures, any more than can controversies in the natural sciences.

THE Rev. J. C. Herrick, College of Mount Saint Vincent, City of New York, in a letter raises the question of the proof of the conservation of mass and energy. He writes: "Lavoisier proved the constancy of mass by the use of the balance" and therefore assumed "the constancy of the mass of his weights," while Joule in his work on the mechanical equivalent of heat also assumed that mass is constant. Mr. Herrick's argument arises from an incomplete statement of the experiments. The only assumption made by Lavoisier and by Joule is that mass does not vary *with time*. Assuming the truth of this fairly obvious proposition, Lavoisier showed that mass is not altered *during chemical combination*, and this result has since been confirmed by Landolt, who showed that the variation of mass as a result of chemical combination cannot exceed some extremely minute fraction of the whole. Joule's experiment merely showed that a given amount of work liberates a given amount of heat There is no absolute proof that the heat liberated might not be due to the destruction of a minute quantity of matter, but there is no shred of evidence to justify the supposition that by merely stirring water with a paddle the molecules can be destroyed.

THE chief point emphasised in a paper on "Surface Indications of Petroleum," read by Mr. A. Beeby Thompson at the Institution of Petroleum Technologists on October 6, was the invariable necessity of interpreting all surface indications of oil in terms of geological environment. Too often is the oil-show, asphaltic rock or seepage, or mud-volcano made *per se* the sole reason of commercial exploitation, and only too often has such adventure proved disastrous. Petroleum at the surface, in whatever form, obviously implies, and frequently does actually indicate, wastage, especially of valuable light constituents; such wastage may be on quite a large scale and may signify the penultimate, if not the ultimate, phase of widespread inspissation, clearly, from an economic point of view, storage and not escape is the obvious desideratum The subject of the paper is by no means new, nor was its treatment; there is, perhaps, nothing new which can be said, the substance of the paper being familiar to oil technologists from practically every text-book concerned with the geology of petroleum, but it at least provoked an interesting discussion, if at times slightly critical of the author's text.

BOTH Mr T. Dewhurst and Prof V. C. Illing, in the discussion on Mr. Beeby Thompson's paper, voiced the urgency of geological criteria in all investigations of surface indications, and Prof. Illing rightly deplored the author's use of the term 'metamorphosed' as applied to ozokerite, in view of the more precise geological meaning attaching to that word. In discoursing on the oil indications of the Gulf Coast fields of America, the author omitted any mention of the controversial substance 'paraffin dirt,' which, as Mr. H. B. Milner pointed out, had been the cause of the loss of large sums of money spent on exploiting this type of evidence. Dr. A. Wade was mildly discursive on the mud-volcanoes of Australia, and he also directed attention to the care needed in diagnosing wax 'indications' of paraffin base oils; unlike mining, the 'salting' of an oil prospect is a rare and difficult practice, and his warnings anent mutton fat and refinery wax were not without interest or humour. Another example of dubious indication was given by Mr. J. Romanes in connexion with bitumen occurring in some of the Quaternary deposits of the Guianas; the possibility of sea-borne material transported from Trinidad cannot be denied, a similar case occurring in the Falkland Islands, implying derivation from the Argentine. The author concluded his paper with a résumé of the coal-oil (carbon ratio) hypothesis, scarcely relevant to the more tangible subjects with which he had previously dealt, but he made no reference to Dr. Murray Stuart's recent contributions to this controversial problem.

PROF. J. L. MYRES, Wykeham professor of ancient history, University of Oxford, has been appointed Sather professor of classical literature for 1926–7 in the University of California. He is to spend the greater part of the semester beginning next month at Berkeley, lecturing in the Department of Classics, and also delivering a public course under the title "Who were the Greeks?" which will be published by the California University Press. On his way to Berkeley he is to attend the Philadelphia meeting of the American Association for the Advancement of Science, as representative of the British Association, and to give a public lecture on the "Geographical Surroundings of Greek Civilisation." He also hopes to attend the meeting of the American Historical Association at Rochester, and has promised to speak to the classical students at Chicago, on his way through.

THE registration of Imperial Chemical Industries, Limited, was formally completed on Saturday, December 4. The company has been registered with an authorised capital of 65,000,000*l*. As has already been announced, if all the shareholders of the merging companies exchange their shares for shares in the new company, the issued capital will be 56,802,996*l*. Amongst the objects of the company are acquiring or holding shares in Brunner Mond and Company, Ltd.; Nobel Industries, Ltd.; the United Alkali, Ltd.; and the British Dyestuffs Corporation, Ltd. The first directors of the company will be: Sir Alfred Mond (chairman), Sir Harry McCowan (president and deputy chairman), Lord Ashfield, Sir John Brunner, Mr. G. C. Clayton, Mr. H. J. Mitchell, Mr. Henry Mond, Sir Max Muspratt, Mr. J. G. Nicholson, Lieut.-Col. G. P. Pollitt, The Marquess of Reading, Sir Josiah Stamp, and Mr. B. E. Todhunter. The company has the biggest initial capital of any company hitherto registered in Great Britain.

NOVEMBER rains were a very special feature of the autumn this year in England and much prominence has been given to it in the *Times*. The Meteorological Office in its summary of the weather for November states that one of the outstanding features was the abnormally heavy rainfall experienced in many districts. At Shanklin it was the wettest November since records began in 1906; at Ross-on-Wye it was the wettest since 1888; and at Kew Observatory it constituted an easy record in November for sixty years. The total for the month was 5·12 in., which is 2·91 in. more than the average, with the exception of October 1923, when 5·32 in. fell, it was the largest total for any calendar month since September 1918. Rains were of frequent occurrence throughout the month, few days having no rain.

THE annual report of the Meteorological Committee to the Air Council for the year ended March last has recently been published (M.O. 288; London: H.M. Stationery Office; 2*s*. net). The report reviews the seventy-first year of the Meteorological Office and the sixth year in which the cost has been borne on Air Ministry votes. Considerable reorganisation of the work amongst the Divisions of the Office has been undertaken. Weather forecasting, weather broadcasting, and climatology have all shared in the changes. The magnetical work formerly carried out at Kew Observatory has been transferred to Eskdalemuir Observatory, and the seismological work from Eskdalemuir to Kew. The changes in the reorganisation will materially affect the efficiency of the work, and so react on the usefulness of the Office to those who need its services. Weather messages are supplied for issue by the British Broadcasting Company. It is shown that in the five years 1921–22 and 1925–26 the inquiries for special forecasts have doubled, increasing from 1914 to 3845 in the year under review. Data for air navigation form an important part of the work of the Office. The Marine Division shows considerable activity, an old difficulty is still experienced, and it is mentioned that renewed efforts are made to obtain an increase of observing ships in Pacific trades. A revision of the Admiralty Wind Charts of the World for the use of H.M. Fleet has been commenced. In the Forecast Division a gazetteer of telegraphic reporting stations has been almost completed. An inquiry is in progress into the relation between upper air temperature and the occurrence of thunderstorms.

REFERRING to the paragraph on the Rev. Edmund Gunter in NATURE of December 4, p. 813, Dr. R. T. Gunther writes from Magdalen College, Oxford: "Any account of Edmund Gunter's inventions should, I think, include the form of slide-rule designed by him which was widely known as a 'Gunter.' To him too are due the words *cotangens* and *co-sinus*, from which we get the familiar abbreviations of *cot* and *cos*. I have lately added models of his improved forms of cross-staff and cross-bow to the Lewis Evans collection, so that his scientific inventions are now for the first time almost completely represented in a modern museum. His work had a great influence on the methods of the next generation."

WE are indebted to Prof. Hugh S. Taylor, of Princeton University, U.S.A., for pointing out an error in the article on "The Reported Conversion of Hydrogen into Helium" (NATURE, October 9) on page 526, col. 2, 8 lines from bottom. The statement that the residual gas, after 12-hours' contact between

Research Items.

Egyptian Antiquities from Southern Russia.—Two communications in *Ancient Egypt* for September deal with Egyptian antiquities which have been found at various times in the course of excavations in southern Russia. Militza Matthieu describes scarabs and other objects found on the northern coast of the Black Sea and at Olbia in 1902, 1911, and 1914. These scarabs are of soft paste, coloured light blue or light yellow, usually right through, and of simple form They have striking analogies with scarabs found at Naucratis. In the same tomb in which five of the scarabs were found at Olbia were three pendants, two representing lions stretched out on a rectangular base, and one a ram's head. Similar pendants are also found at Naucratis, while two of the Black Sea scarabs show a lion with solar disc, exactly similar to a lion and solar disc pendant from Naucratis. In the tomb at Olbia Prof. Pharmakovsky also found black-figure vases, Rhodian, Miletian, and Naucratite ware, pottery, and glass beads. The second communication, by Prof. Zakharoff, describes a fragment of a crown of Osiris found in the Sloboda Nedvigovka (ancient Tanais) near the mouth of the Don—exact place and circumstances unknown. It is a fragment of bronze described erroneously in the Russian Historical Museum Catalogue of 1893 as an ornament of Scythian type It is flat, broken at the top, and on its right side has a uræus, with solar disc on its head The front of the uræus is ornamented with enamel in six cavities. The tail is interlaced with the horns of a ram It may be supposed to be part of a feather crown to be put on a figure of Osiris. It is unique in southern Russia. Similar crowns are shown in the Catalogue of the Cairo Museum, vol 1.

The Antiquity of Man in America.—In the *Scientific American* for November, Mr. Harold J. Cook, who discovered the tooth of Hesperopithecus in the Lower Pliocene deposits of Nebraska, replies to arguments put forward in the July issue by Dr. Aleš Hrdlička against the high antiquity of man in America. Mr. Cook argues that the 'modern' character of the skulls for which antiquity has been claimed may be due to the fact, familiar to palæontologists, that species of vertebrates may remain unchanged over long periods. Man may have remained unchanged physically and structurally in America for thousands and thousands of years No one can say, except in the most general terms, what were the conditions propitious to migration from Asia during glacial times, but conditions which made it possible for the bison and other animals of Asiatic origin to migrate should also be favourable to man. From known evidence it appears that in recent geological times both animals and man have migrated in successive waves. This long-drawn-out process has produced a degree of hybridisation which makes the anatomical evidence difficult to interpret with certainty. Further, the many Indian stocks exhibit as many great differences as characters in common, so that wide differentiation or homogeneity among them depends upon which characters are stressed The discovery some months ago of stone arrows and spear points associated with a buffalo skeleton at Colorado, Texas, gives definite positive evidence of the presence of man in America in Pleistocene times. The skeleton was buried under eighteen feet of old Pleistocene gravels; it was undisturbed, and it belonged, not to the living American bison species, but was of an Asiatic or Indian type not known in America, and it was associated with the bones of extinct mammals known from other sources to be of Pleistocene age. Associated with the 'buffalo,' and under the bones, were three stone implements. All the relics were clearly contemporaneous In the lower Pliocene age, a warm climate which extended to Alaska offered ideal conditions for migration by way of Bering Straits over a temporary elevation, and especially for anthropoid stocks or early man. That such stocks did enter has been shown by the discovery of the tooth of Hesperopithecus, which antedates the classical Anthropopithecus.

Craniometrical Data of an Immature Skull of a Female Chimpanzee.—Dr. E. Warren (*Ann. Natal Mus.*, vol. 5, pt. 3, 1926) has made careful measurements of an immature skull of a chimpanzee with the express purpose of placing on record data which could be used for comparison with the Taungs fossil anthropoid, Australopithecus. From his measurements and observations the author concludes that the young chimpanzee skull is appreciably less human than the Taungs skull, and therefore the peculiarities of the latter cannot be explained by its immaturity. He supports the contention that the Taungs skull exhibits a distinct advance on the living anthropoids in the direction of man, but the relative smallness of the brain would appear to indicate that it is considerably nearer to the living anthropoids than to man himself.

Experiments with Intestinal Protozoa.—Prof. R W Hegner records (*Amer. Jour. Hygiene*, 6, 1926, pp. 593-601) observations which show that the active stages of *Balantidium coli* from the pig are able to withstand conditions in the stomach and small intestine of the guinea-pig and may reach the cæcum of the latter, apparently unharmed, within one hour after ingestion. The active stages of *Trichomonas caviae* and *Chilomastix intestinalis* from one guinea-pig may pass through the digestive tract and reach the cæcum of another unharmed. The active stages of *Giardia canis* from the dog are able to live for considerable periods in the stomach and small intestine of the guinea-pig, and were found to be more numerous in that portion of the small intestine (6 in to 24 in. beyond the stomach) which seems to be their optimum habitat in normally infected animals Possibly it is the nature of the secretion in this region which causes the giardias to attach themselves to the epithelium by means of their sucking discs The active stages of *Endamoeba histolytica* are not quickly killed in the stomach and small intestine of the guinea-pig, but remain alive and mobile for at least an hour Infection by these trophic stages is probably not usual in Nature; the cyst stage is more often concerned in transmission, and methods of control should as heretofore be directed against this. *Trichomonas hominis*, which does not form cysts, is, however, present in about 3 per cent of the population, and infection appears to be by the trophozoite stage, entering by way of the mouth

The Digestive Diverticula in Lamellibranchs.—Dr. C. M. Yonge (*Trans. R. Soc Edin*, Vol 54, No. 15, 1926) has investigated the structure of the digestive diverticula—blind tubules which open into the stomach by ciliated ducts—in thirty-four species of marine lamellibranchs. The tubules have been stated to exhibit three kinds of cells, but Dr Yonge finds only one type. The cells when young stain darkly, but when older are very vacuolated and contain large numbers of coloured granules which disappear after starvation. In fresh material, long, retractile cilia were seen on the tubule cells in a number of the species and are probably present in all. When lamellibranchs are fed with iron saccharate in suspension, this is found later lying in large vacuoles in the cells of the tubules but is afterwards passed on to the amœbocytes. The manner in which particles are taken in, and the presence of digestive enzymes in extracts of the diverticula, point to the occurrence of intracellular digestion. There is no evidence that the cells of the tubules secrete, the presence of enzymes in the stomach can be accounted for by the dissolution of the crystalline style and the occurrence of great numbers of phagocytes free in the lumen. The diverticula provide the extensive surface characteristic of the alimentary systems of animals which possess intracellular digestion, while as a result of the action of sorting mechanisms only the smallest particles are presented to the ingesting surface. The diverticula possess none of the functions of a liver or of a pancreas, but are organs of absorption and of intracellular digestion.

INBREEDING.—In a discussion of inbreeding from the practical breeders' point of view, Mr. A. D. Buchanan Smith (*Eugenics Review*, vol. 18, No. 3) gives many data from the history of Shorthorn cattle and Clydesdale horses. He concludes that Sewall Wright's method of measuring the coefficient of inbreeding is probably best. There has been considerably more inbreeding in Shorthorns than in Clydesdales, but the latter are equally homozygous, probably owing to careful selection. The level of inbreeding must vary with the breed according to the number of undesirable characters still present or latent in the stock and the nature of the selection practised by earlier breeders. Probably the coefficient of inbreeding in Clydesdales will rise much above its present value.

SAMOAN FORAMINIFERA.—J. A. Cushman describes (*Dept. Marine Biol. Carnegie Inst., Washington*, vol. 21, 1924, but only recently received) collections made by the late Dr. A. G. Mayor in Samoa in 1920. The foraminiferal fauna of Polynesia is interesting because living in this region are many forms known elsewhere only fossil. The author expresses his conviction that the shallow-water foraminiferal faunas are as limited in their geographical distribution as many other groups of organisms, and that there are living about oceanic islands many more species of genera such as Quinqueloculina and Spiroloculina than have been suspected. Closer study will, he believes, lead to the recognition of definite faunal areas for Foraminifera such as are known for other groups. The collection at one station in 50 fm. adds many species of especial interest and of rare occurrence. Altogether about 140 species are recorded, 18 of which are described as new, and two new genera are erected.

LONG-LIVED PLANT CELLS.—Dr. D. T. MacDougal points out in the *American Naturalist*, 60, pp. 393-415, 1926, that the living parenchymatous cells of the medulla of the tree cactus, *Carnegiea gigantea*, may continue to grow for more than a century and may still be active until the death of the plant. These old cells behave differently from young cells in the same plant in their reaction to acid or alkaline solution. When immersed in such solutions the young cells become more permeable and have a diminished water-holding capacity. Old cells, on the other hand, have a zone of maximum swelling at such acid reaction as pH 3-3.5 and a secondary maximum between pH 9 and pH 11.

COLLEMBOLA INJURING MANGOLD SEEDLINGS.—In the *Bulletin of Entomological Research*, vol. 17, October 1926, Mr. W. Maldwyn Davies records a significant attack on mangolds by the springtail, *Bourletiella hortensis*. The infestation occurred on one of the fields attached to the Rothamsted Experimental Station, the insects being extremely abundant during the first week of June 1926. Practically 100 per cent. of the seedling mangolds showed leaf damage due to the gnawing propensities of this insect. The nature of the damage was two-fold, for in addition to the actual biting and enlarging of the injured areas, wounds thus caused were kept open and excessive loss of sap ensued. Methods of control were carried out and a contrivance is described by means of which tarred sacking was hung in such a manner that it trailed just above the ridges. As the apparatus was pushed along the Collembola became disturbed by the shadow of the machine and, exercising their characteristic habit of leaping, became trapped in large numbers on the adhesive surface of the tar. This method of control proved so successful that a simple and more permanent type of apparatus attached to a pair of bicycle wheels, easily pushed by a farm hand, was devised for future use.

PERMO-CARBONIFEROUS FAUNA OF JAPAN.—The fauna of the Permo-Carboniferous limestone of Nagato is described by Y. Ozawa (*Jour. Coll. Sci. Imp. Univ. Tokyo*, 45, 6, 1925). It consists mainly of foraminifera and rugose corals, with a few brachiopods and polyzoa. 67 species or varieties of foraminifera are described, of which 51 belong to the Fusulinidæ. The corals belong to the genera Lonsdaleia, Waagenophyllum, Dibunophyllum and Nagatophyllum; one form of Lonsdaleia is identified with a British species, and the Dibunophyllum is regarded as only a variety of a species found in England. In another memoir (*ibid.* 45, 4, 1925) the same author discusses the classification and evolution of the Fusulinidæ.

WORLD WEATHER.—The Royal Meteorological Society has issued a Memoir (vol. i. No. 5) entitled "The Nile Flood and World Weather," by Mr. E. W. Bliss (price to non-fellows, 2*s.* 6*d.*). To establish the relationship it has first been necessary to find a series for the Nile flood. Aswan discharges provide the truest measure of the flood, values of which have been communicated by the Director-General of the Physical Department, Cairo. The values for the four months July to October together are dealt with for the separate years 1869 to 1925. Correlation coefficients are given with pressure, temperature, rain, ice, and wind. Coefficients with pressure give a high negative figure with Cairo, −0·64 for the June to August quarter. The connexion is closest in June to August, but it begins in March to May and persists throughout the following quarters. Rainfall is usually associated with low pressure, but this is scarcely the whole explanation in the present case. After a high Nile flood the North Atlantic circulation is weak, as seen from the coefficients with pressure in Iceland for December to February. Other associations with a good Nile are low equatorial temperatures as shown by Samoa, Batavia, Senegal, and Port-au-Prince. Pressures in the same season are also low, especially in the South Indian Ocean. Like the monsoon, the Nile has closer relations with succeeding than with preceding weather. There is some evidence of a simultaneous connexion with Antarctic conditions.

ELECTRIFICATION OF BALLOON FABRICS.—During the War the risks to airships due to lightning discharges and to their electrification by atmospheric electricity were frequently discussed, but as accurate data were not available, little progress was made in estimating them. We are glad, therefore, that the Aeronautical Research Committee has published a report, No. 1017 (M. 37), by Dr. Guy Barr, on experiments relating to the electrification of balloon fabrics The results prove that spraying the fabric with metal makes the fabric a good conductor but increases its weight by about four ounces per square yard. The surface resistance of the fabric increases if it is crumpled. Fabric 'doped' on the upper surface after having been sprayed on the under surface was satisfactorily conducting after five months' exposure. When the plies of a rubber-proofed two-ply fabric were rapidly separated it was found that the cotton surface left bare became positively charged, and that the rubber attached to the other ply became negatively charged. The experiment was tried of separating the plies of three different rubbered fabrics in a mixture of hydrogen and air, but in no case did any explosion occur. Dr. Barr thinks that this does not prove that ignition cannot take place in any circumstances. So many conditions, however, have to be satisfied that an explosion due to this cause would be a very rare phenomenon, although a considerable electrical effect is produced by separating a heavy rubber proofing from cotton. It is suggested that the graphitisation of the fabric be studied more closely. Further exposure tests should be made and researches carried out to see if the conductivity can be further improved.

THERMAL PROPERTIES OF POTASSIUM AND SOME ALKALI HALIDES.—In order to test the statement of physicists concerning the various electron displacements and dissociations accompanying atomic and molecular energy changes, thermal data calculated from vapour measurements are desirable. On account of the poor agreement between the few existing values, E. F Fiock and W. H. Rodebush have recently determined the vapour pressures of potassium and some alkali halides in an electrically-heated apparatus of nickel. In discussing the results in the *Journal of the American Chemical Society* for October, the authors point out that the most striking feature is the extremely small value of the heats of solution of the solid salt in spite of the large values of the heats of vaporisation and the lattice energies, a fact which is in agreement with Born's theory of lattice energy.

ELECTRIC DISCHARGE THROUGH HELIUM.—In *Scientific Papers of the Institute of Physical and Chemical Research*, Tokyo, No. 69, Dr. T. Takamine describes the results of some experiments on the discharge through helium by two methods: first, the method of exploding wires at high current densities, introduced by Anderson; and secondly, the ordinary condensed discharge in helium at pressures between ½- and 1-atmosphere. In each case some of the lines showed apparent reversal (though not the same lines in the two sets of experiments). Reasons are given for thinking that the appearance is in reality a Stark effect due to the interatomic electric fields, and it is suggested that 'unsymmetrical reversals,' which are commonly met with in spectroscopic work, may sometimes be due to the same cause, and not, as is usually supposed, to absorption.

AN ANCIENT EGYPTIAN COSMETIC.—One of the many interesting objects found by Dr. H. Carter in the tomb of Tut-ankh-Amen at Luxor was a sealed cosmetic jar of calcite. When opened it was found to contain a considerable quantity of cosmetic, consisting of a rather heterogeneous mixture with a decidedly fatty smell. The substance has been carefully examined by A. C. Chapman and H. J. Plenderleith, but unfortunately the results, which appear in the *Journal of the Chemical Society* for October, do not definitely prove the nature of the fats originally employed in its preparation. It seems probable that the cosmetic consisted of about 90 per cent. of a neutral animal fat with about 10 per cent. of some resin or balsam, the latter in the process of time giving rise to the smell of the material, which is one of its most characteristic features.

THE ATOMIC WEIGHT OF SILVER.—The October issue of the *Journal of the Chemical Society* contains an important paper by H. L. Riley and H. B. Baker on the determination of the atomic weight of silver by finding the direct ratio of silver to oxygen in silver oxide, a method which has hitherto failed owing to loss of oxygen on drying the oxide. The product obtained by drying over pure phosphorus pentoxide at ordinary temperatures or in a vacuum at 100° gave a pink chloride with hydrochloric acid, indicating that some very small amount of oxygen was lost, but it was thought, nevertheless, that this loss might be negligible. Samples of pure silver oxide were prepared in an apparatus of special design, but the analyses proved that appreciable quantities of oxygen had been lost, a result contradictory to the preliminary experiments. It was found that the silver oxide was being reduced by small amounts of organic material which passed through the drying tubes. When precautions were taken to exclude organic matter, a product was obtained which gave a perfectly white chloride on precipitation with hydrochloric acid Samples of the pure oxide were decomposed in a silica tube in a current of pure air at 350°-400°, and the silver finally melted in an atmosphere of pure hydrogen. From the loss in weight of the silver oxide and the weight of the residual silver the value of the atomic weight of silver was calculated, the mean value being $107{\cdot}864 \pm 0{\cdot}0013$. This includes, however, a correction for a small amount of water from which it was impossible to free the silver oxide.

MOLECULAR STRUCTURE.—In his recent presidential address to the chemical section of the Australian Association for the Advancement of Science, Prof. James Kenner took as his subject "Some Aspects of the Problem of Molecular Structure." In it he gives a full account of the present position of the theory of valency. He does not confine himself to a discussion of the evidence obtained by purely chemical methods, but gives due place to the results of such other methods of attack as the X-ray investigation of crystals. One of the successes of the modern atomic model was that the electron distribution provided a ready explanation of the formation of many of the simpler molecules, but there is still a long way to go before all the facts known to present-day chemistry are satisfactorily explained. The true nature of the so-called homopolar bond is still unknown. The Werner hypothesis of a uniform attraction round an atom has been very useful in stimulating chemical research and in classifying compounds, but it cannot be said to be entirely consistent with modern views of atomic structure. Recent work suggests that not only the very outermost electrons but also those in the outer sub-groups play an important part in chemical combination, and on such a basis it appears probable that a satisfactory interpretation will eventually emerge. Whatever the final explanation, Prof. Kenner's address should serve a useful purpose in that it gives a broad survey of the existing position and indicates the lines along which progress is being made. Too often the workers in one branch are unfamiliar with the results obtained by other methods, and this address should result in a closer co-ordination of their efforts, the more so as, appended to it, there is a very full list of references to modern literature.

Rectal Alimentation.

THE difficulty of securing adequate nourishment in certain conditions in which the taking of food by mouth is impossible or inadvisable, such as coma or following operations on the gastro-intestinal tract, is well known; the attempt is usually made to supply a certain amount of food and drink by means of nutrient enemata, but there are very few substances which are with certainty absorbed through the mucous membrane of the rectum and large intestine. The knowledge that this part of the bowel in man acts mainly as an absorber of water, and contains none of the digestive enzymes which are found in the upper parts of the gastro-intestinal tract, would suggest that only the ultimate products of digestion of the foodstuffs would stand any chance of being absorbed: such, in fact, appears to be the conclusion to be drawn from many researches on this subject. Dextrose, lævulose, amino-acids, saline solutions, and alcohol are absorbed and thus become available for metabolic processes, but the proof of their actual utilisation has not been so easy to obtain. A recent study by T. M. Carpenter brings forward some new evidence on this question (Carnegie Institution of Washington, Publication No. 369, December 1925).

The experiments were conducted on four healthy medical students; the test substances used were alcohol, dextrose, and lævulose, and their utilisation was studied by observing their absorption when introduced rectally, their excretion in the urine, and their influence upon the respiratory exchange, the pulse rate, and the composition of the urine. The amounts absorbed were obtained by analysing a wash-out enema, which followed the introduction of the nutrient solution: the spirometer or respiration chamber was used for the determination of the respiratory exchange and the pulse rate was recorded by means of a pneumograph placed over the thigh. Among the details to which attention must be directed, so as to ensure the comfort of the subject, are the temperature of the solution and the rate of administration and the total volume given: it was found that the most comfortable posture was the supine, and that the enema should enter the rectum at body temperature, and slowly, preferably by drops: 250 to 500 c.c. can be given in the course of two hours.

The experiments were generally carried out in the afternoon and evening, and the subjects had previously fasted for several hours, but not for the twelve hours usual before an estimation of the 'basal' metabolism. In the majority, one or more preliminary periods were run before the injection was made. The general course of events in a normal subject was studied in a series of control experiments, in which a solution of sodium chloride alone was injected. The changes observed were only slight. The respiratory quotient remained steady, the pulse rate and oxygen consumption fell somewhat, the latter after a slight rise, and the urine, although showing a slightly increased output of fluid, yet had less sodium chloride present: presumably the greater salt excretion in the preliminary period should be related to the intake of this substance in the food. When the experiment continued all night, records of sleep and wakefulness were obtained by the response of the subject to an electrical signal: the pulse rate remained steady, except for periods of wakefulness, and the respiratory quotient, oxygen consumption, and carbon dioxide production showed a tendency to increase slightly. The course of events after the injection of a test substance must be interpreted in the light of those occurring under similar conditions in a control subject at a similar period of the day.

The absorption of alcohol, injected in a 5 to 10 per cent. solution in 0·6 per cent. sodium chloride, was almost complete, in most of the experiments a tota of 25 gm. being given. Signs of alcoholic intoxication could be produced by administration by this route Small amounts of alcohol were excreted in the urine the concentration being of the order of 0·5 per cent and reaching a maximum in about two hours: The amount excreted and the time of the maximum output depended on the quantity of alcohol injected and also on its concentration. Similar results were obtained following the ingestion of alcohol by mouth: but owing to the quicker absorption, a higher maximum excretion was observed. After five or more hours the excretion ceased. If the subject slept during the experiment, more alcohol appeared in the urine suggesting a lessened utilisation It is of interest to note that sometimes the alcohol appeared in the urine in a conjugated condition, distillation following treatment with an inorganic acid yielding slightly higher figures for alcohol than simple distillation alone. The excretion of only small quantities of alcohol after oral ingestion has been confirmed more recently by H. W Southgate (*Biochem. Jour.*, vol. 19, p. 737, 1925) Apart from its presence in the urine, the rectal administration of alcohol led to a marked diuresis, with a decrease in the nitrogen and sodium chloride eliminated.

The effect of alcohol on the general metabolism was shown by the fall in the respiratory quotient, with a rise in the pulse rate and the oxygen consumption When adequate amounts were given, the changes began in about an hour and lasted for six or seven hours. With oral ingestion the respiratory quotient fell still more promptly.

The administration of dextrose or lævulose by the rectal route produced similar effects, except that the respiratory quotient rose, instead of falling, as after the alcohol. Only 60 to 90 per cent. of the dextrose and 50 to 100 per cent. of the lævulose was absorbed in the different experiments; absorption was most rapid in the first two hours. The lævulose solution was the most difficult of all to retain. The changes in the urine were slight in the case of dextrose, there occurring a fall in the nitrogen and sodium chloride output: but this fall was very marked following the injection of lævulose. In both cases the respiratory quotient and the pulse rate increased, with little alteration in the oxygen consumption.

Perhaps the most interesting part of the monograph are the deductions made by the author from the experimental data. He considers that there is sufficient evidence to show that alcohol, dextrose, and lævulose, when introduced rectally, are metabolised by the body. Calculations suggest that alcohol replaces in metabolism all the foodstuffs in the proportions in which they are being utilised at the moment, this replacement may take place to the extent of 50 per cent. By the oxidation of the dextrose absorbed enough carbohydrate would be supplied for the metabolic needs of the body for two to three hours. Lævulose, on the other hand, appears to be mostly retained in the body without oxidation, perhaps as glycogen.

Comparison of the effects of rectal administration with those following oral ingestion showed in a few cases certain discrepancies. Thus alcohol *per os* lowered the respiratory quotient more promptly than after administration by the alternative route, but the peak of the alcohol concentration in the urine was reached in about the same time in either case, so that it may be assumed that the difference is not due to the earlier appearance of an increased concentration in the blood following oral ingestion. Again, lævulose *per os* had a greater effect on the respiratory quotient than when given *per rectum*, whilst with dextrose the reverse appeared to be true, although it was less readily absorbed from the rectum than the former.

The author considers that the differences in the metabolic effects between oral and rectal administration cannot be explained by the absorption of the materials into the systemic venous system alone as distinct from an absorption into the portal system, since the former drains only the extreme lower end of the large bowel. He therefore suggests that the immediate fate of these materials may depend in part upon whether the liver is in an active condition or not. This condition is presupposed following oral ingestion, but if the rectal administration occurs sufficiently long after the previous meal, it may be expected that this organ is in a state of relative quiescence. The idea that the liver may give off to the blood-stream a substance of the nature of an internal secretion has already been envisaged by some experiments of Cannon's on the existence of a substance causing acceleration of the denervated heart, which was only clearly demonstrated in animals digesting meat.

The work suggests lines for future research and at the same time indicates that if resort has to be made to rectal alimentation in a patient, alcohol and dextrose are the substances which should be chosen for this purpose.

The Russian Geographical Society.

WE have received from the Russian State Geographical Society twelve parts of its *Isvestiya*, forming vols. 52-57, for the years 1916–1925. They contain a series of valuable contributions to the geography of the Russian dominions, and British geographers will gladly welcome the renewed activity of that important Society. The word 'Imperial' in the title of the Society was omitted in 1916 and has now been replaced by 'State.' That the conditions of publication in Russia are difficult are indicated by the poverty of the paper, the sparseness and inferior quality of the illustrations and the maps. In these respects the later volumes show a marked improvement, which encourages the hope that the journal will reach its former excellence. The volumes contain many important contributions, but they are rigidly confined to the Russian language, the only exception being that one paper has a title and a short summary in French. If the titles of the papers and the lists of contents were repeated in some western language, the accessibility of its contributions would be much increased. Some of the work has been delayed in publication; thus volume 57, pt. 1 (pp. 3-60), includes papers by Conradi, Kell, and Ghulten on the geological and geographical results of an expedition to Kamchatka in 1908–1910, and a discussion by Prof. Karakash of *Eoanthropus dawsoni* (vol. 52, 1916, pp. 673-714) has been generally overlooked in Great Britain.

Among the papers on physical geography are the discussion by S. C. Bergh (vol. 52, pt. 8, 1916, pp. 579-648) of the origin of loess; many contributions to glacial geography, including a study of the movements of glaciers in the Caucasus by P. Tzirulnikov (vol. 53, 1917, pp. 45-56, 5 pls.), two papers by Belyaev and Besedin (vol. 55, pt. 1, 1919, pp. 1-124) on glaciers in Darvaz from observations during an excursion by the Russian Geographical Society in 1919, and a catalogue by Tronov of the glaciers of the Altai (vol. 57, pt. 2, pp. 107-159). General problems connected with glaciation are discussed by Sobolov (vol. 56, pt. 1, 1924, pp. 101-140, and pt 2, pp. 5-36) on the glacial formation of northern Europe with reference to the geo-morphology of the Russian plain. The evidence from the Caucasus as to the succession of glacial periods is adduced by Renngarten from the Valley of Assa in the northern Caucasus (vol. 57, pt. 2, 1925, pp. 53-106). I. N. Shamkov describes the climate of Abas-Fuman and its value as a health resort.

The papers on European geography are relatively few, but Alyabev (vol. 56, pt. 1, 1924, pp. 5-54) contributes an account of the Kurghalov Peninsula and the south coast of Finland, and their geographical relationship. Yakovlev (vol. 57, pt. 2, 1925, pp 3-22) describes the relief of Leningrad and its effect on the inundations.

Shokalskii in a short paper discusses the acceptance of republics by the north-western Russian States (vol. 56, pt. 1, 1924, pp. 154-161), and A. Petrov discusses the physical geography of the Murmansk area (vol 55, pt. 2, 1924, pp. 3-13)

Studies of the Siberian rivers are given by Saporhnikov and Nitikin, dealing especially with the plant distribution on the lower valley of the Obi (vol. 55, pt. 1, 1923, pp. 135-180); and by Ghromov, who describes his work at the mouth of the Yenisei (vol. 56, pt. 2, 1925, pp 107-118).

Contributions on Russian Turkestan include the papers by Spiridonov on the natural history of parts of the Kizil-Kuma (vol. 56, pt. 2, 1924, pp. 145-173), and Smirnova describes the western parts of the Kirghiz Territories (vol. 55, pt. 2, pp. 103-112); Pavlov describes the North Gobi Desert and a traverse of Mongolia (vol. 57, pt. 1, 1925, pp. 111-168).

Mushketov describes the eastern Ferghana and the Alai (vol. 53, 1917, pp. 83-137, 8 pls.), and also a journey in Narjensk and Kashgar (*ibid.*, pp. 138-166). There are some obituaries, including one of P. O. Rovinskii, dealing especially with his work in Serbia (vol. 52, 1916, pp. 515-542), and an appreciation by Sokolovskii of the geographical work of Philip Avril (vol. 57, pt. 1, 1925, pp. 67-98).

Peat Investigation in Canada.

ABOUT eight years ago a Peat Committee was appointed by the Government of Ontario and the Federal Government of Canada, and was directed to find, if possible, a practical commercial method for converting raw peat into fuel. The Committee considered carefully all the more important processes for winning peat fuel which had been previously proposed, and concluded that the only practical commercial method of winning peat fuel is by excavating, mixing, spreading and forming the raw peat by automatic machines. The peat blocks thus formed and spread are then to be dried in the air. Since this process decreases considerably the number of labourers required per ton of fuel, it is well adapted for countries such as Canada, where the cost of labour is high.

The Committee made a careful and exhaustive examination of the efficiencies of two large-scale excavating and spreading plants. One of these had been devised in Sweden by Anrep, and the other in

Canada by Moore. The two machines were provided with mechanical excavators, which, however, differed in detail, and with field-presses. The conveying of the peat pulp from its excavator to the drying ground was by means of tipping cars on a portable railway in the Anrep method, and by means of an automatic belt-conveyer in that of Moore. As a result of the trials, which are fully described in its final report, the Committee found that the best type of process is one which combines the excavating elements of the Anrep system with the conveying and spreading elements of Moore's.

Incidentally it was found that a shredding machine of the Jeffrey swing-hammer type, used for pulping kelp on the Pacific coast of America, is far more efficient as a macerator than those with knives and screws commonly employed in Europe. Two other conclusions of the Committee deserve the serious attentions of peat experts. The operations of excavating, macerating, forming and spreading can be efficiently performed by automatic machines, but there is no cheap automatic method of collecting dry peat sods from the spreading ground. Furthermore, with the introduction of automatic machines for winning the peat, the overhead charges have increased so much that they now amount to nearly half the total cost of the finished peat fuel.

The report of the Committee merits a careful study, not only because it describes the field results of actual large-scale experiments on the winning of peat fuel, but also because it gives in addition a comprehensive and authoritative account of the recent advances in the peat industry. HUGH RYAN.

University and Educational Intelligence.

BIRMINGHAM.—The following appointments have been made:—Dr. Edmund L. Hirst, to be a lecturer in the Department of Chemistry; Mr. Gordon Manley, to be assistant lecturer in geography; Dr. Oscar Brenner, to be part-time assistant in pathology and bacteriology.

The British Thomson-Houston Co. has presented two A. C. motors for use in the Coal Treatment Laboratory.

The Huxley Lecture is to be delivered by Prof. Elliot Smith on February 1, 1927.

CAMBRIDGE.—D. H. R. Rastall has been elected to a supernumerary fellowship at Christ's College. The following have been elected to represent the scientific faculties on the General Board of the Faculties: Mr. R. H. Fowler, Prof. C. E. Inglis, Dr. T. S. Hele, Mr. T. C. Nicholas.

The Governing Body of Emmanuel College offers to a research student commencing residence at the University in October 1927 a studentship of the annual value of 150*l*., tenable at Emmanuel College for two years. The studentship will be awarded in July, and applications should be sent so as to reach the Master of Emmanuel (The Master's Lodge, Emmanuel College, Cambridge, England) not later than June 30. The award will be made on the evidence submitted by the candidates, which should include a statement of the proposed course of research, a brief account of the candidate's career up to the date of the application, and evidence of general ability and of special fitness for the proposed course of research.

LIVERPOOL.—Dr. W. S. Patton, lecturer on entomology in the University of Edinburgh, has been appointed to the Dutton Memorial chair of entomology at Liverpool as from January 1 next. Dr. Patton graduated in medicine at Edinburgh in 1901 and later studied in the University of Marburg. He joined the Indian Medical Service in 1902, from which he retired with the rank of major in 1921. During the War he was entomologist to the Mesopotamian Expeditionary Force. He has acted as Director to the King Institute of Preventive Medicine in Madras and as Director of the Pasteur Institute of Southern India. He has recently been engaged in investigations in China, and has had charge of the Kala-Azar Commission of the Royal Society.

Prof. H. J. W. Hetherington, professor of moral philosophy in the University of Glasgow, has been appointed Vice-Chancellor of the University of Liverpool in succession to the late Dr. J. G. Adami. Prof. Hetherington was educated at Dollar Academy and the University of Glasgow, in which he distinguished himself in the Departments of Mental Philosophy, Economics, and Classics. From 1910 until 1914 he held a lectureship in moral philosophy in Glasgow and became a member of Merton College, Oxford. In 1914 he was appointed lecturer in philosophy in the University of Sheffield, and a year later became professor of logic and philosophy in University College, Cardiff. In 1920 he became Principal and professor of philosophy of University College, Exeter, in which positions he distinguished himself as an administrator. In 1924 he relinquished his post in Exeter to take the chair of moral philosophy in Glasgow University. He is thirty-eight years of age. Prof. Hetherington is the author of "International Labour Legislation" and has published, in conjunction with Prof. J. H. Muirhead, a study in social philosophy entitled "Social Purpose." He will assume the office of Vice-Chancellor at the beginning of the session 1927–28.

APPLICATIONS are invited by the Royal Society for the appointment of a Foulerton Research Studentship, value 700*l*. per annum. The duties of the student will be to conduct researches in medicine or the contributory sciences under the supervision and control of the management committee. The studentship will be tenable for three years, but may be renewed from year to year up to six years. Members of either sex are equally eligible, but must be of British nationality. Applications must reach the Royal Society, Burlington House, Piccadilly, W. 1, not later than March 1 next.

THE annual meeting of the Geographical Association will be held on January 6-8 at the London School of Economics, Houghton Street, Aldwych, W.C.2, under the presidency of Sir Charles Close, formerly Director-General of the Ordnance Survey. The programme includes a discussion on January 6 for university teachers of geography on research in geography (opened by Sir Henry Lyons), and an address by Mr. J. Fairgrieve to primary school teachers, and a visit on January 7 to the Science Museum, South Kensington, with an address by Prof. H. H. Turner on solar eclipses. There will also be four concurrent discussions on the morning of January 7, on geography in advanced courses, on broadcasting and nature-study respectively in geography, and on school journeys. Sir Charles Close will deliver his presidential address, "Population and Migration," on January 7, and later in the day Col. E. M. Jack, the present Director-General of the Ordnance Survey, will describe the work of his department. The annual dinner of the Association will be held on January 7, and on January 8 a visit to the geography room of the William Ellis School is being arranged. Prof. L. P. Abercombie of Liverpool is organising a visit on January 8-10 to see the changes taking place in east Kent. The honorary secretary of the Association is Prof. H. J. Fleure, Geographical Association, Marine Terrace, Aberystwyth.

Contemporary Birthdays.

December 12, 1838.	Prof. W. C. Unwin, F.R.S.
December 12, 1866.	Prof. E. W. MacBride, F.R.S.
December 12, 1855.	Mr Arthur William Clayden.
December 13, 1861.	Prof. A. G. Perkin, F.R.S.
December 15, 1869.	Sir John F. C. Snell, G.B.E.
December 16, 1884.	Prof. John W. Bews.
December 16, 1859.	Prof. Douglas H. Campbell
December 16, 1854.	Prof. John T. Cash, F.R.S.

Prof. UNWIN celebrates his eighty-eighth birthday on Sunday, and very hearty congratulations are accorded to this distinguished veteran of the engineering world. Educated at the City of London School, he began his technical career as a pupil in the firm of William Fairbairn, Manchester. For twenty years he taught the principles of engineering at the Central Technical College, City and Guilds of London Institute. Prof. Unwin is a past president of the Institutions of Civil Engineers and Mechanical Engineers.

Prof. MACBRIDE, the distinguished zoologist, who occupies the chair of zoology in the Imperial College of Science and Technology, South Kensington, was born at Belfast and educated there at Queen's College, and at St. John's College, Cambridge. From 1897 until 1909 he was Strathcona professor of zoology in McGill University, Montreal. A teacher of distinction, Prof. MacBride has made noteworthy contributions to invertebrate embryology. In 1924 he published his "Introduction to the Study of Heredity."

Mr CLAYDEN was born at Boston, Lincolnshire, and educated at University College School, from whence he graduated at Christ's College, Cambridge. From 1894 until 1920 he was principal of University College, Exeter. Mr Clayden has contributed much of sterling value to meteorological photography.

Prof. A. G. PERKIN, who, it will be recalled, retired recently from the chair of colour chemistry and dyeing in the University of Leeds, was born at Sudbury. He was educated at the City of London School and Royal College of Science. In 1924 the Royal Society awarded him its Davy medal for researches on the structure of natural colouring matters.

Sir JOHN SNELL was born at Saltash, Cornwall, and educated at Plymouth Grammar School and King's College, London. A past president of the Institution of Electrical Engineers, he is a member of the Advisory Council, Department of Scientific and Industrial Research, and the General Board, National Physical Laboratory. Sir John's advice and guidance are sought frequently in parliamentary projects concerning the technical industries.

Prof. BEWS, born at Kirkwall, Orkney, graduated at the University of Edinburgh. Assistant professor of botany there (1908–10), he left to take up the chair of botany in University College, Natal. In 1924 he published "Plant Forms and their Evolution in South Africa."

Prof. D. H. CAMPBELL, botanist, was born at Detroit, U.S.A. After graduation at the University of Michigan, he studied at Bonn, Tübingen, and Berlin. Professor of botany at Indiana University from 1888 until 1891, he was then elected to a similar chair at Stanford University, California. Prof. Campbell is a foreign member of the Linnean Society of London and a fellow of the Royal Society of Edinburgh. He is the author of "Plant Life and Evolution" (1911) and of many papers on systematic botany.

Prof. CASH, a graduate of the University of Edinburgh, is Emeritus Regius professor of materia medica in the University of Aberdeen.

Societies and Academies.

LONDON.

Royal Society, December 2.—**T. M. Lowry** and **W. R. C. Coode-Adams**: Optical rotatory dispersion (Pt. 3). The rotatory dispersion of quartz in the infra-red, visible, and ultra-violet regions. Measurements of optical rotatory power of quartz were begun in 1908 with the view of testing, in the most drastic way possible, methods that were being developed for studying rotatory dispersion in organic compounds. Data are now given for the rotatory power at 20° C. of a column of quartz, 496·4735 mm. in length, over a range of wave-lengths from 25,170 Å.U. to 2263 Å.U. Observed rotations range from 450° to 101,332°, and rotations per mm. from 0·906° to 202·328°/mm. The latter can be expressed, over the entire range of wave-lengths, by the formula—

$$\alpha = \frac{9{\cdot}5639}{\lambda^2 - 0{\cdot}0127943} - \frac{2{\cdot}3113}{\lambda^2 - 0{\cdot}000974} - 0{\cdot}1905$$

This formula postulates the existence of bands of selective absorption at 1130 Å.U. and 310 Å.U. The influence of infra-red bands is covered by the small constant $-0{\cdot}1905$.

O. W. Richardson: Structure in the secondary hydrogen spectrum (v). Fulcher's red bands as extended by various authors form a sequence of bands with the respective vibration transitions 0 → 0, 1 → 1, 2 → 2, 3 → 3, 4 → 4, and 5 → 5. The green bands belong to the same group and have the vibration transitions 1 → 0, 2 → 1, 3 → 2, 4 → 3, and 5 → 4. Associated with these are five bands in the infra-red with transitions 0 → 1, 1 → 2, 2 → 3, 3 → 4, and 4 → 5, and four in the blue-green with transitions 2 → 0, 3 → 1, 4 → 2, and 5 → 3. The blue bands arranged by Dieke form a sequence in another group and have the transitions 0 → 0, 1 → 1, 2 → 2, 3 → 3, and 4 → 4. Belonging to this group are three other sequences with transitions 1 up, 1 down, and 2 down respectively. There are also at least three less well-developed groups in the violet side of these. The Q (1) lines of the bands with 0 → 0 vibration transitions are given by the Rydberg-Ritz formula

$$\nu = A - \frac{R}{(m - 0{\cdot}056704 - 0{\cdot}06080/m^2)^2},$$

where $A = 29330{\cdot}305$, $R = 109678{\cdot}3$, and $m = 3, 4, 5, 6, 7, 8$. The value of A is close to that of the second member when $m = 2$. It follows that the various groups of bands are associated with electron transitions 3 → 2, 4 → 2, 5 → 2, etc. The lines of the Q branches are connected together by a combination rule which extends not only within each group but also from each group to the others.

R. H. Fowler: General forms of statistical mechanics, with special reference to the new quantum mechanics. This paper discusses a very general form of statistical mechanics which includes as special cases the classical form, the form of Bose and Einstein, and of Fermi and Dirac. It is shown generally that assemblies of many independent systems are always thermodynamic systems. The correct form for material particles obeying the laws of quantum mechanics is then discussed, and the arguments in favour of the form of Fermi and Dirac summarised. The applications of this form are then greatly extended. Previously it had been applied only to structureless mass-points; it is here shown how to treat assemblies as general as any handled in the classical form. Problems of distribution in space according to the new mechanics are also briefly treated.

R. H. Fowler and **E. K. Rideal**: On the rate of maximum activation by collision for the complex molecules, with applications to velocities of gas particles. New formulæ are used to compute the maximum rate of activation by collision and applied to the dissociation of nitrogen pentoxide. The maximum possible rate of activation by collision is 100 times greater than the observed rate of dissociation at the lowest pressures hitherto investigated. The maximum possible rate of dissociation of bromine molecules by collision and the rate of formation of hydrobromic acid are of the same order. The rate of dissociation need not be 10^5-10^6 times smaller, as claimed by Polanyi.

H. **Dingle**: The spectrum of fluorine (F I). The spectrum of neutral fluorine (F I) has been examined by means of discharges through silicon tetrafluoride, and lists of established and doubtful lines have been tabulated. It contains doublet and quartet systems of terms. The suggested arrangement is consistent with Carragan's observations of the Zeeman effect for fluorine. Relative term values have been deduced for each system, and an ionisation potential of about 17 volts suggested. The discussion suggests that lines of F I should appear with maximum intensity at or near Ao in the Harvard sequence.

Eighteen papers were read in title only.

MANCHESTER.

Literary and Philosophical Society, November 2.—H. B. **Dixon** and W. F. **Higgins**: The burning of gases in nitrous oxide. A small jet of hydrogen burning in air is almost invisible and its light is inappreciable: if nitrous oxide, instead of air, is made to feed the flame, the increase in the size and luminosity of the flames is remarkable The jet of issuing gas is surrounded by a luminous apricot-coloured zone, and outside this is a thick sheath of greenish-grey colour. The luminous zone appears to give a continuous spectrum, and this is confirmed by a spectrogram taken with a 24 hours' exposure Hydrocarbon gases burning in nitrous oxide show an intensely bright centre surrounded by a luminous apricot zone, and round all a wide-stretching green-grey envelope The propylene and acetylene flames deposit a sheath of carbon round their luminous cores. All the gases tested in the 'concentric-tube' apparatus have ignition-points in nitrous oxide lower than those in oxygen or air. They all exhibit a lowering of nitrous-point above and below the *crucial pressure*, just as in oxygen or in air.—R. W. **James**: The intensity of reflexion of X-ray from crystals at low temperatures. The temperature coefficient of X-ray reflection from crystals of rock-salt over a range of temperatures from 290° Abs. to 85° Abs. has been measured. The crystal is suspended just above the surface of liquid air contained in a Dewar flask having specially thin walls made of boro-silicate glass. With molybdenum $K\alpha$ the absorption in the glass is only about 30 per cent. The ratios of the intensities of reflection at 85° Abs. to that at 290° Abs are 1·22, 1·61, 2·36, 3·39, for the 2nd, 3rd, 4th, and 5th order reflections respectively, from the cube face of the crystal. This is in accord with Debye's theory. At higher temperatures the intensity decreases too rapidly According to recent work by Waller the value of the exponent should be double that calculated by Debye At low temperatures the present experiments point to the substantial correctness of Waller's formula.

November 16.—R **Robinson**: Some recent advances in organic chemistry. In the aliphatic group, special interest attaches to the work of Dudley, Rosenheim, and Starling on the tetra-acid base, spermine, which has been isolated and proved by synthesis to possess the formula—

$$NH_2(CH_2)_3NH(CH_2)_4NH(CH_2)_3NH_2.$$

In the alicyclic group, Ruzicka, after doing much to clear up the chemistry of the sesquiterpenes, has made the astonishing discovery of the stability of large rings of carbon atoms The clue was furnished by the study of the ketone, civetone, from certain glands of the civet cat. This substance was proved to be cycloheptadecenone. In the aromatic groups Harington has studied the active constituent of the thyroid gland and shown it to be the tetra-iodo derivative of a compound termed deiodothyroxin. The latter contains a diphenyl ether group, is related to tyrosine and has been synthesised. Turning to the heterocyclic groups, H. Fischer's recent announcement of the transformation of cryptopyrrole into aetioporphyrin marks a great advance in our knowledge of chlorophyll and of the blood pigment. For the first time the synthetical method affords evidence of the arrangement of the four pyrrole nuclei in the molecule. The most striking feature of recent organic chemical theory is the increasing use which is made of conceptions based on the electronic theory of valency. Thus, it can be shown theoretically that electrophile groups, those which attract electrons and, for example, actually positively charged centres, have a *m*-directive tendency. On the other hand, groups which are less electrophile than hydrogen is, have an *o-p*-directive tendency.

PARIS.

Academy of Sciences, November 8.—Ch. **Lallemand**: A world-wide scheme for measurements of longitude. The scheme starts with the determination of the differences of longitude between three fundamental points, nearly on the same parallel, and about 120° apart. For these points three permanent observatories were chosen (Algiers, Shanghai, San Diego), and these are to be connected by secondary polygons. Full use is made of radio telegraphy, associated with the most perfect methods of astronomical observation available. Wherever possible, self-recording methods are utilised.—H. **Dauvillé**: Some observations on the Cretaceous strata to the south of Paris.—R. Jarry **Desloges**: The changes observed in the planet Mars during the apposition of 1926. A list of changes from the configurations seen in 1924.—J. **Schokalsky**: The expedition of the Russian Geographical Society in Mongolia (1924–1926).—S **Drzewiecki**: A new representation of a gas Application to the barometric pressure. Starting with a simple deduction from the kinetic theory of gases, a new formula for the variation of barometric pressure with altitude is deduced. This formula contains a series in ascending powers of *g*, and if all terms of this series except the first be neglected, it reduces to the ordinary Laplace formula.—W. **Arkadiew**: The oscillations and resonance of elementary magnets.—H. **Volkringer**: The continuous spectrum of mercury The continuous spectrum of mercury vapour under oscillating discharge, studied in a tube without electrodes, was of maximum intensity at about 240° C (vapour pressure 35 mm.). The distribution of energy in the spectrum was determined by comparison with the energy emitted by a black body at 1520° C. The curve given shows a maximum in the neighbourhood of $\lambda = 0{\cdot}512\mu$ and is nearly symmetrical about this point —René **Dubrisay**: The action of heat on the superficial properties of kaolin. Kaolin was heated to 250° C, 550°-600° C., and 950°-1000° C. The unheated sample and the three heated samples were compared with respect to their adsorption of iodine and of methylene blue, the heat developed on moistening with water and ammonia solution, and apparent volume after shaking up with water and ammonia solution. The comparative results of these experiments are given in tabular form.

—**Pierre Jolibois**, **Henri Lefebvre**, and **Pierre Montagne**: Comparison between the effects of the electric spark and of thermal dissociation.—**H. Forestier** and **G. Chaudron**: The ferromagnetic characters of stable iron sesquioxide.—**Jean Cournót** and **Jean Bary**: Electrolytic plating of aluminium and light alloys, their adherence and resistance to corrosion by sea water. Aluminium and duralumin were used in these experiments. The deposited metals were cadmium, cobalt, and chromium (all on a copper film), also cadmium directly on duralumin. Detailed accounts of cleaning methods and depositing baths are given. As regards resistance to sea water, copper-chromium deposited on aluminium gave the best results.—**A. Sanfourche**: The cementation of iron by silicon chloride.—**C. Marie** and **J. Bertheloot**: Two causes of error in the electrolytic determination of nickel in the presence of iron. The precipitated oxide of iron retains some nickel and the deposited nickel contains some iron. These errors may sometimes compensate each other. The first error may be prevented by the addition of magnesium sulphate, the second by using a diaphragm of filter paper round the cathode.—**Georges Dubois**: Geological study of the Flemish coast in the neighbourhood of Gravelines.—**P. Russo**: The presence of a large volcanic region in the lower plain of Moulouya (Northern Morocco).—**Const. A. Ktėnas**: The evolution of the volcano of Kamenis (Santorin) in 1926.—**Louis Besson**: Relation between the temperatures of certain months in the year. Taking the mean monthly temperatures at Paris for 123 years, and plotting the figures for July and April against the date, it is seen that there is a remarkable similitude between the two curves; if one curve is displaced, seven years the two curves are almost parallel.—**J. Magrou**: *Bacterium tumefaciens* in the tissues of plant cancers. The observations described, which agree with those of Robinson and Walkden and of Pinoy, suggest that the agent of cancer in plants acts at a distance, by a mechanism which remains to be explained, on the cells in which it is causing multiplication.—**Stefan Jellinek**: A biological sign marking the return of spontaneous respiration in cases of apparent death. The first sign of restoration of breathing is a swallowing movement of the larynx and lips.—**Alphonse Labbé**: Herouardia, a new genus of copepod, intermediate between the Harpacticidæ and the Cyclopidæ.—**A. Dorier**: The commensalism of the larva of *Dactylocladius brevipalpis*.—**Auguste Lumière** and **Mme. Montoloy**: The formation of abscesses of fixation.

Official Publications Received.

BRITISH AND COLONIAL.

Ministry of Finance, Egypt: Survey of Egypt, Geological Survey. The Geography and Geology of the District between Gebel 'Atâqa and El-Galâla El-Bahariya (Gulf of Suez). By Dr. H. Sadek. (Survey of Egypt Paper No. 40.) Pp. viii+120+6 plates. (Cairo: Government Publications Office.) 10 P.T.

Proceedings of the Isle of Wight Natural History Society for 1925. Vol. 1, Part 6. Pp. cccxxii-cccxviii+319-403. (Newport, I.W.: The County Press.) 3s.

Union of South Africa: Department of Agriculture. Science Bulletin No. 53: Yoking Oxen to the Plough; a new System. By Dr. W. S. H. Cleghorne. Pp. 14. (Pretoria: Government Printing and Stationery Office.) 3d.

CATALOGUES.

Catalogue of General and Industrial Laboratory Appliances. Eighth edition. Pp. 1214. (London: A. Gallenkamp and Co., Ltd.)

Medizin und Naturwissenschaften. Mit einem Vorwort von Prof. Dr. Henry E. Sigerist. Pp. xii+103. (Leipzig: Georg Thieme Verlag.)

Books on Art and the Decorative Crafts. Catalogue 488, November. Pp. 56. (London: Francis Edwards.)

A New Catalogue of Publishers' Remainders and other Purchases. No. 181. Pp. 24. (London: Henry W. Glover.)

Firth 'Staybrite': the New Acid-Resisting Steel. Pp. 20. (Sheffield: Thos. Firth and Sons, Ltd.)

Cambridge Unipivot Instruments for D.C. Measurements. List No. 160. Pp. 27. (London: Cambridge Instrument Co., Ltd.)

Diary of Societies.

SATURDAY, DECEMBER 11.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District Meeting) (at Vestry Hall, Dawlish), at 2.15.—S. F. C. Church: Twenty Years in an Urban District.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Sections) (jointly with Graduate Sections of North-East Coast Institution of Engineers and Shipbuilders, and Institution of Electrical Engineers) (at Neville Hall, Newcastle-upon-Tyne), at 3.—Joint Discussion on The Production and Transport of Coal by Machinery.

MINING INSTITUTE OF SCOTLAND (at Royal Technical College, Glasgow), at 3.—A. Kyle: Mineral Boring.—Discussions on the following:—Coal-Cutting by Machinery and Conveyors in Scottish Mines, G. L. Kerr.—The Problem of In-bye Transport, D. C. Gemmell.—Miner's Nystagmus, Dr. F. Fergus.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. C. Rootham: Henry Purcell and his Contemporaries (1).

PHYSIOLOGICAL SOCIETY (at London Hospital Medical College), at 3.30.—Demonstrations—A Simple Colorimeter Lamp, H. D. Kay.—An Easily-constructed Ultrafilter, R. S. Aitken and H. D. Kay.—A Method of Collecting 'Alveolar Air' during Exercise, A. E. Clark-Kennedy and T. Owen.—The Fractional Analysis of an Expired Breath, R. S. Aitken and A. E. Clark-Kennedy.—Apparatus for Measuring the Osmotic Pressure of Proteins at Constant Hydrogen-Ion Concentration, J. R. Marrack.—Dr. W. A. M. Smart: Some Nomograms of Physiological Interest.—Prof. H. E. Roaf: (a) Apparatus for Measuring the Influence of Intensity of Light on Discrimination of Wave-lengths; (b) Effect of Exposure of the Eye to a Coloured Light on its Sensitivity to Various Regions of the Spectrum; (c) Apparatus for Measuring the After Effects of Exposure of the Eye to any Region of the Spectrum.—S. Wright: A Simple Respiratory Apparatus for Man or Animals.—D. T. Barry: Experimental Lesions of Mitral and Tricuspid Valves.—E. D. Adrian and R. Eckhard: The Time Relations and Frequency of Impulses in the Optic Nerve.—J. T. Cunningham: The Function of the Scrotum.—H. A. Harris: The Growth of the Long Bones in Health and Disease; its Relation to Vitamines and Tissue-Culture.—Dr. F. W. Edridge-Green: The White Equation and its Relation to the Theory of Colour Vision.—F. R. Curtis, A. A. Moncrieff, and S. Wright: On a Supposed Pressor Substance in the Blood of Patients with Hypertension.—I. de Burgh Daly: Effect of a Negative Pressure on the Heart-Lung Preparation.—K. Furusawa: A Muscle Twitch Lasting for Hours.—D. T. Barry and J. Freud: Toxæmia from Liver Grafting.—Prof. H. S. Raper: Indole Derivatives from Tyrosine.—F. Campbell Smith: The Ultra-violet Absorption Spectra of Centrospinal Fluids (Preliminary Communication).

BRITISH PSYCHOLOGICAL SOCIETY (Annual General Meeting) (at University College), at 3.30.—J. C. Flugel: Practice, Fatigue, and Oscillation.

INSTITUTE OF BRITISH FOUNDRYMEN (Newcastle and District Branch) (at Neville Hall, Newcastle-upon-Tyne), at 6.15.—W. J. Molineux: The Manufacture of Iron Castings for Petrol Engines.

INSTITUTE OF BRITISH FOUNDRYMEN (Birmingham, Coventry, and West Midlands Branch) (at Engineers' Club, Birmingham), at 6.30.—W. West: Oil, Sand, and Motor Castings.

HULL ASSOCIATION OF ENGINEERS (at Hull Technical College), at 7.15.—Prof. F. C. Lea: Hydro-Electrical Developments.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Manchester).—R. S. Horsfall: Modern Industrial Chemistry.

MONDAY, DECEMBER 13.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Sir Henry Lyons: Ancient Survey Instruments.

SOCIETY OF ENGINEERS (at Geological Society), at 5.45.—Prof. F. H. Hummel: The Economic Proportions, and the Stresses in a Solid Masonry Dam or Buttress, subjected to Water Pressure acting on an Inclined Face.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section) (at Institution of Mechanical Engineers), at 7.—H. H. Lewis: Payment by Results.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Section) (at Liverpool University), at 7.—H. W. Edmundson and G. B. Robertson: The Making of a Radio Valve.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Circle) (at Armstrong College, Newcastle-upon-Tyne), at 7.—J. R. Beard and T. G. N. Haldane: The Design of City Distribution Systems, and the Problem of Standardisation.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London) (jointly with Student Sections of the Institutions of Civil and Electrical Engineers), at 7.—H. H. Lewis: Payment by Results.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Protection Coating of Metals:—C. H. Faris: Færoolising.—N. C. Marples: Colorising.—E. A. Ollard: Chromium Plating.

RAILWAY CLUB, at 7.30.—W. H. R. Dawson: The Underground Railway.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—G. Drysdale: The Work of Leonard Stokes.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—J. Anderson: The Knower and the Known.

INSTITUTE OF CHEMISTRY (Leeds Area Section).—F. Scholefield: Registration of Chemists.

TUESDAY, DECEMBER 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: The Imperfect Crystallisation of Common Things (4).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. W. R. Ormandy, E. C. Craven, Prof. I. M. Heilbron, and H. J. Channon: A Contribution to the Study of the Origin of Petroleum. The Berginisation of Fish Liver Oils and Other Bodies.

INSTITUTION OF CIVIL ENGINEERS, at 6.—G. Ellson: The Remodelling of Charing Cross and Cannon Street Stations.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Presidential Address.

Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole, Leeds), at 7.

Institution of Electrical Engineers (North-Western Centre) (at Engineers' Club, Manchester), at 7.

Royal Photographic Society of Great Britain (Scientific and Technical Group), at 7.—W. B. Ferguson: A Modified F.R.B. Photometer Working with Constant Illumination of Field.—F. J. Tritton: The Application of Copper Salts in the Carbro Process.—A. B. Crow: A New Camera for Colour Photography.

Institute of British Foundrymen (Lancashire Branch, Burnley Section) (at Burnley Municipal College), at 7.15.—Discussion.

Society of Chemical Industry (Newcastle-on-Tyne Section) (at Armstrong College, Newcastle-on-Tyne), at 7.30.—L. H. Sensicle: The Future of High Temperature Carbonisation.

Institution of Electrical Engineers (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—J. R. Beard and T. G. N. Haldane: The Design of City Distribution Systems, and the Problem of Standardisation.

Institution of Automobile Engineers (Coventry Centre) (at Parkside, Coventry), at 7.30.—G. Rushton: The L.G.O.C. Methods of Repairing Motor Buses.

North-East Coast Institution of Engineers and Shipbuilders (Middlesbrough Branch) (at Middlesbrough), at 7.30.—W. J. Williams: Technical Education.

Quekett Microscopical Club, at 7.30.—Miss A. Lorrain Smith: Some Aspects of Lichens in Nature and in Art.

Pharmaceutical Society, at 8.—F. H. Carr: The Vitamins in their Relation to Pharmacy.

Royal Anthropological Institute, at 8.30.—Capt. G. Pitt-Rivers: The Effect on Native Races of Contact with European Culture, followed by a discussion by the Hon. W. Ormsby-Gore, Major A. G. Church, Major H. Vischer, and others.

Royal Society of Medicine (Psychiatry Section), at 8.30.—Dr. W. Aldren Turner: Some Observations upon Epilepsy (Presidential Address).

WEDNESDAY, December 15.

Society of Glass Technology (at University College), at 2.30.—J. F. Hyslop, R. Gumm, and H. Biggs: Some Corrosion and Erosion Phenomena and their Bearing on the Macrostructure of Refractories.—J. F. Hyslop and H. P. Rooksby: A Note on the X-Ray Patterns of Mullite and Sillimanite.—Prof. W. E. S. Turner: Further Note on Sillimanite as a Glass Works Refractory.—V. H. Stott: The Viscous Properties of Glass.—Prof. W. E. S. Turner: The Effect of Cullet on the Melting of Glass.—Dr. S. English: The Design of Parison Moulds.

Royal Meteorological Society, at 5.—N. K. Johnson: Some Meteorological Observations made at Sea.—N. K. Johnson and E. L. Davies: Some Measurements of the Surface Temperatures in Various Kinds of Soil.—Dr. A. N. Puri: Investigation on the Behaviour of Hair Hygrometers.

Geological Society of London, at 5.30.—J. H. Davies and Dr. A. E. Trueman: A Revision of the Non-Marine Lamellibranchs of the Coal Measures, and a Discussion of their Zonal Sequences.—Major L. M. Davies: The Ranikot Beds of Thal (North-West Frontier Provinces of India).

Newcomen Society for the Study of the History of Engineering and Technology (at 17 Fleet Street), at 5.30.—J. G. A. Rhodin: Christofer Polhem, 'The Archimedes of the North.'—A. Waarland: Mårten Triewald and the First Steam Engine in Sweden.

Institution of Civil Engineers (Students' Meeting), at 6.30.—J. G. Kimber: Some Applications and Advantages of Town Gas.

Institution of Automobile Engineers (Manchester Centre) (at Engineers' Club, Manchester), at 7.—F. Randle: Radiator Design.

Society of Chemical Industry (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7.—Dr. E. W. Smith: Some Technical Aspects of the Fuel Problem.

North-East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Newcastle-upon-Tyne), at 7.15.—L. P. Tappin: Some Problems of the Locomotive.

Institution of Electrical Engineers (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.

Merseyside Aquarium Society (at 1 Falkland Road, Egremont), at 7.30.—R. J. Daniel: Marine Fishes and their Food.

Society of Technical Engineers (London Area) (at 102 Belgrave Road), at 7.30.—The Present Status and Position of Technical Engineers in Russia (Address).

Royal Society of Arts, at 8.—W. J. U. Woolcock: Some Aspects of the Chemical Industry.

C.B.C. Society for Constructive Birth Control and Racial Progress (at Essex Hall, Strand), at 8.—Lieut.-Col. Sir John Ramsay: Birth Control as an Official and Administrative Question.

Eugenics Society (at London University Union, Malet Street), at 8.—Dr. C. V. Drysdale and others: Discussion on The Common Sense of Heredity: Natural Selection Reversed, Results in Reversal of Evolution.

Folk-Lore Society (at University College), at 8.—C. Tabor: The Folk-lore of Dancing.

Royal Microscopical Society, at 8.—C. Beck: A Method of Testing Zonal Aberration.—S. Hirst: Note on the Development of *Allothrombium fuliginosum* Hermann.—Dr. A. Kefalas: A Method of Staining Sections in Acetone.—Capt. J. Ramsbottom and E. H. Ellis: Seedling Structure of Cultivated Orchids.

Electroplaters' and Depositors' Technical Society (at Northampton Polytechnic Institute), at 8.15.—A. W. Hothersall: Acidity of certain Plating Solutions.

British Psychological Society (Medical Section) (at Royal Society of Medicine), at 8.30.—Dr. B. Hart: The Dissociation of Conception (Chairman's Address).

Merseyside Aquarium Society (at Egremont, Cheshire).—R. J. Daniel: Marine Fishes and their Food.

THURSDAY, December 16.

Royal Institution of Great Britain, at 5.15.—Sir Squire Sprigge: Medical Literature in relation to Journalism.

Child-Study Society (at Royal Sanitary Institute), at 6.—Dr. J. H. Jagger: Criticism of the Infant School.

Institution of Electrical Engineers, at 6.—Col. E. Mercier: Notes on the 60,000-Volt Underground Network of the Union d'Electricité.

Institute of Metals (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—Dr. W. Rosenhain: Hardening.

Chemical Society, at 8.—E. J. B. Willey and Dr. E. K. Rideal: On Active Nitrogen. Part I. The Heat of Formation and Nature of Active Nitrogen.—Dr. E. K. Rideal and W. M. Wright: Low Temperature Oxidation at Charcoal Surfaces. Part III. The Behaviour of Blood Charcoal and the Influence of Temperature on the Reaction Rate.—S. G. Clarke, J. Kenyon, and H. Phillips: Investigations on the Dependence of Rotatory Power on Chemical Constitution. Part XXXI. The Resolution of a Sulphilimine into its Optically Active Forms.

Royal Aeronautical Society.—Wing-Comdr. C. D. Breese: The Training of Aircraft Apprentices.

Institution of Mechanical Engineers (Birmingham Branch) (at Birmingham).—Prof. E. G. Coker: Elasticity and Plasticity (Thomas Hawksley Lecture).

Institution of Mechanical Engineers (Manchester Branch) (at Manchester).—T. A. F. Stone: Electric Locomotives: A Method of Classifying, Analysing, and Comparing their Characteristics.

Institution of Mechanical Engineers (Yorkshire Branch) (at Leeds).—J. H. Barker: Chairman's Address.

Institution of Mining and Metallurgy (at Geological Society).

FRIDAY, December 17.

Society of Chemical Industry (Liverpool Section, jointly with Fuel Section) (at Liverpool), at 6.—H. P. Lupton: Gas Undertakings and the Fuel Problem.

Royal Photographic Society of Great Britain (Pictorial Group), at 7.—Questions and Problems.

Photomicrographic Society (at 4 Fetter Lane), at 7.—Members' Evening.

Society of Chemical Industry (Chemical Engineering Group, jointly with Birmingham Section) (at Birmingham University), at 7.15.—Prof. J. W. Hinchley: Measurement of Temperature in Technical Practice.

Junior Institution of Engineers, at 7.30.—H. D. Glover: Progress Methods employed in a Large Mass Production Motor Works.

Institute of Metals (Sheffield Local Section) (at Sheffield University), at 7.30.—J. E. Hurst: The Influence of Sulphur in Cast Iron.

Royal Society of Medicine (Electro-Therapeutics and Surgery Sections), at 8.30.—Dr. E. P. Cumberbatch (Electro-Therapeutics) and F. J. Steward (Surgery): Discussion on Diathermy.

Society of Dyers and Colourists (Manchester Section) (at Manchester).—H. L. Hockney and C. W. Bancroft: Cloth Dyeing suitable for Rubber Proofing.

Manchester Literary and Philosophical Society (Chemical Section) (at Manchester).

West of Scotland Iron and Steel Institute (at Royal Technical College, Glasgow).—J. E. G. Primrose: Rod Rolling and Wire Drawing.

SATURDAY, December 18.

North of England Institute of Mining and Mechanical Engineers, at 2.30.

Royal Institution of Great Britain, at 3.—Dr. C. Rootham: Henry Purcell and his Contemporaries (2).

PUBLIC LECTURES.

SATURDAY, December 11.

Horniman Museum (Forest Hill), at 3.30.—M. A. Phillips: The Nursery Life of Animals.

SUNDAY, December 12.

Guildhouse (Eccleston Square), at 3.30.—Viscount Grey: The National Genius of England.

MONDAY, December 13.

Royal Sanitary Institute, at 5.—Dr. W. A. Robson: Legal Conceptions of Public Health (Chadwick Lecture).

TUESDAY, December 14.

Royal Institute of British Architects, at 7.30.—W. G. Newton: The Wealth of England.

Swedenborg Hall (Hart Street, W.C.1), at 8.—Rev. C. A. Hall: The Philosophy and Theology of Swedenborg.

WEDNESDAY, December 15.

University College, at 5.30.—Prof. A. E. Richardson: Public Library Architecture.

SUNDAY, December 19.

Guildhouse (Eccleston Square), at 3.30.—Miss Maude Royden: The Debt of Theology to Science.

SATURDAY, DECEMBER 18, 1926.

CONTENTS.

PAGE
e New Physics 865
Half-way House of Science. Dr. Helene E. Bargmann 867
hemy and Mysticism. By E. J. Holmyard . 869
n Barleycorn. By A. B. B. 871
bour Policy in Education. By F. S. M. . . 871
r Bookshelf 872
ters to the Editor:
The Conservation of Photons.—Prof. Gilbert N. Lewis 874
The Synthesis and Disintegration of Atoms as Revealed by the Photography of Wilson Cloud Tracks.—Prof. William D. Harkins and Hugh A. Shadduck 875
Quantum Mechanics and the Magnetic Moment of Atoms.—Prof. Enrico Fermi 876
Psychical Phenomena and their Interpretation.—Prof. Charles Richet 876
The Fluorescence of Superheated Mercury Vapour.—Dr. Henryk Niewodniczański 877
Dr. Jeans and the 'Disease' of Life.—J. J. Robinson; The Writer of the Notes . . 877
The Action of Silica on Electrolytes.—Dr. A. F. Joseph 878
"Colloid Chemistry."—Jerome Alexander; P. C. L. Thorne 878
The 'Bleeding' of Trees through Injury.—John Parkin 878
J. J. Thomson's Seventieth Birthday. MESSAGES F CONGRATULATION FROM ABROAD 879
e Jolly Electron. By Sir R. A. S. Paget, Bart. . 885
e Cavendish Laboratory as a Factor in a Counter-Revolution. By Sir Napier Shaw, F.R.S. . . . 885
ws and Views 887
r Astronomical Column 891
search Items 892
mospheric Electricity. By Dr. C. Chree, F.R.S. 894
e Formation of Lactic Acid in Muscle. By Prof. Arthur Harden, F.R.S. 895
Royal Collection of Scientific Instruments. By D.B. 896
iversity and Educational Intelligence 897
ntemporary Birthdays 898
cieties and Academies 898
ficial Publications Received 900
ary of Societies and Public Lectures 900

PPLEMENT.
trospect. By Sir J. J. Thomson, O.M., F.R.S. 41
mes Clerk Maxwell. By Sir Joseph Larmor, F.R.S. 44
rd Rayleigh. By Sir Arthur Schuster, F.R.S. . 47
J. J. Thomson, O.M., F.R.S. By Sir Oliver Lodge, F.R.S. 49
Ernest Rutherford, O.M., P.R.S. By Prof. Niels Bohr, For. Mem. R.S. 51
e Cavendish Laboratory: 1876–1900. By Sir Richard Glazebrook, K.C.B., F.R.S. 52
search Work in the Cavendish Laboratory in 1910–1918. By Prof. J. A. Crowther . . . 58

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

The New Physics.

SIR JOSEPH THOMSON is being entertained to dinner at Cambridge to-day on the attainment of his seventieth birthday. The event is one in which all who are concerned with scientific progress would desire to be associated in congratulatory expression, though only a limited number of friends are participating in the actual celebration. We are therefore devoting the main part of this week's issue of NATURE, as well as the whole of the special Supplement, to articles on the Cavendish Laboratory and its directors, with particular reference to Sir Joseph Thomson's work and influence. It would of course have been easy to obtain hundreds of appreciative messages for publication on this occasion, but in inviting such expressions of congratulation, we limited ourselves to some distinguished men of science abroad who have carried on research in the Cavendish Laboratory or have devoted themselves particularly to investigations along lines which started there. We are proud of the opportunity of publishing the tributes of affection and esteem received in response to our invitation, and we are sure that they represent the feelings of the whole scientific world.

When, in 1879, the late Sir William Crookes showed his beautiful experiments on the properties of what he called radiant matter, he could scarcely have foreseen the immense importance which such experiments were destined to assume before the close of the century. Nor could he then have suspected that the Cavendish Laboratory, inaugurated in 1874, would become the focus of the world's researches on pure electricity.

The influence of Cambridge upon electrical science since the foundation of the Cavendish Laboratory and the chair of experimental physics, has been unexampled and unrivalled. Glasgow through Kelvin, Leyden through Lorentz, Liverpool through Lodge, Manchester through Moseley, and Berlin through Helmholtz, Planck, and Einstein, have made great contributions to electrical fact and theory, but the galaxy of talent which has followed in the footsteps of Maxwell on the banks of the Cam must surely be generally acknowledged as the finest team yet engaged in the elucidation of a special branch of physics.

The importance of the work of Clerk Maxwell lay in the unification of two disciplines—those of light and of electricity respectively. It passed through several phases, in which the ultimate analysis of the phenomena then known was based upon more or less mechanical models with an underlying conception of essential continuity. Such continuity was a legacy of Faraday's recognition of the importance of the medium across which electric and magnetic forces are transmitted.

It lent a new significance to the conception of a luminiferous ether, and although the idea of a grainless continuum must always have presented certain philosophical difficulties, there is no doubt that it had a considerable heuristic value both in optics and in electromagnetism.

It does not detract from the great tradition of the Cavendish Laboratory that Sir J. J. Thomson's most noteworthy achievements have pointed in the opposite direction. His discovery of the electron in 1897 brought about a fundamental change in the ultimate conceptions of physical science. How radical was that change can only be realised by those whose electrical training took place in the 'eighties. Their preoccupation then was with the vectors and stresses in the electromagnetic field, with mechanical and hydrodynamical analogies, with sources and sinks, with the slip of lines of force on a conductor. Instead of all this, the new science of physics gives us electrons and positive nuclei, ionisation in gases, in liquids, and in solids, the emission of 'naked electricity' from hot wires, the collapse of electronic orbits, and the discrete structure of energy. Could a revolution be more complete; and the revolutionaries are the successors and disciples of the man who conceived the continuous electromagnetic ether and identified it with the all-pervading vehicle of light!

Nor can any one deny that this change of front has been exceptionally fruitful. The arch-revolutionary himself, who is now the revered Master of Trinity, devised the most powerful method of chemical analysis yet known, that positive-ray method which in the hands of Aston has brought about a new era in chemistry and shed a flood of light on the constitution of the atom and the true meaning of atomic weight. It has revealed the underlying unity of chemical substances, and has justified the bold guesses of Prout and Crookes, both of whom contended that all substances are derived from the same fundamental substance.

The Cavendish Laboratory, though one of the oldest of physical laboratories, is by no means the best equipped. Many of the new universities can boast of a better provision of expensive and up-to-date apparatus, and a few of them are far better designed. The more powerful electrical corporations, both in Europe and America, have magnificently equipped research laboratories. But tradition counts for much, even in pure science, and the habitual cultivation of science for its own sake imparts a breadth of outlook and of enterprise which is foreign to institutions working under a perpetual utilitarian effort.

We may confidently expect that Cambridge, under the guidance of Sir Ernest Rutherford, will regard the complete elucidation of atomic structure as its main function; and this elucidation may produ
some very unexpected results. For no one can s
that physical conceptions have settled down into
groove, as they seem to do after some revolutio
Quite the contrary. For the science is actually in
state of acute crisis. Never has its instrumental pow
been greater, but each new method of research see
to lead us to new and formidable problems. Einstei
conceptions of the universe as a four-dimensio
manifold of space and time have gained ground rapidl
especially since the corroboration of his astronomi
predictions by photographs taken during total sol
eclipses. They have gained ground in spite of t
greatest reluctance of the older physicists to give
their Newtonian principles. They have won the d
in spite of several serious and fundamental modificatio
introduced by Einstein himself in his original argumen
These modifications have not cancelled his main thes
and time is no longer independent of space, or spa
independent of time. Gravitation is a form of inerti
and produces a sort of kink in space impossible
conceive and impossible to formulate in terms
ordinary geometry. No wonder there are still so
physicists of the old school who think that th
cherished science has gone awry, and have given
all theorising in the expectation of better days.

Another powerful German challenge to accept
views came from Max Planck, whose conception
'quanta' of energy has been more readily accept
than relativity, solely because we happen to live in
era which looks for discontinuous structure everywhe
If the value of a physical hypothesis is to be measur
by the extent of the field covered by it and by
success in connecting phenomena previously isolat
then the quantum hypothesis must be accorded a ve
high rank indeed. For it provides a link betwe
such hitherto unrelated things as specific heat, atom
volume, photoelectricity, series spectra, and the dec
of radioactive substances. Even if it were not tr
it would deserve to be so, and it might be adjudg
ben trovato on account of its quickening effect up
research. Much remains to be done, however, befo
the new views have been linked up with the o
A multitude of questions remain to be solved. If
energy is transferred in discrete quanta, what is t
nature of such a quantum? What is its form
structure while it is on its way from one materi
system to another? Is it a wave-train? And if
what is it that undulates?

The physical theories prevalent in 1870 would ha
unhesitatingly ascribed the undulation to a fix
ether resembling in many respects a stiff jelly, b
otherwise permeable to ordinary matter. Twen
years afterwards, an incompressible continuum havi

many analogies to water would have occurred to most physicists when asked to provide (as the late Lord Salisbury asked them in his presidential address to the British Association at Oxford in 1894) a nominative case to the verb 'to undulate.' Einstein's 'gesture of despair' in renouncing all hope of ever discovering a phenomenon which would exhibit the ether drift demanded by many ingenious experimental arrangements led to a widespread abandonment of all ether hypotheses, on the plea that a substance the existence of which could not be proved might as well not exist at all.

The generalised theory of relativity more recently formulated by Einstein does, in effect, re-introduce the ether as the bearer of gravitational and electromagnetic energies, but it is an ether which remains inaccessible to any analysis based upon the classical mechanics. The same defect—if it is a defect—attaches to Niels Bohr's beautiful model of the hydrogen atom consisting of a positive nucleus with its valency electron in one of several possible orbits. The change from one orbit to the next is attended by the emission or absorption of one energy quantum, the value of which is in exact proportion to the frequency of the radiation. This model has been completely successful in explaining the spacing of the spectrum lines of hydrogen, but no one can say why the model should be so constituted. Attempts have been made, notably by Schrodinger, to formulate a new system of mechanics, provisionally called 'undulatory mechanics,' which shall be founded upon atomic phenomena rather than upon those large-scale observations which since Galileo have provided the foundation for mechanical hypotheses.

All this, however, is yet in embryo. Practical physicists concern themselves less with theoretical foundations than with the applications of a ready-made hypothesis which appears to provide a valuable guidance through unexplored mazes; and so they try the new weapons furnished by the quantum theory on all sorts of things, the excitation of line and band spectra, catalysis, photochemistry, X-rays, heat radiation, absorption spectra, and countless other matters. Some of them even attempt to count the quanta emitted by a feeble radiator by allowing them to impinge upon a fine metallic point and observing the photoelectric flash produced. Such experiments, first initiated by Geiger, will no doubt be followed up soon. The human eye, gazing upon a sixth-magnitude star, receives several hundred quanta per second. It is just possible that its insensibility to anything below that brightness is the result of a long evolutionary adaptation. For the utility of vision must depend upon the constancy of the visual impression of a point fixed in space, and an eye provided with a much greater sensitiveness would defeat the object of vision by revealing discontinuities in the light itself, due entirely to its discontinuous structure.

There is little doubt that practice will rush ahead of theory. The conception of a magneton or elementary magnetic moment, first advanced by Weiss and Langevin, has been elaborated by Bohr on the basis of his hydrogen model, and may yet do for magnetism what the electron has done for electricity. But experimentalists appear to be content with the slenderest guidance by hypothesis. They are tackling the constitution of crystals, the refraction and dispersion of Röntgen rays, and the artificial disintegration of the atomic nucleus without pausing to ask themselves for a clear conception of what they are doing or whither their results will lead. If we may follow Jeans in his graphic exposition of conditions in the distant bowels of space, we may rest assured that the most astounding discoveries made in our laboratories will fall short of those hidden in the interiors of distant stars and nebulæ, where unknown elements heavier than uranium are generated from unknown power sources, where substances have densities amounting to tons per cubic inch, where matter dies in a burst of radiant energy, and is born again by a process as mysterious as time itself.

The younger generation of physicists may well be envied. So far from being confined in their discoveries to the 'third decimal place,' they have before them an untilled field in which the transition from the apparently unknowable to the knowable, and from the knowable to the known, is not only rapid, but is also undergoing a constant acceleration.

A Half-way House of Science.

Tierpsychologie: vom Standpunkte des Biologen. Von Prof. Dr. Friedrich Hempelmann. Pp. viii+676. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 36 gold marks.

THE rival camps of mechanists and vitalists have been struck, the contending parties have advanced to meet one another, holding out the 'right hand of fellowship,' and are jointly engaged in constructing a half-way house, a shelter for those who wander on the path between biology and physiology. Here, in this shelter, the teaching of the school of animal psychology and its new technique can be imbibed. Its fundamental study has commanded attention, since interest in the phenomena of living matter was first aroused, but its establishment as a science is of recent date, and is at present much handicapped by the incompleteness of the physiological record of structure and function. The *Sturm und Drang* period in the history of science is now passed, and a stage entered upon where the accumulation of knowledge by careful individual effort adds stone after stone to an ever-growing structure. The *Zeitgeist* seems to call for a survey of the work done on animal psychology, and with this object in view Dr. Hempelmann prepared his book. A glance at the exhaustive bibliographical section will show at once with what thoroughness and conscientiousness he has attacked the work.

The physiological aspect of the subject is necessarily of primary importance, and as an assemblage of such data alone the book would be valuable. Dr. Hempelmann points out that it is useless to compare the nervous systems of invertebrates and vertebrates structurally, for too many branches have been lopped off the evolutionary tree and lost. Functionally, it is possible to adopt the human brain as a criterion, and given that it functions as a centre for (1) the summation of stimuli, (2) associative thought and memory, (3) initiation of spontaneous behaviour, (4) maintenance of muscle tone, (5) reception of sensory stimuli, to trace these functions back to their earliest appearance, collectively or singly, in simpler animal forms.

The first section of the book is devoted to these considerations. The experimental work done on the various phyla of the animal kingdom is collected here and reviewed, and immediately, while dealing only with the Protozoa, the complexity of the problem becomes apparent. Even in the Amœba it is impossible to discriminate between 'cause and effect'; the reactions of the animal are indirect, *i.e.* external stimuli induce internal changes in the protoplasm, and these in their turn produce visible reactions. These internal protoplasmic changes are also variable owing to nutritive and respiratory mechanisms, yet continuous adjustment enables the habit and behaviour of the animal to remain constant, not only in one individual, but also throughout successive generations.

Increasing complexity of structure enables the ciliate and flagellate Protozoa to exhibit an increasing variety of reactions. There is no power of discriminating between stimuli, since they automatically exhibit the whole sequence of reactions, until a suitable one is arrived at, even after continued stimulation in the same way. This method of 'trial and error' (Lloyd Morgan) results in increased efficiency of reaction which, according to some workers, may indicate the glimmerings of very primitive memory, but is more generally interpreted as being due to greater power of automatic co-ordination.

Dr. Hempelmann urges the importance of applying Loeb's theory of tropisms only in its strictest sense. Response to stimuli, being explained as a chemical reaction, presupposes the organism to be either unicellular or else of very simple structure. Higher animals, with greater complexity of structure, cannot be said to exhibit tropisms in the true sense of the word.

Clearly, then, to the simplest animals, their external life must consist of those things in the environment which stimulate the senses. The reactions which this environment calls forth in the nervous system depend on the degree of complexity of structure. These reactions, together with the internal physiological processes which they invoke, constitute the inner life of the animal (V. Uexküll). With the development of a head, and the concentration of ganglionic masses in this region, as in worms, higher control of these reactions probably comes into existence, and with the appearance of an elaborate eye, as in the Cephalopoda, calculated movements can be made. The exact significance of perception cannot be gauged—as V. Uexküll remarks, it is impossible to determine whether the animal perceives an external world of light-spaces and dots, or a cerebral world of water, land, etc.

The great specialisation of the body in the Insecta has led to a corresponding specialisation of the nervous system. All action is still instinctive, although great plasticity is displayed, which gives the appearance in some cases of controlled action. Recognition of objects, and hence memory, is shown by the homing powers and activities of bees, etc.

Associative thought, power of recognition, and memory are manifested by vertebrates to a varying degree, and above the Amphibia, purposeful action, *e.g.* as in the search for food, is met with. The warm-blooded birds and mammals appear more active and have a greater range of plastic instincts, which leads to a highly developed associative memory.

The effects of domestication are sometimes advantageous, sometimes disadvantageous to the animal. Instinctive reactions are part and parcel of the type of animal body. A greater or less power of co-ordination of sensory impressions with body movement constitutes the degree of education and stimulation. Certain reactions will be found to be an actual structural impossibility for some animals to perform, and these animals are probably judged as being 'less intelligent' than others more plastically designed. Dogs, if possessed of fore-limbs like a monkey, would probably prove more teachable, although the process might be a slower one. Apes lack application and are easily deflected from the business in hand; but they learn to do a thing suddenly, and after that generally perform it correctly. It is questionable whether this lack of application does not indicate a more marked individuality, and is, hence, a sign of greater mental development or of higher consciousness.

The question of higher consciousness is dealt with, in comparison with the psychology of man, in the econd part of Hempelmann's book, and involves much epetition of what has gone before. This division of he subject into what might be termed the mechanistic and vitalistic aspects does not make for clearness or brevity, and the first special section would have been more appropriately included under the sub-headings of the second general section. In the present state of our knowledge we are not in a position to attempt to discriminate sharply between instinctive and controlled behaviour, as Dr. Hempelmann remarks. Yet from the arrangement of his book this is what he would appear to wish to do. As a result, the information is scattered, and the index does not help very materially in its co-ordination.

Such problems as the homing instinct, sense of numbers, 'thinking animals,' and so forth, are discussed. The explanation in the case of the first two probably lies in the recognition by the animal of the 'look of the thing,' and in its perception of some expression, conscious or sub-conscious, on the part of the master in the last case. Bühler's suggestion that a slight sense of time is developed in predacious animals, since they are able to judge the interval which elapses between disappearance and reappearance of their prey behind trees, etc., is an interesting one.

The subjective side of animal life can only be examined by analogy with that of man. Even the primitive sensation, pain, with its corresponding emotion, fear, cannot be accurately gauged. How much reaction is due to the stimulus, and how much is due to the inherent excitability of nervous tissue, it is impossible to say. The Arthropoda appear insensible to pain and continue their avocations though seriously maimed, and frogs exhibit ordinary 'pain' reflexes when the higher nerve centres have been destroyed. The sensation of pain is usually associated with the 'free' nerve endings in the skin of higher vertebrates, birds, and mammals. Ziegler denies its existence as a separate sensation, and there is difficulty in distinguishing between the touch and pressure centres, etc., in the skin. V. Uexküll, on the other hand, regards it as a biological necessity, having a definite place in the scheme of things, while Plate believes it is primitively developed in the Metazoa. Research shows that the physiological occurrences which accompany sensations and emotions in man occur similarly in animals. In man, these sensations are regarded as manifestations of higher consciousness, and though we must credit their similar occurrence in animals, we may be far from allowing the latter a similar possession of consciousness. Only the higher vertebrates show signs of this, and then only by analogy with man; yet it is impossible to say what processes are lacking to make its presence dubious.

Physiological occurrences, as at present understood, do not explain all the phenomena of living matter, and this realisation is at the root of vitalistic theories, which postulate some extra force or factor, entelechy, élan vital, cell intelligence, and so on. Since man is conscious of the possession of a directive will, he tends to see manifestations of the same force among the animals. As Dr. Hempelmann points out, this introduces the danger of anthropomorphism into the subject. In the words of the Chinese story: "'How delightfully the fishes are enjoying themselves!' exclaimed Tschuang-Tse, while walking on the bank of a river with Hui-Tse, who rejoined: 'You are not a fish; how do you know that the fishes are enjoying themselves?' 'You are not myself,' returned Tschuang-Tse, 'how do you know that I do not know that the fishes are enjoying themselves? I know because of my own pleasure in the water.'"

Helene E. Bargmann.

Alchemy and Mysticism.

The Secret Tradition in Alchemy: its Development and Records. By A. E. Waite. Pp. xxii+415. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 15*s*. net.

THERE are two varieties of alchemical literature, which may be roughly described as mystical and practical. The former employs the terms of alchemy in a figurative sense in the attempt to convey the ineffable, to picture the soul's progress along the Way, and to delineate the states of ecstasy which are common to the mystics of all nations and religions. The practical books, on the other hand, are exactly what they profess to be, namely, text-books of chemistry in which the principal theme is the transmutation of the metals. If this were all, there would be no particular difficulty in deciding to which of the two classes any given book should be assigned, and the task of the historian of chemistry—or of mysticism—would be correspondingly lighter. Unfortunately, however, the actual state of affairs is not so simple, for there is no sharp line of demarcation which divides the alchemical allegory from the text-book of chemical transmutation.

It is not difficult to understand how the confusion may have arisen, for there were two factors at work which would almost inevitably cause it. In the first place, the distinction which we now recognise between physics and metaphysics was not clearly defined in the middle ages, and Aristotle's postulation of a *Fifth Essence* afforded a convenient basis for occult speculations of all kinds. It is significant that the greatest of early chemists, Geber, was also a member of the mystical order of Sufis, then newly founded, and that mastery of alchemy was considered to be acquired by direct or indirect inspiration from divinity itself. Secondly, the belief that lead, tin, and the other base metals were diseased or imperfect forms of gold and silver which could be cured or perfected by elixirs soon led to an exaggerated idea of the supposed powers of the latter. Besides healing the metals, why should they not be able to cure man of his bodily infirmities, since man is composed of the same four elements combined in a not very dissimilar way? We do in fact find that, even so far back as Geber, the medicine of metals is also the medicine of man, which will cure him of all disease and restore him to that state of equilibrium which is health. From this stage to the final conclusion that there must be a spiritual alchemy which would do for the soul of man what the most noble elixir did for his body, was but a short step.

The outcome of this intricate interweaving has been that chemists have tried to read experimental facts into allegorical descriptions, and have failed, and that students of mysticism have tried to read allegory in laboratory notebooks, and have succeeded. In other words, a school of thought has arisen which claims that all alchemical books, not merely a section of them, deal with spiritual alchemy, and that to interpret them in their literal sense is to go astray. It is very difficult to understand how such a position can be seriously maintained, but we should perhaps not be unduly surprised that it has been taken up when we remember the 'Bacon-is-Shakespeare' thesis and the occult interpretation of the Great Pyramid.

It is, therefore, with genuine pleasure that we welcome Mr. Waite's book, in which he has set himself the problem of ascertaining as conclusively as possible the grounds upon which the extravagant claims just described are based. No one could be more fitted for the task than Mr. Waite, whose knowledge of occult literature of all kinds has probably never been surpassed, and who will certainly not be accused of undue bias toward the literal interpretation of alchemy. "The transmutation of metals *per se*," he says, "is no concern of mine; but it has been said that great secrets of the soul are hidden under veils of *Chemia*; that they are of a kind which called for concealment in those persecuting days when the literature came into being; and that even now—when things are proclaimed on the housetops which used to be whispered in crypts—it is impermissible to speak of them openly because they are liable to abuse."

It is clearly of great importance that the question should be settled one way or the other, for if alchemical treatises are nothing more than rhapsodies of the mystic, the historian of chemistry is wasting his time when he investigates them. Hence, although the answer Mr. Waite gives may be guessed beforehand—since according to the mystical school, chemistry must have sprung into being fully armed at some undetermined period—he has done good service in exposing the pretensions to a searching and ruthless criticism. He first examines the alchemical literature of the Greeks, Byzantines, Syrians, Arabs, and Persians, and shows that, obscure though the language and vocabulary may be, the subject matter is definitely concerned with physical, metallic transmutation or with such technical matters as dyeing, metal-working, and the like. Marvellous medicinal properties of elixirs are mentioned less frequently, but that alchemy was undoubtedly a branch of contemporary natural science is demonstrated with an unassailable logic. Medieval Latin alchemy, in the cold light of this analysis, yields the same results.

According to Mr. Waite, it is only with Heinrich Khunrath (1560–1605) that the mystical variety of alchemy definitely began. Khunrath, he says, "is concerned solely with an *itinerarium mentis in Deum*, and because he was an alchemist he used things seen, imagined, or reported in the process of the Stone to illustrate—as he understood them—the states and stages of the soul's ascent upward. To adopt popular terms, it follows that the *Amphitheatrum Sapientiae Aeternae* is a Book of Divine Alchemy, and it is of great importance, not only because the physical aspects of the Art dissolve continually and are intended to merge in the spiritual, but most especially because it is the very first of the kind." The well-spring and fountain-head of spiritual alchemy was Jacob Boehme, who began to unfold his revelations in 1610, by which time physical alchemy was about to merge into chemistry proper. The later developments of the fashion set by Khunrath and Boehme need not detain us; no historian of chemistry has ever been misled by them, and their study belongs rather to occultism than to the history of science.

Mr. Waite has, in short, finally and irretrievably demolished the fantastic thesis set up by Mrs. Atwood and others, and has proved beyond refutation that early and medieval alchemy was almost entirely concerned with physics or physic. Our only criticism is that he has perhaps overstated his case in referring the origin of spiritual alchemy to so late a date as that of Khunrath, for the great mystic of Islam, Al-Ghazzali (died A.D. 1111), had already applied the terms of alchemy to the life and progress of the soul, though in such a way as to cause no confusion to any one except him who set out to be confused.

E. J. HOLMYARD.

John Barleycorn.

The Barley Crop: a Record of some Recent Investigations. By Dr. Herbert Hunter. Pp. viii+166. (London: Ernest Benn, Ltd., 1926.) 10*s.* 6*d.* net.

THIS little book serves to illustrate a thesis which frequently finds expression in this journal—that science embraces more than the mere ascertainment and enunciation of the laws of Nature: it connotes a logical system universal in its application. When in 1900 the Irish Department of Agriculture, in association with a leading firm of brewers, set out to solve the problem of what is the best barley to grow in Ireland, they attacked it scientifically. They cleared the ground of so-called practical opinions depending, as they do so often, on irrational ideas and traditions, and from the outset employed the tools upon which, as Kelvin once declared, all accurate scientific work must be founded, namely, weighing and measurement.

After upwards of twenty years of careful work, a variety of barley was found which can be proved to be best, and, as a matter of fact, it now occupies 90 per cent of the total area under the crop in that country. It is a further tribute to the value of scientific work that the variety of barley in question was ultimately made 'according to plan' by the application of the discoveries of Mendel to the problem. The author of the work under notice, Dr. Hunter, to whom the credit of the final achievement is due, has an interesting story to tell, and it is a story with a lesson for the plant-breeder and administrator with a definite economic object in view; a lesson, moreover, learned and practised in other countries which (like Ireland in pre-War days) possessed a Government ready to adopt the teachings of the scientific worker.

The finding and making of a super-barley followed what is now a well-trodden path: first, the recognition that the age-old varieties of the farmer are populations of various genetic types; the isolation of pure lines by propagation from a single plant; and, finally, the crossing of two pure lines in order to effect an exchange of desired characters. The first ten years were spent in isolating a pure line of "Danish Archer" barley as the best of existing types, giving both yield and quality, but possessing a weak straw: the next five in extracting the stiff straw from "Spratt" barley, transferring it to "Archer" and building up a stock of seed, starting again, be it noted, from a single plant. In the end, as already noted, nearly 100 per cent. of the barley area in Ireland is now sown with "Spratt Archer." Note also that when the original plans were laid in 1900, Mendel had just been re-discovered, Johannsen's pure line had not been heard of: scientific methods were the only guide.

There was much the same story to tell in noticing Mr. A. Howard's book on "Crop-Production in India," and there also the plant-breeder's work has been exploited by the State. As Mr. Howard has said, the making of a new variety is futile, unless some means of introducing it to the farmer can be definitely organised. Nor is it less important, as Dr. Hunter points out, to provide for a continuous flow of pure seed ever after.

A few words of criticism: Dr. Hunter does not indicate what the desired quality of barley, other than low nitrogen content, may be, or the part played by diastase in the malting process. It is not quite clear, either, what effect various manurial treatments of the soil may have on quality. In a future edition it might be well to bring the statistics of barley acreage and yield in Ireland down to a later date than 1922. Finally, a problem is suggested by the graphs of nitrogen content and yield. May it not be the case that high nitrogen content of the seed promotes vigorous growth and that, consequently, a super-excellent malting sample (within the line) is not necessarily a good mother for the resulting plant? We seem to recollect some work of Dr. Beaven (of barley fame) which suggests this query.

We must compliment the author not only on a successful piece of work, but also on the interesting account he has written of its progress and results. It should prove of extreme interest to the enlightened farmer, the professional plant-breeder, and even to the ordinary men, who, through the ages, have hymned John Barleycorn and his products! A. B. B.

Labour Policy in Education.

From Nursery School to University: a Labour Policy. Report of the Education Advisory Committee of the Trades Union Congress and the Labour Party. Pp. 93. (London: Trades Union Congress and the Labour Party, n.d.) Paper, 6*d.*; cloth, 1*s.*

THE little book which has just appeared with a foreword by Mr. Ramsay MacDonald follows lines now well understood in the matter of labour zeal for public education. It is the strongest side of Socialist policy, and all those who have experience, either official or private, with educational work, will testify that members of the Labour Party are foremost everywhere in their efforts to promote the education of the people.

Those who feel compelled to take a somewhat critical attitude will fasten on three points in the manifesto before us which give occasion to pause, if not actually to oppose the steps proposed. The first, and to most people the most serious, difficulty is dealt with in the last section of the pamphlet. It lies, of course, in the expenditure involved. The detailed proposals would raise the educational budget by about fifty per cent., making the total equal to the expenditure on army, navy, and air forces combined—*i.e.* just over a hundred millions a year. No one can on principle complain of that, but the proposition will assume a rather different aspect to a Chancellor of the Exchequer who has to raise the money from a country clamouring for a reduction in taxation, and in face of the strongly organised bodies of opinion which demand the maintenance of the other types of expenditure.

The question is, in short, a matter of the balance of public opinion which every government has ultimately to follow. The same consideration occurs when the writers point out that we actually spend more both on tobacco and on drink (separately) than the total they propose for education. Here, of course, the spending is in our own hands. We do as a nation prefer to spend all that money on smoke and drink rather than on books or pictures or going to concerts, and, so long as we do so, it is still less likely that we shall be willing for the government to take the money away from us in order to spend it on some purpose which some members of it think better.

There is another consideration of rather wider bearing which arises from the memorandum. The policy suggested throughout is for the State to do all that is wanted out of public funds. It is urged that all secondary schools should be free, and every one should be encouraged, if not compelled, to go to the State preparatory schools.

This encouragement has, as a matter of fact, become practical compulsion in some other countries, notably in the more socialist parts of Germany, but it would be, we are convinced, both a grave mistake and very repugnant to the free spirit of England. The practical problem for wise statesmanship in England is to combine State encouragement and financial help to education with the freedom of choice and teaching which we have always followed, and with the private generosity which has done so much in the past and is by no means wanting in the present.

The pure educationist will raise one more question when he reads of the hosts of new teachers who will be needed to carry out the vast extension of secondary schools and the further limitation of the size of classes. Both excellent things, ardently to be desired, but, in view of the supreme importance of good teachers, will it not be wise as well as necessary to go a little slowly?

F. S. M.

Our Bookshelf.

The Outline of History: a Plain History of Life and Mankind. By H. G. Wells. New edition, fully revised. Parts 1-24. (London: Cassell and Co., Ltd., 1925–1926.) 1*s.* 3*d.* net each part.

Mr. Belloc objects to "The Outline of History." By H. G. Wells. (The Forum Series.) Pp. vii + 55 (London: Watts and Co., 1926.) 1*s.* net.

ON the appearance of the first number we directed attention to the new edition of Mr. H. G. Wells's "Outline of History," the serial issue of which has recently been completed. The "Outline" has been almost entirely rewritten, brought up-to-date, and provided with a fresh set of illustrations—perhaps as remarkable a collection of photographs covering all sides of human evolution and history as has ever been gathered together within the covers of one book. Apart from matters of opinion, in which Mr. Wells is characteristically individual—it is emphatically Mr. Wells's outline of history—there is little even in matters of detail which requires criticism. To have mastered so vast a body of material, and to have kept abreast of current opinion on so many technical subjects, is in itself no small intellectual feat. To take an example only, he is prepared to assign the Taungs man a place in his evolutionary scheme, although this skull was discovered only while the book was in process of writing. On certain points in dealing with the bronze and iron ages, and on ethnological questions relating to the origin and migrations of races, the views adopted by Mr. Wells are open to argument, just as his views of great personalities, such as Alexander, Julius Cæsar, or Napoleon, invite or even provoke discussion. These, however, are little more than matters of detail in relation to the broad scheme of evolutionary history which Mr. Wells has set himself to expound.

To those, be they men of science or historians, who grasp the broader issues of biological and anthropological science, Mr. Wells may seem neither revolutionary nor iconoclast; but it is evident that the "Outline" has been a stumbling-block to a certain type of orthodoxy. Criticisms of Mr. Wells and his views by Mr. Hilaire Belloc have appeared in certain Roman Catholic newspapers *pari passu* with the fortnightly issue of the "Outline." Mr. Wells, having failed to secure adequate opportunity for reply in the periodicals in question, now replies in a little volume which he has issued himself. It is scarcely necessary to say that Mr. Wells's humorous, if caustic, pen makes short work of Mr. Belloc's criticisms as well as his views on the subjects of natural selection, evolution, and the ancestry of man.

Pitman's Building Educator. Edited by Richard Greenhalgh. Complete in 30 fortnightly parts. Part 1. Pp. ii + 56. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 1*s.* 3*d.* net each part.

THE aim of this publication is to cover the whole range of work embraced not only under the term 'building,' but also architecture. Modern buildings require an extraordinary range of services for which an architect takes responsibility, and the task imposed in an endeavour to cover this field, even in a work which, it is presumed, will eventually comprise some 160 pages, is no light one. Among the editor's forty contributors appear the names of a number of leading men in the architectural and engineering professions who have each taken a subject upon which progressive articles will appear in successive issues, and the editor points out that many ordinary text-books are incomplete and that certain administrative and commercial aspects of building work have been much neglected by writers in the past, which gaps it is proposed to fill.

The issues will deal with such diverse subjects as architectural design, builder's accounts, gas fitting and building law. Opinions may differ as to whether the presentation of so many subjects in articles of only two or three pages is the best method of education, inasmuch as these subjects are obviously not equally suitable for study at one particular age, but a selection of articles is suggested for the special perusal of the aspiring architect, surveyor, builder and engineer.

The work is well illustrated by photographs and cuts and well printed, but we think that the compilation which involves back references, such as an article on superintendence continued on page 31 from page 49, open to criticism. A full index is promised on the completion of the publication, which should reduce the labour of a student wishing to traverse the ground of a particular subject with the thirty parts before him.

The Evolution of the Horse. By Prof. F. B. Loomis. (The Amherst Books: Second Series.) Pp. xvi + 233 + 26 plates. (Boston, Mass.: Marshall Jones Co., 1926.) 3 dollars.

For the Mammalia the family of horses has long been the standard example of an evolutionary series. There is no doubt that of all such series it is the most completely known and that it throws much light on the manner, if not on the method, of evolutionary change in mammals. Properly to understand this change, and the theoretical arguments which arise therefrom, it is necessary that the available data should be presented in considerable detail. The majority of text-books fail in this respect from lack, no doubt, of sufficient space. A summary of what has happened in some millions of years (forty-five millions according to the present author), illustrated by perhaps a dozen examples of horses chosen from successive strata to form a gradated series, cannot give a true impression of the facts. There is, moreover, a danger of such series becoming stereotyped, and for the student in consequence to come to think that it represents the whole picture and so to remain ignorant not only of the wealth of material that has been collected together but also of the fact that the horses, so far from being a straight line of evolution, and no more, had, on the contrary, many lines adapted in different ways, some successful, others the reverse.

Prof. Loomis has contributed to our knowledge of the horses, not only by original work in the field, but also by the publication of a small book which will help in some measure to correct the mistaken views adverted to above. It should be useful in the hands of the student, and is not too technical for the layman who is interested in the subject. Within the limit of some two hundred pages the family is traced from its beginning in the Eocene period up to modern times. The twenty-six plates are good, but the text figures, while adequate, are perhaps not up to the usual standard of artistic excellence of American palæontological publications. Here and there the specialist may find a statement with which he is not in complete accord, but as a general account, Prof. Loomis's book can safely be recommended.

Tabulae Biologicae. Herausgegeben von C. Oppenheimer und L. Pincussen. Band 2: *Thermochemie, Physikalische Chemie der Fermente, Elektrizitat und Elektrochemie, Strahlenlehre, Spezielle Biophysik, Sekrete.* Pp. viii + 567 + 25 Tafeln. (Berlin: W. Junk, 1925.) 55 gold marks.

The "Tabulae Biologicae" gives in compact tabular form the data which have been accumulated by many authors in all branches of the biological sciences. In addition, information is given on certain aspects of related sciences, where knowledge of the latter is a necessary preliminary to the performance and evaluation of biological experiments: for example, in this, the second, volume, the electrical section includes data on the electrical properties of metals, dissociation constants, and the pH values of different solutions. Data are also given on X-rays, radioactivity, and the spectral energy of lights of different wave-lengths. The kinetics and conditions of activity of the different enzymes are very fully treated.

Among the other subjects dealt with, attention may be directed to the data on the special senses and the physiology of muscle and nerve: tables of the actions of drugs on the vegetative nervous system and plates of the physiological anatomy of the central nervous system are included. The composition of the following will also be found in this volume: blood, skin, the digestive secretions, lymph; cerebrospinal fluid and transudates, milk. We note a useful table of the structure of the salivary glands in different animals. Although possessing a strong Teutonic flavour, the volume may be thoroughly recommended as an extremely useful work of reference. A fairly full table of contents acts also as an index.

Die intraindividuelle fluktuierende Variabilitat: eine Untersuchung uber die Abanderung des Pflanzenindividuums und die Periodizitat der Lebenserscheinungen. Von Prof. Dr. E. Dennert. (Botanische Abhandlungen, Heft 9.) Pp. 149. (Jena: Gustav Fischer, 1926.) 7 gold marks.

Whereas most of the statistical work on fluctuations (Darwin's individual variations) has related to their occurrence in a race or species, the author has focussed his attention upon fluctuations within the individual plant. His extensive data are derived from measurements of leaves and various floral parts, as well as by counting the numbers of ray-florets in two species of Aster. The conclusion is reached that extra-individual fluctuation is a summation of the fluctuations within the various individuals and that the two phenomena are identical. The graphs in all cases betray a definite rhythm, a rise to a maximum and a subsequent fall to a minimum, but the fluctuations show slight differences in character which can be reduced to three principal types. In the final section the author concludes that the ultimate causes of this fluctuation are inherent in the protoplasm, but that its manifestation, and to some extent also its special character, are dependent on external and internal factors.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Conservation of Photons.

WHATEVER view is held regarding the nature of light, it must now be admitted that the process whereby an atom loses radiant energy, and another near or distant atom receives the same energy, is characterised by a remarkable abruptness and singleness. We are reminded of the process in which a molecule loses or gains a whole atom or a whole electron but never a fraction of one or the other. When the genius of Planck brought him to the first formulation of the quantum theory, a new kind of atomicity was suggested, and thus Einstein was led to the idea of light quanta which has proved so fertile. Indeed, we now have ample evidence that radiant energy (at least in the case of high frequencies) may be regarded as travelling in discrete units, each of which passes over a definite path in accordance with mechanical laws.

Had there not seemed to be insuperable objections, one might have been tempted to adopt the hypothesis that we are dealing here with a new type of atom, an identifiable entity, uncreatable and indestructible, which acts as the carrier of radiant energy and, after absorption, persists as an essential constituent of the absorbing atom until it is later sent out again bearing a new amount of energy. If I now advance this hypothesis of a new kind of atom, I do not claim that it can yet be proved, but only that a consideration of the several objections that might be adduced shows that there is not one of them that can not be overcome.

It would seem inappropriate to speak of one of these hypothetical entities as a particle of light, a corpuscle of light, a light quantum, or a light quant, if we are to assume that it spends only a minute fraction of its existence as a carrier of radiant energy, while the rest of the time it remains as an important structural element within the atom. It would also cause confusion to call it merely a quantum, for later it will be necessary to distinguish between the number of these entities present in an atom and the so-called quantum number. I therefore take the liberty of proposing for this hypothetical new atom, which is not light but plays an essential part in every process of radiation, the name *photon*.

Let us postulate for the photon the following properties: (1) In any isolated system the total number of photons is constant. (2) All radiant energy is carried by photons, the only difference between the radiation from a wireless station and from an X-ray tube being that the former emits a vastly greater number of photons, each carrying a very much smaller amount of energy. (3) All photons are intrinsically identical. As the molecules of hydrogen differ from one another in direction and energy of translation, and in direction and amount of rotation, so two photons, as seen by a single observer, differ in direction of motion, in energy, and in polarisation. If we were moving with rapid acceleration toward a wireless station, its photons would appear to possess increasing amounts of energy, and would pass over the whole spectral scale through the visible and into the ultraviolet. At a certain instant, for example, they would be indistinguishable from the photons emitted by excited sodium atoms. (4) The energy of an isolated photon, divided by the Planck constant, gives the frequency of the photon, which is therefore by definition strictly monochromatic; although two photons coming even from similar atoms would never have precisely the same frequency. (5) All photons are alike in one property which has the dimensions of action or of angular momentum, and is invariant to a relativity transformation. (6) The condition that the frequency of a photon emitted by a certain system be equal to some physical frequency existing within that system, is not in general fulfilled, but comes nearer to fulfilment the lower the frequency is.

The serious objections to the idea of the conservation of photons are met in a consideration of the thermodynamics of radiation and of the laws of spectroscopy. According to the classical thermodynamics of radiation, the energy of a *hohlraum* at a given temperature is determined solely by the volume. If we define the number of photons in a small spectral interval by the amount of energy in that interval divided by $h\nu$, then, by Wien's displacement law, the number of photons remains constant in any reversible adiabatic process. Also, in the irreversible adiabatic process of free expansion from a given volume to a larger volume (both with perfectly reflecting walls) the number of photons remains constant, for neither the energies nor the frequencies are changed. If the original radiation, corresponding to a definite temperature, freely expands, let us say, to sixteen times the first volume, then, according to the thermodynamics of Wien and Planck, it may be brought to a new temperature equilibrium by introducing an infinitesimal black body. Calculating from their equations, we find that in this process the number of photons is doubled. If this is so, there obviously can be no conservation law for photons. However, if we analyse carefully the thermodynamics of radiation, we find that Wien and Planck have tacitly employed a postulate which is supported by no experimental facts; namely, if an infinitesimal black body is introduced into a *hohlraum*, the radiation will come to a certain temperature, and then *no further change will ensue* when a large black body of the same temperature is introduced.

Dispensing with this postulate, and adding a new variable, the number of photons, to the variables which have previously been deemed sufficient to define the state of a system, we obtain a greatly enlarged science of thermodynamics. In this new thermodynamics, which includes as true and stable equilibria such states of equilibrium as those to which Einstein has applied the terms "aussergewöhnlich" and "improprement dit" (*Ann. Phys.*, 38, 881, 1912; *Jour. de Phys.*, 3, 277, 1913), the familiar laws of radiation and of physical and chemical equilibrium become special cases, true only for an unlimited supply of photons. Even so fundamental a process as the flow of heat must involve two factors, the amount of energy and the number of photons transferred. A fuller account of this new thermodynamics will shortly be published.

Turning to spectroscopy, we find that the principle of the conservation of photons is in obvious conflict with existing notions of the radiation process. We must assume that in an elementary process of radiation one, and only one, photon is lost by the emitting atom. Suppose that an atom which is in the 4-2 state drops to the 3-3, then to the 2-2, then to the 1-1. It thus loses three photons, but the same atom dropping directly from the 4-2 state to the 1-1 loses only one photon. If, therefore, we are to admit the conservation of photons, we must say that the atom does not pass from precisely the same initial to the same final state by the two paths, but rather that either the 4-2 or the

1-1 states, must be multiple. Even if the inner quantum number is given, as well as the total and the azimuthal quantum numbers, the atomic states must still be regarded as not completely specified. Indeed, numerous examples have been found (see the review by Ruark and Chenault, *Phil Mag.*, 50, 937, 1925) of a superfine structure which is not yet accounted for.

I had hoped to be able to derive certain familiar selection principles from the conservation of photons. Here I have not as yet succeeded, and can only state that if we assume the existence of a number of atomic states with nearly the same energy but with different numbers of photons, the new theory is not in conflict with the results of spectroscopy.

The rule that one, and only one, photon is lost in each elementary radiation process, is far more rigorous than any existing selection principle, and forbids the majority of processes which are now supposed to occur. To account for the apparent existence of these processes, it is necessary to assume that atoms are frequently changing their photon number by the exchange of photons of very small energy, corresponding to thermal radiation in the extreme infra-red. The new theory therefore predicts that many atomic processes will be inhibited at very low temperatures, and for this there seems to be some experimental evidence. But the existence of numerous extraneous factors obscures the issue. In order to simplify matters, a molecular stream might be passed through the centre of a tube cooled to a very low temperature, so as to reduce to a minimum the amount of thermal radiation. The theory would predict that in such circumstances certain processes within the stream, such as fluorescence or the emission of light from activated atoms, would be profoundly changed. Experiments in this direction are now in progress.

GILBERT N. LEWIS.

Berkeley, California,
October 29.

The Synthesis and Disintegration of Atoms as Revealed by the Photography of Wilson Cloud Tracks.

IN 1923 Harkins and Ryan developed a simple method (NATURE, 112, 54; *J. Am. Chem. Soc.*, 45, 2095) for obtaining a knowledge of what occurs when an atom disintegrates. This consisted of the use of very fast α-rays, such as those of thorium or radium-C, in a modified Wilson (Shimizu) ray track apparatus, and the photography of an extremely large number of tracks. By the use of these fast rays, about 20,000 photographs in air and 21,000 in argon were obtained. Each photograph gave two views at right angles. That Wilson's apparatus had not been applied earlier for this purpose was undoubtedly due to the fact that it had previously seemed almost hopeless to obtain sufficient photographs.

In 1925 Blackett (*Proc. Roy. Soc. A.*, 107, 349), by the use of the method applied earlier by Harkins and Ryan, obtained 22,000 photographs in nitrogen. In these, eight disintegrations of nitrogen atoms to give protons were obtained, and it was found that in rare instances a fast α-particle attaches itself to the nucleus of a nitrogen atom.

The purpose of this letter is to present the results obtained from 34,000 photographs not previously reported. These contained an average of about 14 α-particle tracks each; so that about 270,000 tracks of 8·6 cm. range were obtained.

These have given two cases in which an α-particle attached itself to a nitrogen nucleus. One of the protons was emitted in a forward direction, that is, with a component of velocity in the same direction as that of the α-particle, while in the other case the proton was emitted backward.

Fig. 1 is from a photograph which was presented to the National Academy of Sciences in April 1926.

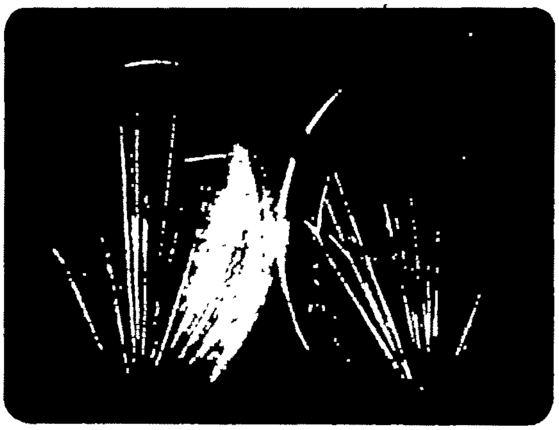


FIG. 1.—Simultaneous views at right angles of Wilson cloud tracks. In the original negative the track of the H+-particle has about one-tenth the intensity of that of the α-particle or of the oxygen of mass 17. The disintegration is shown at the left side of each of the two views, but is much more distinct in the right-hand view.

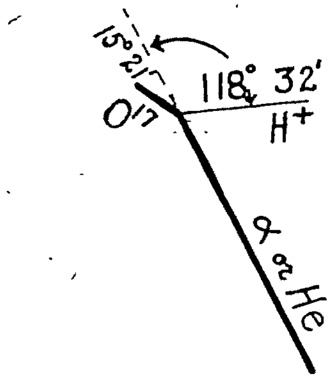


FIG. 2.—The space relations of the synthesis and disintegration exhibited in Fig. 1.

The values obtained in this case (Fig. 2) are θ, 118° 32′; φ, 15° 21′; remaining range of α-particle at time of collision, 6·3 cm.; velocity of α-particle at collision, $1{\cdot}86 \times 10^9$ cm. per sec.; initial velocity of proton, $2{\cdot}7 \times 10^9$ cm. per sec.; range of the proton, 19·6 cm., and velocity of heavy nucleus formed, $5{\cdot}3 \times 10^8$ cm. per second.

The kinetic energy after collision is 89 per cent. of that of the α-particle at time of impact, so 11 per cent of the kinetic energy is stored up in the atom (presumably oxygen of mass 17) which is synthesised.

The hydrogen track of Fig. 1 has, on the original film, only about one-tenth the intensity of the tracks produced by the helium and the oxygen. That this is actually a hydrogen track is also indicated by the fact that the visible range in the original photograph is more than three times the range for an α-particle under the same conditions.

It may be noted that we have obtained only two atomic syntheses and disintegrations in the photography of 265,000 tracks, while with the same number of tracks Blackett obtained eight similar events, which, however, the Cambridge workers consider an abnormally high number. Since we have investigated carefully every bend in the α-ray tracks, it seems improbable that we could have overlooked more than two such events.

It is of interest that the smallest velocity of the α-particle which has thus far been sufficient to disintergrate a nitrogen atom in the work at Cambridge and in Chicago corresponds to a remaining range at 15° of about 6·2 cm. Now the range of an α-particle from polonium, which was used in practically all of the early work on α-ray tracks, is only 3·925 cm. It is evident that if polonium had been used as a source, not one of the ten disintegrations thus far found would have been obtained. It was because the early work on the scintillation method indicated such a result that Harkins and Ryan changed to a source which contained thorium C′, such as thorium C, or thorium B and C.

According to Petterson and Schmidt ("Atomzertrummerung," p. 109) the α-rays from polonium liberate H-particles from aluminium, but the results cited above do not indicate this to be true in the case of nitrogen. However, it will be necessary to obtain more photographs, and to examine again those already obtained before a definite conclusion can be drawn.

A part of the measurements on the photograph (Fig. 1) were obtained by a new method, which corrects for errors in the lenses and mirrors. It is equivalent to the establishment in the ionisation chamber of a set of co-ordinates in space.

We wish to thank Mr. C. N. Shah for a considerable part of the calculations involved, and for much time spent in the examination of the films.

WILLIAM D. HARKINS.
HUGH A. SHADDUCK.

Quantum Mechanics and the Magnetic Moment of Atoms.

IN a recent paper E. Schrodinger (*Ann. d. Phys.*, 81, 1926, 109) put forward a hypothesis connecting the field scalar ψ of his undulatory mechanics with the electric density of current. His formulæ in the case of a system with only one electron (expressing j in electromagnetic units) reduce to .

$$\rho = e\psi\bar{\psi}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$j = \frac{he}{4\pi imc}(\psi \text{ grad. } \bar{\psi} - \bar{\psi} \text{ grad. } \psi), \quad . \quad (2)$$

where ρ and j are respectively the electric density and density of current. The field scalar must be normalised in such a way that

$$\int\psi\bar{\psi}d\tau = 1, \quad . \quad . \quad . \quad . \quad (3)$$

$d\tau$ being the element of volume.

Evidence in favour of the expression for ρ is given by the fact that the calculation of the intensity of emission of the atom, based on it, is in accordance both with experiment and with the results of Heisenberg's quantum mechanics. Expression (2) for j is assumed by Schrodinger as the simplest way of satisfying the equation of continuity of electricity.

It is desirable, therefore, to find some further evidence for this expression. I propose to show that it leads to the right expression for the magnetic moment of a hydrogen-like atom. We will consider only the part of the magnetic moment which, in the old quantum theory, was supposed to be due to the orbital motion of the electron, not taking into account the magnetic moment of the spinning electron, which can be considered separately.

The wave equation for a hydrogen-like atom in a magnetic field (without considering the spinning electron) was integrated by Fock (*Zeit. f. Phys.*, 28 1926, 242). His expression for ψ can be written in th form

$$\psi = f(\theta, r)e^{in_1\phi}e^{2\pi i\frac{E}{h}t}, \quad . \quad . \quad . \quad (4$$

where r, θ, ϕ are polar co-ordinates; $f(\theta, r)$ is a rea function of r and θ, n_1 is an integer correspondin to the magnetio quantum number of the old theory.

It is easily seen from (2) and (4) that j is a vecto perpendicular at each point to the plane passin through the point and the polar axis, the magnitud of which is

$$j = \frac{he}{4\pi imc}\frac{1}{R}\left(\psi\frac{\partial\bar{\psi}}{\partial\phi} - \bar{\psi}\frac{\partial\psi}{\partial\phi}\right) = -\frac{he}{2\pi mcR}n_1f^2, \quad . \quad (5)$$

R being the distance of the point from the axis. Th lines of current are circles situated in planes perpendicular to the axis and with their centres on the axis

Let us now consider the current passing throug an element $d\sigma$ of a meridian plane; its intensity is given by $jd\sigma$ and its circuit is a circle with radius R The magnetic moment of this current is therefor $\pi R^2jd\sigma$ (in the direction of the field).

The magnetic moment of the atom becomes, putting for j the expression (5),

$$\mu = \pi\int R^2jd\sigma = -\frac{hen_1}{2mc}\int Rf^2d\sigma. \quad . \quad . \quad (6)$$

The last integral can be valuated by substituting (4) in (3), and observing that $d\tau = 2\pi Rd\sigma$, we find then $2\pi\int Rf^2d\sigma = 1$. Putting this value into (6) we find at last

$$\mu = -\frac{he}{4\pi mc}n_1. \quad . \quad . \quad . \quad (7)$$

That is, the component of the magnetic moment in the direction of the field is the product of a Bohr magneton $\left(-\frac{he}{4\pi mc}\right)$ and the magnetic quantum number n_1, as it was expected.

It is noteworthy that the magnetic moment (7) arises in a certain way through the action of the field. In the absence of a magnetic field, the two states with n_1 equal in absolute value but of opposite signs, have the same energy; every linear combination of these two states is therefore a quantum state. Now it is easily seen from (4) that we can combine the two states in such a way that ψ becomes the product of $e^{2\pi i\frac{E}{h}t}$ and a real function of r, θ, ϕ (containing cos $n_1\phi$ or sin $n_1\phi$, as a factor). In this case the density of current j would vanish everywhere, and the magnetic moment would reduce to zero.

ENRICO FERMI.

Physical Institute of the University,
Rome, November 14.

Psychical Phenomena and their Interpretation.

PUISQUE une controverse courtoise a pris place dans ce journal au sujet des recherches psychiques, il me sera permis de vous adresser quelques mots au sujet de mon opinion, motivée par de longues recherches (voir mon "Traité de Métapsychique," traduit en anglais, 1925, "Thirty Years of Psychical Research").

Il importe avant tout de distinguer les faits et les théories.

Pour les faits, ils ont été, à ce qu'il me semble, établis en toute évidence, et on ne peut attribuer ni à la fraude, ni à l'erreur, ni à l'illusion, la constatation de la plupart des phénomènes. Encore, à l'extrême rigueur peut-on soutenir que les faits d'ectoplasmie, de lumières, de télékinésie, demandent quelques confirmations nouvelles. Mais quant à la télépathie, la lucidité (second sight), la cryptesthésie, la prémonition, tous phénomènes n'impliquant pas d'action physique matérielle, il y a des témoignages si abondants et si précis qu'on ne peut se refuser à les admettre. A moins qu'on ne fasse fi de la méthode expérimentale. C'est se diminuer que de ne pas les reconnaître, suivant la forte parole d'Oliver Lodge

L'expérience est là pour établir, en toute certitude, qu'il y a, à la connaissance, d'autres voies que *les voies sensorielles habituelles*.

Et c'est tout ce que je puis admettre, jusqu'à présent, comme irrévocablement démontré. Mais c'est beaucoup déjà. L'existence de ce sixième sens est véritablement un monde nouveau qui s'ouvre à nous

L'intelligence est atteinte par des forces qui lui révèlent des faits que ni la vue, ni l'ouïe, ni le toucher ne peuvent lui faire connaître.

Alors, comme l'a dit mon illustre ami O. Lodge, deux hypothèses sont en présence. Ou bien ce sont des *esprits*, les âmes des défunts qui se manifestent à nous. Ou bien ce sont des *vibrations* (de nature inconnue) qui agissent sur notre organisme.

L'hypothèse des *esprits* est quelquefois très commode et s'adapte admirablement à certains faits ; mais elle soulève des objections formidables. Je ne la repousse nullement Pourtant je ne peux guère y croire et je ne la regarde que comme une hypothèse de travail.

L'hypothèse des *vibrations* (inconnues) me paraît préférable.

Après tout pourquoi ne pas supposer que la réalité émet des vibrations ? Ne voyons-nous pas des vibrations innombrables et puissantes, comme les ondes hertziennes et les ondes magnétiques, qui ne sont décelées que par des *détecteurs* spéciaux, et qui sans ces détecteurs, passeraient inaperçues ?

A vrai dire, je me préoccupe peu de ces hypothèses. Ce qui m'intéresse passionément, c'est la constatation des faits. Or il a été démontré par Crookes, Lodge, Myers, Sidgwick, et beaucoup d'autres, que l'intelligence humaine a parfois sur la réalité (très rarement, je le veux bien), des notions que les sens normaux ne peuvent lui donner. Tous ceux qui ont méthodiquement et sans préjugés étudié cette psychologie nouvelle ont été finalement forcés de l'admettre.

CHARLES RICHET.

The Fluorescence of Superheated Mercury Vapour.

IN a letter to NATURE (April 17, 1926, p. 555) I gave a short report of experiments on the fluorescence of mercury vapour. The conclusion arrived at was that the total intensity of the visible fluorescence in saturated mercury vapour, as well as that of different bands and lines in the visible and ultra-violet part of the spectrum, is, for a given exciting light, a function of the temperature only. These results are in disagreement with those of R. W. Wood and van der Lingen (*Proc. Roy. Soc.*, 99, 362, 1921, and *Astrophys. Jour.*, 54, 149, 1921). According to these authors the fluorescence can only be excited in freshly formed mercury vapour.

Further experiments, with various vessels containing mercury vapour and different kinds of exciting light, have fully confirmed my previous results. The fluorescence does not depend on whether the saturated mercury vapour is old or freshly formed.

These experiments suggest the possibility of exciting the fluorescence in the unsaturated mercury vapour. For this purpose some experiments have been carried out. An evacuated and sealed quartz tube was used containing an amount of mercury just sufficient to fill the vessel with saturated vapour at about 240° C The vessel was heated in an electric furnace closed with quartz windows. The temperature was measured by a thermometer and a thermopile fixed to the walls of the tube in two different places. The fluorescence excited by a condensed aluminium spark was observed visually and the spectrum taken with a quartz spectrograph. With rising temperature the minute mercury droplets in the vessel disappear gradually. At about 240° C. the last droplets vanish, the intensity of the fluorescence remaining unchanged. The intensity did not change either when the vessel was heated to 355° C. or kept for several hours at some constant temperatures above 300° C. The intensities of single bands and lines of the fluorescence spectrum remain likewise practically unchanged. The appearance of the spectrum is practically the same as in the case of saturated mercury vapour at about 240° C., and this proves that, above 240° C., the vapour was really unsaturated. Indeed, for the saturated mercury vapour the line 2537 Å.U. would disappear at about 260° C., and similarly the band situated on the long wave-length side of this line at about 280° C.

Previous experiments have shown that with changing vapour density (by varying the temperature of the saturated vapour) the fluorescence changes. In the present experiments the vapour density above 240° C. was constant and the fluorescence remained very nearly constant.

These results may be summed up by saying that for a given exciting light the fluorescence of the mercury vapour depends mainly on the density of the vapour. The age of the vapour is of no importance.

HENRYK NIEWODNICZAŃSKI.

Stefan Batory University,
Wilno, Poland, October 8.

Dr. Jeans and the 'Disease' of Life.

DR. JEANS can see after himself, I feel sure; and if he accepts the statement of the writer of the note on his address in NATURE of December 4, p. 812, that in his view life is "possibly merely a disease infesting the rubbish heap in the corner" of the universe, no other interpretation can live. But as a student of life I was on the point of writing to thank Dr. Jeans not only for his masterly address, but also, most of all, for his stately and hopeful close wherein no such opinion as the above was fathered by him. Readers of NATURE can turn to the original in the Supplement to the issue of December 4 and judge for themselves. Dr. Jeans put two interpretations, in two different ways, and his final brace were: Is life of the nature of a disease which affects matter in its old age, or is it the only reality, which creates, instead of being created by? The writer of the paragraph takes the first only and fixes it as Dr. Jeans's own view. Why?

It is probably of no importance to anybody but myself to say that I welcomed the second, and have long taken it, for the simple, and I suggest scientific, reason, among many others, that matter as I see it cannot apprehend or understand me, and that I at least am able to apprehend it. I do not see why the apprehender should be subordinate to the apprehended, which, whatever its volume, does not apprehend anything, not even itself.

J. J. ROBINSON.

Barnham, Sussex.

MR. ROBINSON'S letter reveals a misapprehension which might be shared by others, and should at once be removed. The note in question was not an independent report of Dr. Jeans's article. It was a comment on the article, published in the same issue of NATURE, and intended to be read in conjunction therewith. Its purpose was to direct attention to the Supplement and to indicate its general tendency. It was obviously impossible and undesirable to mention all Dr. Jeans's suggestions about life Those suggestions, indeed, were entirely secondary to the main thesis, which was that "the primary physical process of the universe is the conversion of matter into radiation." The possible view of life referred to in the note was selected because it threw the main thesis into the strongest relief. The selection carried no implication whatever that the view was the one favoured by Dr. Jeans or by modern scientific thought. As Mr. Robinson says: "readers can turn to the original and judge for themselves." In case Mr. Robinson imagines that there has been an insidious attempt to propagate materialism in the guise of science, let me say that personally I hold the idealistic view—so strongly, indeed, as to be able to contemplate the alternative with equanimity

It may possibly save further misunderstanding if this opportunity is taken of correcting two misprints in the original notes In line 3 of the first paragraph, "contributions" should be "constitution," and in line 4 of the second paragraph, "testing" should be "tasting."

THE WRITER OF THE NOTES.

The Action of Silica on Electrolytes.

THE importance of this subject in chemistry and pedology is my excuse for a further letter in reply to that of Prof. Mukherjee in NATURE of October 9 I could wish that he had told us more as to the method by which he demonstrates 'primary adsorption,' as until it is established—and this is the point of disagreement between us—it is scarcely worth while discussing its mechanism I have now tried so many variations of the experiment in attempting without success to obtain Prof. Mukherjee's results, that I am a little discouraged, and this the more because the magnitude of the effects described in successive communications has been greatly reduced. Thus the early statement that considerable quantities of acids could be adsorbed by silica was modified by his letter in NATURE (January 31, 1925) stating that the silica used contained alkali Again, in the issue of April 4, 1925, it was stated that 10 grams silica adsorbed 42 c.c of decinormal hydrochloric acid, *i.e.* 250×10^{-4} gram molecules of acid per gram molecule of silica. But in the letter under reply, this 250 has been reduced to 1.

In the letter of January 31, 1925, it is stated that the *p*H value hydrochloric acid rose from 3·4 to 4·6 by passage through air-dried silica We tried mixing pure silica with acid of this strength and found the *p*H values to be 3·45 before and 3·46 after the addition of the silica, results well within the experimental error.

It is most desirable that this question should be settled definitely. I would willingly try further direct experiments on mixing silica with acid if Prof Mukherjee would tell me the strengths and quantities which must be taken to be sure of obtaining his results. Meanwhile, I am of the opinion that silica does not adsorb acids A. F. JOSEPH.

Wellcome Tropical Research Laboratories,
Khartoum, November 3.

"Colloid Chemistry."

REFERRING to the review of vol. 1 of "Colloid Chemistry: Theoretical and Applied," which appeared in NATURE of October 23, p. 585, three references to electrodialysis are given in the book on p. 937, ultrafiltration dialysis is treated on p. 832, and electro-ultrafiltration on p. 834 *et seq.*, where a foot-note states that Dr P H. Prausnitz' paper on electro-osmosis (Graf Botha Schwerin, etc) will appear in vol. 3 It has so many descriptions of practical applications, that it justly belongs in the volume on technology. Diffusion is, furthermore, treated in the latter part of Svedberg's paper on centrifugal and diffusion methods for the study of dispersity and hydration in sols, and in papers by Liesegang, Bradford, and Holmes; and as Liesegang says, p. 784, "dialysis is practically the same thing as diffusion in jellies, only it permits us to recognise more distinctly the processes going on inside of the membrane" It would seem, then, that dialysis has more than "casual mention in two places," and that electrodialysis is not "neglected," even though neither is given elementary discussion JEROME ALEXANDER

50 East 41st Street,
New York City, November 15

THE process of dialysis is so widely used for the purification of colloids that one would expect to find some general treatment of it in a book of this size dealing with 'theory and *methods*' Diffusion into jellies, or without a septum, is not dialysis, nor are these methods used to any extent for the removal of non-colloidal substances. Similarly, the scattered references to electrodialysis are no substitute for a systematic treatment, nor is the promise of an article, in a future volume, on electro-osmosis, which is a different phenomenon P. C. L. THORNE

The 'Bleeding' of Trees through Injury.

MORE than two years ago there was a short correspondence in NATURE (113, pp. 492 and 604) on the 'bleeding' of trees in the spring through injury. The trees especially mentioned were the sycamore and birch. It may be of interest to record the fact that the common walnut (*Juglans regia*) may be included among the 'bleeders'—at any rate, the specimen I have had under observation behaved markedly so. Casually severing a twig of this tree in mid-spring, 1925, I was a little surprised to find that sap immediately exuded. On February 1 last this tree for certain reasons had reluctantly to be felled As the walnut is late in coming into leaf and adapted to a climate warmer than Cumberland can afford it, it was scarcely to be expected that so early in the year there would have been any exudation of sap My surprise therefore was great to find such an outflow, on the application of the crosscut-saw to the base of the trunk, as to cause the sawdust to become quite moist. In addition, as the woodmen lopped off the branches of the felled tree, sap issued so freely from the cut surfaces that it could have been collected.

The tree still further astonished me, for throughout the spring, summer, and early autumn, sap exuded copiously from the stump, making the soil around quite soppy. Micro-organisms of one kind or another revelled in the exudation and gave rise to a sickly stench. This during a spell of warm weather became so obnoxious that the surface of the stump had to be cleaned, dried, and disinfected. The outflow still continued after the treatment, and appears only to have stopped through the setting-in of the cold weather of October.

I have never noticed such a long-sustained bleeding in the case of the stools of the sycamore or birch These, however, usually sucker, and the sap may be utilised in this way, thus preventing any visible outflow. The walnut stump in question has shown no signs of sending up sucker-shoots.

JOHN PARKIN.

Blaithwaite, Wigton, Cumberland,
November 18.

Sir J. J. Thomson's Seventieth Birthday.

MESSAGES OF CONGRATULATION FROM ABROAD.

Prof. E P. ADAMS,
Princeton University, N.J.

IT is pleasant to have this opportunity to express the satisfaction I feel in having had the privilege of working in the Cavendish Laboratory under Sir Joseph Thomson. Modern physics owes much to his genius; in fact, modern physics is very largely built upon the work he himself did and the ideas he furnished to the workers in the Cavendish Laboratory Under his inspiring leadership the Cavendish Laboratory became the dominant centre for physical research, attracting students from all over the world who wished to come under his influence.

In addition to his stimulating interest in all the research carried out in the laboratory, Sir Joseph's lectures contributed much to the influence that the Cavendish Laboratory has exerted upon modern physics. His wonderful facility for making his hearers feel the reality of his point of view made his lectures full of suggestions for further work, and thus they carried out the principal object of lectures, which is to make the hearers think for themselves

Here in Princeton Sir Joseph is remembered with real affection. For in 1896, at the time of the sesquicentennial of the founding of the College, he came over and lectured on the results of his latest work. He aroused great interest in the new discoveries, and in his belief, rather startling at the time, that electrons are constituents of the chemical atoms. It was largely through his influence that Profs. J. H. Jeans and O. W. Richardson came to Princeton from Cambridge. Prof. Richardson was mainly responsible for building up at Princeton, in the Palmer Physical Laboratory, a school of physical research. This is only one illustration of many that might be given of the way in which the influence of Sir Joseph Thomson has spread out far beyond the Cavendish Laboratory.

Prof S. J. M. ALLEN,
University of Cincinnati.

If we say that a prophet receives more credit abroad than at home, it is equally true that in estimating the work of a great scientist the opinion of those outside his own country may be of more critical value than even that of his countrymen. This is especially true of Sir J J Thomson. To a reputation gained in his own country, and richly deserved, has been added the unstinted admiration of his co-workers in foreign lands, especially in the United States and Canada.

A fertile imagination, and true understanding of the nature of the problem, combined with the finest experimental skill, produced results of the greatest importance, reminding one of the immortal Faraday His method of subjecting a moving charge to the combined action of electrostatic and magnetic fields, with the resulting determination of e/m, for the electron, and later for the positive ray, made his fame secure, and paved the way for the recent brilliant work of Aston on the isotopes. When the time comes to erect his monument (may it be far distant), perhaps the noblest symbol that could be placed thereon would be "e/m."

The American, or Canadian, who has had the great pleasure and honour of meeting 'J. J.' as director of the Cavendish Laboratory, or as Master of Trinity, carries back with him the remembrance of a great scholar and genial host, and gains through this association a wealth of knowledge and suggestions that are invaluable to him in his future work.

Prof. NIELS BOHR, For Mem.R.S.,
University Institute of Theoretical Physics, Copenhagen.

It is with great pleasure that I accept the invitation of the editor of NATURE to take part in the universal celebration of the seventieth birthday of Sir J. J. Thomson, to whom every one interested in the problem of the constitution of the atom is so greatly indebted. Not to speak of the leading part he has taken in the discovery of the electron as a common constituent of all atoms, we owe to him an abundance of ideas which have proved fruitful in the attempts to develop a detailed theory of atomic constitution based on this fundamental discovery. At a time when even the existence of atoms was regarded by many prominent scientists with scepticism, Thomson had the courage to venture on an exploration of the inner world of the atom. Guided by his wonderful imagination and leaning on the new discoveries of the cathode rays, Röntgen rays and radioactivity, he opened up an unknown land to science. By following electrical particles and ether-waves on their way through atoms he obtained the first estimate of the number of electrons contained in an atom and of the forces by which they were bound, laying in this way the foundation of that elaborate structure which has been built up in recent years through the joint efforts of a large number of workers. We find in his famous attempt to account for the remarkable periodicity of the physical and chemical properties exhibited by the elements when arranged in the order of their atomic weights, the germ of the ideas characteristic of the modern interpretation of the periodic table. Indeed, it is difficult for scientists of the younger generation, who are working on the new land to which Thomson has opened the gates, fully to realise the magnitude of the task with which the pioneers were confronted.

M. LE DUC DE BROGLIE,
Membre de l'Académie des Sciences, Paris.

Il suffit d'un coup d'œil jeté sur l'histoire scientifique des quarante dernières années pour voir que le développement de la physique moderne, c'est-à-dire de la théorie électronique de la matière a pris naissance quand on a compris en quoi consistait le passage de l'électricité à travers les gaz.

C'est la notion d'ionisation qui a permis d'étudier les rayons X et de découvrir la radioactivité comme c'est elle également qui a mis sur la voie des représentations actuelles de l'atome, si profondes, si fécondes déjà et si pleines de promesses pour l'avenir.

Or c'est à Sir Joseph Thomson et à ses élèves qu'est due presque entièrement l'interprétation de l'ionisation des gaz, expliquée pas à pas par les physiciens de Cambridge et si objectivement mise en évidence par l'un d'eux, le professeur C. T. R. Wilson

Aujourd'hui encore le premier livre à mettre entre les mains de celui qui veut s'initier à la physique du vingtième siècle est la "conductibilité électrique des gaz" écrit par le chef et l'animateur du Cavendish Laboratory. Il y a peu de temps, en en voyant une récente édition j'admirais combien la plus ancienne avait été merveilleusement composée pour avoir été si peu modifiée par les travaux des vingt-cinq années les plus actives de la physique électronique. Sir Joseph Thomson avait tracé un cadre si parfait des nouvelles perspectives de la science que les progrès ultérieurs de celle-ci semblent n'avoir été que le développement et l'achèvement des divers chapitres de son ouvrage. La part personnelle prise par l'ancien chef du Cavendish Laboratory, tant au point de vue théorique qu'expérimental dans toute cette partie de la physique, et le couronnement plus récemment apporté par la découverte fondamentale des spectres de masse des corps simples lui vaudront la gloire difficile d'inscrire sans crainte son nom à côté de celui de ses illustres prédécesseurs.

Le titre auquel a droit le très grand savant que l'on honore aujourd'hui est peut-être le plus beau que puisse ambitionner un homme de science et de génie: il a été le guide et le flambeau de toute une génération de physiciens qui portent aujourd'hui les noms les plus illustres de la science actuelle et son influence se fait sentir maintenant sur les élèves de ses élèves.

Toutes les nations du monde envient le Cavendish Laboratory pour son passé comme pour son présent.

Prof. D. F. COMSTOCK,

Massachusetts Institute of Technology, Boston.

On the occasion of Sir Joseph Thomson's seventieth birthday, will you allow one of his old students, who long since strayed from physics into the field of engineering research, to express his congratulations and to acknowledge gratefully a many-sided debt to him?

I went to the Cavendish for the purpose of absorbing, if possible, a little of his vision, a little of his way of looking at problems which were still nebulous; and through his kindly patience with the immaturity of a young student, I absorbed as much of this subtle influence as my capacity would allow. Whatever originality I may have shown through the intervening years is traceable in no small part either to his direct influence at that time or to his writings before or since.

I know that many, who are not primarily physicists, have benefited by this extraordinary power of Sir Joseph's to stimulate the originality of others, and because of this characteristic of his genius, his influence has spread far beyond the confines of pure physics.

I know that I am expressing the feeling of industrial research workers in general when I gratefully acknowledge our obligation to Sir Joseph not only for the new truths of Nature which his researches have uncovered, but also for the subtle stimulus which comes even from his writings and makes research work in any field happier and more successful.

Mme. CURIE,

Radium Institute, Paris.

Sur la demande de M. l'Éditeur de NATURE, il m'est agréable de m'associer à l'hommage rendu par le monde scientifique à M. le Professeur J. J. Thomson dont j'apprécie hautement l'œuvre, aussi bien pour la profondeur et l'originalité des vues théoriques que pour l'important ensemble de recherches expérimentales. Sans essayer d'envisager toute la variété des travaux de Sir J. J. Thomson, je désire rappeler que nous lui devons un grand nombre de résultats fondamentaux relatifs à l'étude des particules chargées, molécules, atomes et électrons. Parmi ces résultats, nous trouvons les premières déterminations de la charge élémentaire et du rapport de la charge à la masse pour l'électron, ainsi que la première notion de la masse électromagnétique. Non moins riches en conséquences sont les recherches de Sir J. J. Thomson sur les rayons positifs et l'interprétation si sûre qu'il en a donnée, conduisant à une nouvelle méthode d'analyse chimique qui est applicable à de très petites quantités de matière et dont on connaît le succès dans la généralisation de la notion de l'isotopie.

Le nom de Sir J. J. Thomson est souvent prononcé dans les laboratoires de physique, plus particulièrement dans ceux qui se consacrent à l'étude des particules portant une charge électrique et à celle de leur mouvement. C'est là un des problèmes qu'on aborde fréquemment dans les laboratoires destinés aux recherches sur les phénomènes radio-actifs—et c'est à ce titre que j'ai plaisir à exprimer à Sir J. J Thomson ma gratitude pour l'importante contribution scientifique représentée par ses travaux personnels ainsi que par ceux qu'il a inspirés et dirigés.

Prof. GEORGE E. HALE, For Mem.R.S,

Mount Wilson Observatory, Pasadena, California.

I have always felt the exceptional stimulus of two great English laboratories, which for generations have maintained positions of leadership because of the men who have worked in them. The Royal Institution, dating from the time of Rumford and Young, is rich in traditions for the astronomer scarcely less than for the physicist. But in these days, when cosmic experiments are so frequently necessary to test the tenets of relativity or the ultimate consequences of theories of matter, we who devote ourselves to astrophysical research perhaps feel an even greater indebtedness to the Cavendish Laboratory. What a lineage of directors it holds before us—Maxwell, Rayleigh, Thomson, Rutherford! Among these we must attribute chiefly to Thomson its advance to an international position as a centre of research.

I remember with special pleasure my frequent visits to Cambridge, in peace and war, and the never-failing inspiration of my talks with Sir Joseph. It has been a great privilege to watch the growth of his ideas and to see the vacuum tube transformed under his hand from a coiled spectacle for the curious to a powerful instrument of research. He was among the first to explain the presence of charged particles in the sun, and in many other ways he has placed students of astrophysics under obligation. I am personally indebted to his writings for more than one basic suggestion, and I appreciate no less his encouragement during my efforts to extend the use of laboratory methods in astronomical observatories. I am, therefore, pleased to be permitted to join in warm congratulations to Sir Joseph and the Cavendish Laboratory on the occasion of the celebration of his seventieth birthday. I can offer no better wish than that the splendid successes of the past may continue through a long and happy future.

Prof. CHAS. T. KNIPP,

University of Illinois, Urbana.

Sir Joseph Thomson's influence reached the central of the United States during the early 'eighties. I remember distinctly, a decade later, as a pupil in a small county seat high school in north-western Ohio, that our teacher in 'natural philosophy' directed the attention of the class to a possible new theory of the structure of matter proposed by Prof. J. J. Thomson, of the Cavendish Laboratory of physics at Cambridge, England. This reference was to his vortex theory. The story caught the attention of the class, for we all had seen the wonderful smoke rings shoot up from the old style funnel-shaped locomotive stacks. From that time on any reference in the newspapers to Prof Thomson was eagerly sought, and almost unconsciously I became a great admirer of his ability.

A few years later while in the university, I found this same feeling of respect and admiration shared by those studying in the domains of physics and chemistry. Theories advanced by Thomson formed our topics for discussions. His discovery that the electron carries a negative charge and is a constituent of all matter, his identification of the Edison effect as due to electrons, and his later measurement of the charge and mass of the electron, were accomplishments that promptly received the commendation of American physicists and chemists. He was the leader during this the electron period. Afterwards his great contribution on the study of the properties of the elements by positive ray analysis attracted wide attention in America. Here again he was the pioneer worker and blazed the way for entrance upon the positive electricity or proton period, as it may now be called.

Nor are we in the States unmindful of Sir Joseph Thomson's brilliant conception of atomic structure, in which the various elements are represented as combinations of negative electrons and positive charges arranged as miniature solar systems—a conception that will always stand for the guidance of research on this fundamental problem.

Beginning with 1890, and continuing up to the present, the writings of no one person have had a greater influence upon the research activities in physics in American universities than those of Sir Joseph Thomson. That this statement is correct is attested by the large number of students from there that have sought out the Cavendish Laboratory for the doing of productive research. Personally, it is this high regard for Sir Joseph as a scholar, investigator, and as a gentleman, that impelled my second visit (the present one) to the Cavendish Laboratory, to engage in research and to lay claim, as it were, to his terse and illuminating criticisms and valuable suggestions.

Research in physics and chemistry in the United States owes a debt of gratitude to Sir Joseph Thomson for his marvellous record of nearly fifty years of uninterrupted original contributions. As one of many from across the Atlantic, I humbly add the foregoing as a message of appreciation of the accomplishments of an active and productive personality.

Prof. ALOIS F. KOVARIK,

Yale University, New Haven, Connecticut.

During the past as well as during the present generation, the Cavendish Laboratory has been the Mecca for physicists from all parts of the world, and we Americans owe a debt of gratitude to it for aiding and developing the spirit of research in physics in America. There is scarcely a physicist in America who has not been a pupil of Sir Joseph or else a pupil of one of his pupils. In the case of the latter, the enthusiasm for research and the high esteem for the Master came not only by reflection from those more fortunate ones who had been with the Master himself, but even in some cases with added force, for the powers inherent in his pupils were released by virtue of their contact with him. To these men Sir Joseph was made known not only as a physicist who opened the fields of electronics and of atomic structure, but also as a most congenial and sympathetic man. To them also he soon became simply 'J. J.' They seemed to learn to know him intimately even before meeting him personally on his several welcome visits to America.

Those of us who have been more fortunate and to be privileged to associate with him at one time or another, have had an increasing esteem for him not only because of the great scientific achievements which his mind made possible, but also for those things which a man likes to find in another man. Not only did he show interest in one's scientific work, but also he always showed human interest in the man himself, his friends, and the institutions with which he was connected. We all love his characteristic smile, and every one of us felt a certain pleasure within ourselves on hearing a footstep that every Cavendish man recognises as solely 'J. J.'s.'

It was my good fortune to have been a pupil of two of his pupils and to have experienced the delights from such associations, but at more recent time I had the privilege to be associated with him in the Cavendish and in Trinity—as a guest in both—and it is a pleasure to admit that my love for him, for his human and personal qualities, causes no less pleasure to me than my great admiration for his genius as a physicist.

Prof. PAUL LANGEVIN,

Collège de France, Paris.

J'ai eu la bonne fortune de commencer ma carrière scientifique par un séjour d'une année au Cavendish Laboratory, dans la période où, sous l'impulsion de Sir Joseph Thomson, immédiatement après la découverte des rayons de Rontgen et de la radioactivité, se constituait cette École de Cambridge dont l'influence a été si grande depuis trente ans sur le développement de la physique moderne.

Le plus charmant souvenir m'est resté de cette époque déjà lointaine depuis laquelle l'importance et la réputation du laboratoire n'ont cessé de grandir. Nous étions une quinzaine de jeunes gens venus de pays bien différents pour mettre en commun l'enthousiasme que leur inspirait la science nouvelle et réunis dans une commune admiration pour le jeune maître dont le rayonnement les avait attirés.

Il y avait là Brown, Child, McClelland, Henderson, Henry, Richardson, Rutherford, Shakespear, Townsend, Vincent, Wade, C T. R. Wilson, H. A. Wilson, Zeleny Nous avons eu récemment à déplorer la mort prématurée de McClelland ; celui qui est maintenant Sir Ernest Rutherford est venu diriger un Cavendish Laboratory singulièrement agrandi ; les autres sont dispersés un peu partout dans le monde. J'espère qu'un bon nombre d'entre eux se retrouveront la semaine prochaine à Cambridge pour évoquer des souvenirs et reprendre, autour du maître resté si actif malgré les années, les conversations anciennes qui s'échangeaient à l'heure du thé, dans son cabinet où nous nous réunissions après sa visite quotidienne à chacun de nous

De cette époque datent les premiers travaux de Sir Joseph Thomson sur les rayons cathodiques et la décharge disruptive. Il commençait cette admirable série d'expériences qui devait aboutir à la découverte de l'électron négatif et à la création de la méthode si féconde des spectres de masse.

Du côté théorique comme du côté expérimental, l'œuvre si personnelle de Sir Joseph n'a fait que grandir en même temps que de plus en plus nombreux ont été ceux qui, chaque année, sont venus s'inspirer de sa parole et de son exemple pour répandre ensuite sa pensée et garder entre eux des liens précieux pour eux-mêmes et pour l'avenir de la science.

Les témoignages de reconnaissance et d'admiration qui viendront vers lui à l'occasion de son soixante-dixième anniversaire montreront à Sir Joseph Thomson combien son action a été grande et combien sont fortes les affections qu'il a su rassembler autour du laboratoire illustré par lui.

Prof. THEODORE LYMAN,

Jefferson Physical Laboratory, Harvard University, Cambridge, Mass.

When I entered the Cavendish Laboratory as a graduate student in the fall of 1901, I found myself in an atmosphere of a stimulating quality which I have never seen equalled in any other place Not infrequently the influence of a great man upon his time is indirect, but Prof. Thomson not only illuminated the scientific world of the period of which I speak, but also managed to carry his students with him into his own realm of intellectual enthusiasm.

To the majority of us the prosecution of research is a laborious business ; the road is long and steep, blind byways beset us, the perversity of inanimate objects foils us. But those of us who know Sir Joseph Thomson and appreciate his genius are in a position to realise that to one whose mind is attuned to Nature the path of knowledge is neither tortuous nor laborious. The experience gained at the Cavendish remains, even after the lapse of a quarter of a century, a happy memory and a source of lasting inspiration.

Prof A A. MICHELSON, For Mem.R S.,

Ryerson Physical Laboratory, University of Chicago

It gives me sincere pleasure to add to the others an expression of my high appreciation of the magnificent work of Sir Joseph Thomson and the influence it has had on the whole field of electronics and radioactivity. No other discovery has so profoundly altered our notions of the ultimate structure of matter. I welcome the opportunity of expressing my most cordial congratulations and best wishes for the continuation of his activities for many decades to come

Prof. ROBERT A. MILLIKAN,

California Institute of Technology, Pasadena

It is not merely the group of erstwhile workers in the Cavendish Laboratory who owe to Sir Joseph Thomson the chief inspiration of their scientific careers. I speak for many who have never been students there when I say that no man living has exerted so large an influence upon my own activity in physics as has Sir Joseph It was his writing which stimulated my entrance in 1903 into the domain of photoelectric research, a domain which has been one of my chief interests ever since. It was he who inspired me so early as 1905 to try to pull electrons out of cold metals by fields alone, a research which led through all the mazes of high vacuum technique, and yielded results of importance in the direction aimed at only after ten years of effort. It was he whom I followed in making cloud experiments when I first observed, and worked with, isolated electrons. It was he who directed the thought of all of us in seeking to build atomic models based on electron configuration It was he who made the first analysis of space charge effects, who pointed out the existence of mass as a function of electric charge and showed how to compute its value. In a word, it was he who, more than any other one individual, was responsible for formulating, and gaining general acceptance for, the theory of the electronic construction of matter—an idea that is probably to exert larger influence upon the destinies of the race than any other idea which has appeared since Galileo's time.

Prof. VLAD. NOVÁK,

Technical High School, Brno.

Forty years ago little was known of British methods in physics and other natural sciences in the historic lands of Czechoslovakia Our instructors, having been taught and trained in German schools, followed German methods. The German University of Prague was divided into German and Bohemian schools in sections in 1882. The natural sciences were studied in the Bohemian Philosophical Faculty of the Charles and Ferdinand University of Prague in the first ten

BOWES, CAMBRIDGE.

DEALERS IN

SCIENTIFIC BOOKS AND JOURNALS.

Librarians and others wishing either to buy or sell

SECOND-HAND BOOKS

are invited to communicate with us.

Being in direct touch with the principal Publishing Houses on the Continent, we can also supply promptly and at moderate prices the

LATEST FOREIGN WORKS.

Special attention is paid to the requirements of Research Workers, and those interested in particular subjects can receive advice of new publications as they appear, and classified lists of new books, English and Foreign, in those subjects.

A FEW ITEMS OF INTEREST.

The Scientific Papers of James Clerk Maxwell. Edited by W. D. NIVEN. Portraits engraved by Stodart. 2 vols. 4to. Cloth. 1890. **£12 : 12s.**

Miscellaneous Papers by Heinrich Hertz. With an Introduction by Professor P. Lenard. Authorised English Translation by D. E. JONES and G. A. SCHOTT. Portrait. 8vo. Cloth. 1896. **7s. 6d.**

Consisting mainly of Hertz's earlier investigations, difficult of access and scarcely obtainable.

History of the Cavendish Laboratory, 1871-1910. With three portraits and eight other illustrations. 8vo. Cloth. 1910. Published at **7s. 6d. net,** ***now offered for* 5s.** post free. By T. C. FITZPATRICK, A. SCHUSTER, R. T. GLAZEBROOK, H. F. NEWALL, E. RUTHERFORD, C. T. R. WILSON, N. R. CAMPBELL, L. R. WILBERFORCE, with a Survey of the last twenty years by Sir J. J. THOMSON. Portraits of J. Clerk Maxwell, Lord Rayleigh, and J. J. Thomson. Issued to commemorate Sir J. J. Thomson's twenty-five years' tenure of the Cavendish Professorship.

Proceedings of the Cambridge Philosophical Society. Vols. XI. to XXI. (1923), in cloth and parts. **£9 : 9s.**

Physikalisch-chemisches Centralblatt. Complete from Vols. I. (1904) to VI. (1909). Six vols. hf. leather. **£9 : 9s.**

Physikalische Zeitschrift. HERAUSGEGEBEN VON E. RIECKE u. H. T. SIMON. Vols. IX. (1908) to XV. (1914). Buckram. **£7 : 7s.**

Other Journals in stock—particulars on application.

JUST ISSUED.

Post-Prandial Proceedings of the Cavendish Society. A Collection of Topical Verse on Modern Physics and other matters, written by Members of the Physics Research Society of the Cavendish Laboratory, Cambridge. *Sixth Edition,* with additional Poems (1926). Fcap. 8vo. Price **2s.** net Postage **1d.**

1 TRINITY STREET, CAMBRIDGE, ENGLAND.

Telegrams : Bowes, Cambridge. *Telephone :* 408

University Tutorial Press

SELECTED SCIENCE TEXT-BOOKS

Agriculture.

Chemistry for Agricultural Students. By R. H. ADIE, M.A., B.Sc., Lecturer in Physics and Chemistry, School of Agriculture, Cambridge; Examiner in Agricultural Science for the Cambridge School Certificate Examination. **5s. 6d.**

"The student of agriculture who is desirous of mastering the fundamentals of Chemistry and Physics will find no better help than this book."—*Chemical Trade Journal.*

Biology.

Text-book of Botany. By J. M. LOWSON, M.A., B.Sc., F.L.S. *Sixth Edition.* **9s. 6d.**

This text-book gives in a clear and simple manner a general survey of the science, including Angiosperms, Gymnosperms, Vascular Cryptogams, and Lower Cryptogams, with a chapter on Evolution and Genetics.

"It represents the nearest approach to the ideal botanical text-book that has yet been produced."—*Pharmaceutical Journal.*

Text-Book of Zoology. By H. G. WELLS, B.Sc., and A. M. DAVIES, D.Sc. Revised by J. T. CUNNINGHAM, M.A. *Sixth Edition.* **8s. 6d.**

A careful work on Vertebrates and Invertebrates suitable for school and college use.

"Admirably adapted for its purpose."—*Cambridge Review.*

Chemistry.

The Tutorial Chemistry. By G. H. BAILEY, D.Sc., Ph.D., late Lecturer in Chemistry at the Victoria University of Manchester. Edited by WILLIAM BRIGGS, LL.D., M.A., B.Sc., F.C.S.

PART I. Non-Metals. *Fourth Edition.* **5s.**

Section I. gives the student a thorough insight into the nature of the problems with which Chemistry deals, and a clear idea of the broad lines of chemical theory.

Section II. contains a systematic treatment of the non-metals, with suitable illustrative experiments.

PART II. Metals and Physical Chemistry. *Sixth Edition.* **7s. 6d.**

This volume contains an account of Physical Chemistry and of the Chemistry of the Metals.

"The leading truths and laws of chemistry are here expounded in a most masterly manner."—*Chemical News.*

Complete Catalogue and Science Sectional Catalogue post free on application.

University Tutorial Press Ld.,

25 High Street, New Oxford Street, London, W.C.2.

THE SIR JOHN CASS TECHNICAL INSTITUTE,
JEWRY STREET, ALDGATE, E.C.3.

Principal—GEO. PATCHIN, A.R.S.M., M.I.M.M.

ALTERNATING CURRENTS AND ELECTRICAL OSCILLATIONS

By D. OWEN, B.A., D.Sc., F.Inst.P.

A course of 10 lectures accompanied by practical demonstrations, intended for post-graduate students and those otherwise qualified to pursue this branch of electrical science and its applications in wireless telegraphy and telephony.

Tuesdays, from 7 to 8.30 P.M., commencing January 11, 1927.

ELECTROLYTIC ANALYSIS

By H. J. S. SAND, D.Sc., Ph.D., F.I.C.

A course of 5 lectures and practical work intended for analysts and others. It is also suitable as a revision class in electrochemistry for students preparing for the examinations of the Institute of Chemistry and London University.

Thursdays, from 7 to 9 P.M., commencing January 13, 1927.

ADVANCED COLLOID CHEMISTRY

By E. HATSCHEK, F.Inst.P.

A course of 10 lectures and demonstrations with the object of giving to those possessing a general knowledge of colloid chemistry the mathematical theory and a detailed account of a number of important aspects of the subject.

Tuesdays, from 8.15 to 9.15 P.M., commencing January 18, 1927.

MODERN DEVELOPMENTS RELATING TO FUEL

A special course of about 8 lectures dealing with the latest developments in connection with coal mining, carbonisation and powdered and liquid fuel, will be given by recognised experts on:

Monday evenings, 6 to 7 P.M., commencing January 24, 1927, at 6 P.M.

Details of the above courses may be had upon application to the PRINCIPAL.

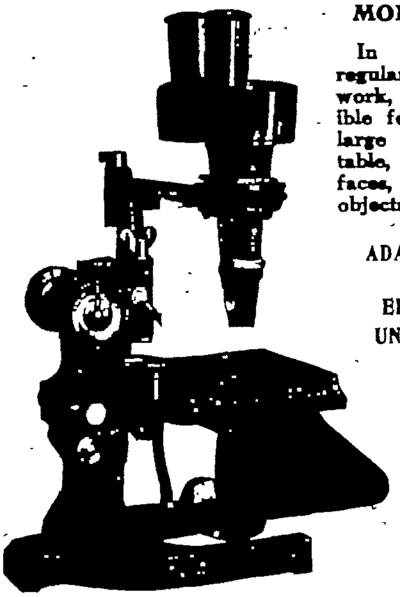
CHEMICAL AND TECHNICAL BOOKS

We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms.

Write for Catalogue.

**WILLIAM BRYCE, Scientific Bookseller,
54-54a Lothian Street, EDINBURGH.**

SPENCER BINOCULAR MICROSCOPE



MODEL 58

In addition to regular microscopic work, it is convertible for examining large objects on a table, vertical surfaces, and high objects.

ADAPTABILITY AND EFFICIENCY UNEQUALLED

MICROSCOPE LAMPS FOR ALL REQUIREMENTS

NEW DAYLIGHT LAMP

MICROTOMES THOMA-HAWKSLEY HÆMACYTOMETERS, ETC.

Catalogues free.

REPAIRS A SPECIALITY

**HAWKSLEY & SONS, LTD.
83 Wigmore Street, London, W.1.**

NEW

JENA COMBUSTION TUBES

"SUPREMAX"
(Patented)
Lowest coefficient of heat-expansion.
High softening point. Greatest durability

"DUROBAX"
(One Red Stripe)
For Explosion-Furnace Tubes

"FIOLAX" GLASS
(One Black Stripe)
For Ampoules, Phials, and
First-rate Test Tubes

"MAXOS" Plates and Discs
For Steam and Chemical Boilers

For particulars apply to the Representative:

E. O. MAEMPEL,
Finsbury Pavement House, Moorgate,
LONDON, E.C.2

or to the Wholesalers.

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals. General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact sciences, as well as sets of scientific periodicals. They invite correspondence in connection with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

J. POOLE & CO.
ESTABLISHED 1854
NEW & SECOND-HAND
SCIENTIFIC AND EDUCATIONAL
BOOKSELLERS

ENQUIRIES BY LETTER RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

JUST PUBLISHED
FARRER'S LAST JOURNEY
UPPER BURMA, 1919-20
By E. H. M. COX
Demy 8vo Pp. xx + 244. Illustrated. 18s. net, or post free 18s. 9d.
Of all booksellers or direct from
DULAU & CO., LTD., 34-36 MARGARET STREET, LONDON, W.1.

SCIENTIFIC BOOKS
AND PERIODICALS
including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

THE PRECIOUS METALS
GOLD, PLATINUM, SILVER.
SPINK & SON, LIMITED
(By Appointment)
17-18 PICCADILLY, LONDON, W.1.
Established 153 years.
VALUE, PURCHASE or ASSAY the above in any form.
Parcels can be safely sent by registered post.

Estab.] **STEVENS'S AUCTION ROOMS, LTD.** [1760

A SALE by AUCTION is held EVERY FRIDAY, at 12.30, which affords first-class opportunities for the disposal or purchase of **SCIENTIFIC, OPTICAL, ELECTRICAL, and WIRELESS APPARATUS**, Microscopes and Accessories, Telescopes, Surveying Instruments, Photographic Cameras and Lenses, Cinematographs and Films, Lanterns and Slides, Lathes and Tools, Books and Miscellaneous Property.

Frequent Sales of Natural History and Ethnological Specimens, Curiosities, etc., are also held.

Catalogues and terms for selling will be forwarded on application to 38 King Street, Covent Garden, London, W.C.2.

FROM MURBY'S LIST

Cr. 8vo. 9s. 6d. net.
SUPPLEMENT
TO AN INTRODUCTION
TO SEDIMENTARY PETROGRAPHY
By HENRY B. MILNER, M.A., F.G.S., M.Inst.P.T., Lecturer in Petroleum Technology, Imperial College of Science
With 28 species figured.

This Supplement contains much that is new in technique and made known since the publication of the original volume.

"Great advances have lately been made in that aspect of petrological research concerned with the investigation of sediments, and these are embodied by Mr. Milner in a clear and concise manner in this 'Supplement.'"—*Mining Journal.*

The original volume published in 1922,
SEDIMENTARY PETROGRAPHY, An Introduction to
by H. B. MILNER, is still on sale. 8s. 6d. net.

Royal 8vo. 6s. 6d. net.
THE IGNEOUS ROCKS
OF THE
MOUNTSORREL DISTRICT
their relationship to each other and to the Charnwood Forest area
By E. E. LOWE, B.Sc., Ph.D., with an introduction by Professor W. W. WATTS, Sc.D., F.R.S.

A survey of the rock types found in the Mountsorrel area, with full descriptions and plates of their sections, etc. Fundamental characters of great interest are displayed by the igneous rocks of this well-known locality.

12s. 6d. net
GEOLOGY
IN ITS
RELATION TO LANDSCAPE
By Prof. JUNIUS HENDERSON, University of Colorado.
. . . "may be warmly recommended in particular to teachers and students of Geography," and to those "who find in scenery one of the leading attractions of a holiday."—*Nature.*

T. MURBY & CO., 1 Fleet Lane, E.C.4

¶ W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE, will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ CATALOGUE 269. Scientific Books and Publications of learned Societies.

Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone: [illegible] (2 lines).

That Book you want!

Foyles can supply any Scientific Book that is in print and most of those that are out of print. They have a Special Department for this class of literature under a Manager who has experience and knowledge of the Natural Sciences. Call and consult him, or write and you will get an intelligent reply. Books sent on approval. Over a million volumes Second-hand and New on every conceivable subject in stock. Twenty-one Departmental Catalogues issued; any of which will be sent gratis and post free on mentioning interests.

That Book you do not want!
Foyles will buy it.—A single volume to a library.
Expert valuers sent any distance.

FOYLES, 121 Charing Cross Road, London.

MACMILLAN'S NEW AND RECENT BOOKS.

CATALYSIS IN THEORY AND PRACTICE. By ERIC K. RIDEAL, Owen Jones Lecturer on Physical Chemistry, Cambridge University, England, and HUGH S. TAYLOR, Professor of Physical Chemistry, Princeton University, U.S.A. Second Edition. Illustrated. 8vo. 20s. net.

Progress in catalytic studies since this volume was first published has necessitated a complete revision of the text and the addition of several new chapters in this second edition.

CRYSTALLINE FORM AND CHEMICAL CONSTITUTION. By A. E. H. TUTTON, D.Sc., M.A.(Oxon), F.R.S., Past President of the Mineralogical Society, London; Author of "Crystallography and Practical Crystal Measurement." With 72 Illustrations. 8vo. 10s. 6d. net.

THE MINERALOGICAL MAGAZINE —"The book is well printed and illustrated, and it gives a very clear and readable account of the subject It should be seen by all students of chemistry as well as those of crystallography."

REALITY: A NEW CORRELATION OF SCIENCE AND RELIGION. By CANON BURNETT HILLMAN STREETER. 8s. 6d. net.

THE SUNDAY TIMES.—"This is an altogether admirable book on a subject which is attracting more and more attention at the present day It is hardly too much to say that it is the best book of its kind that has been published in recent years."

MIND IN EVOLUTION. By L. T. HOBHOUSE, Hon.D.Lit., Hon.LL.D., F.B.A., Martin White Professor of Sociology in the University of London. Third Edition. 8vo. 12s. 6d. net.

Appendices on the German "Configuration Theory" and on the problem of "Instinct in Man" have been added to this new edition.

HOLISM AND EVOLUTION. By GENERAL THE RIGHT HON. J. C. SMUTS. 8vo. 18s. net.

THE MORNING POST.—"General Smuts has admittedly confined himself to an introductory sketch in the present book, but he has suggested a valuable line of inquiry which is in harmony with important currents of scientific and philosophic thought of to-day."

NATURAL MAN: A RECORD FROM BORNEO. By CHARLES HOSE, Hon. Sc.D., formerly Divisional Resident, and member of the Supreme Council of Sarawak. With a Preface by PROF. G. ELLIOT SMITH, F.R.S. With Illustrations and Map Super Royal 8vo. 30s. net.

THE SATURDAY REVIEW.—"One of the most attractive features of a fascinating book are the plates. . . . It is superfluous to congratulate Dr. Hose on his latest achievement, for it is only what was expected of him."

A SHORT HISTORY OF MARRIAGE. By EDWARD WESTERMARCK, Ph.D., Author of "Ritual and Belief in Morocco," etc. 8vo. 10s. 6d. net.

THE NEW STATESMAN.—"Those who had neither the leisure nor the courage to face the three volumes of Dr. Westermarck's monumental *History of Human Marriage* should welcome this shorter monograph."

PROJECTIVE GEOMETRY. By CLEMENT V. DURELL, M.A., Senior Mathematical Master at Winchester College. Crown 8vo. 7s. 6d.

THE MATHEMATICAL GAZETTE, in a review of the volume of which this is an abridged form, says. "The author possesses a thorough grasp of his subject, and the power of presenting it in an eminently attractive manner. . . . The book is a notable and most attractive addition to the literature of the subject."

ANSWERS, HINTS AND SOLUTIONS OF THE EXERCISES IN SAME. Crown 8vo. Limp Cloth. 2s. 6d.

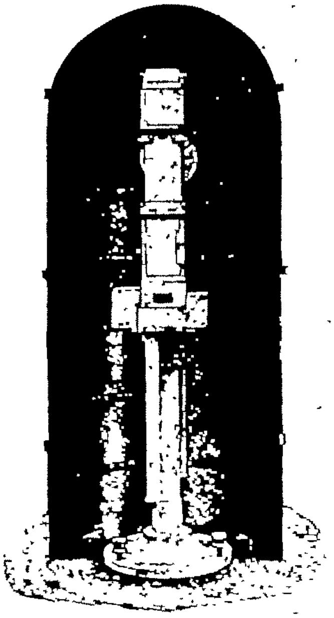
HIGHER MATHEMATICS FOR STUDENTS OF ENGINEERING AND SCIENCE. By FREDERICK G. W. BROWN, M.Sc.(London), F.C.P, Senior Mathematical Master, West Ham Secondary School. Crown 8vo. 10s.

AN ATLAS OF HUMAN ANATOMY FOR STUDENTS AND PHYSICIANS. By CARL TOLDT, M.D., assisted by PROFESSOR A. D. ROSA, M.D. Adapted to English and American and International Terminology by M. EDEN PAUL, M.D.Brux., M.R.C.S., L.R.C.P. Revised Edition. With 1505 Illustrations. 2 vols. Demy 4to. 42s. net.

⁂ ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

Oertling



NEW TYPE

EÖTVÖS TORSION BALANCE

FOR LOCATING DEPOSITS
OF OIL AND MINERALS

¶ See article, "The Eötvös Torsion Balance and its Use in the Field," by Capt. H. Shaw and E. Lancaster Jones, NATURE, June 23, 1923, page 849 *et seq.*

Government and Prospecting Geologists, Mining and Oil Companies should be in possession of our Manual of Instruction, price £1 : 1s. prepaid (see review in NATURE, September 18, 1926, page 406).

Booklet describing the Instrument will be sent post free.

EXPLORATION WORK CARRIED OUT
Correspondence Invited

MANUFACTURERS :

L. OERTLING LTD. (ESTAB. 1849), 88-90 Turnmill Street, LONDON, E.C.1

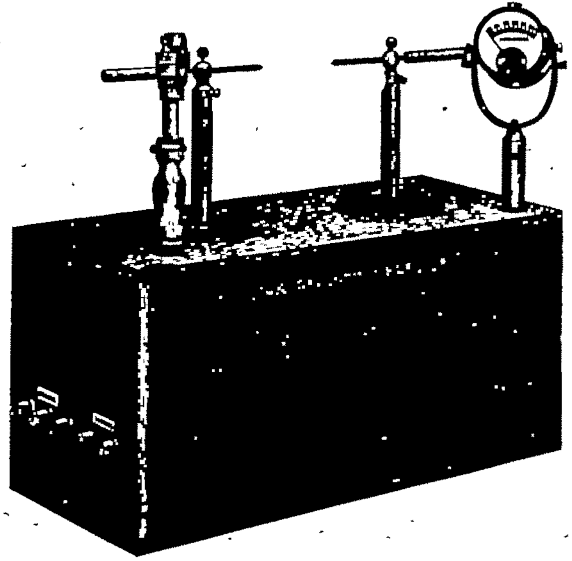
Bargains in Government Surplus Stores

12-14-INCH SPARK HEAVY DISCHARGE INDUCTION COILS

Every one of these Coils was submitted to a very exacting Government test for output and efficiency.

They are further guaranteed by us to be in first-class working order and condition, and therefore confidently recommended.

Specification. — 12-14-inch Spark Heavy Discharge Coil, complete with Condenser, Variable Primary, Discharge Pillars, Heavily Insulated, and fitted in Solid Polished Teak Cases. Can be used in the vertical or horizontal position. Fitted with removable Carrying Handles.



These tested and approved Induction Coils are offered at the extremely

Low Price of £28 each
Exclusive of Meter.
Milliamperemeter £3 extra.

Only a limited number can be supplied.

A UNIQUE OPPORTUNITY FOR LABORATORIES

Write for List of Guaranteed Second-hand Laboratory X-Ray Apparatus.

THE COX-CAVENDISH ELECTRICAL CO. (1924) LTD.
105 Great Portland Street, London, W.1
Telephone : LANGHAM 1145 (2 lines)

AGRICULTURE.

Research and the Land. An Account of Recent Progress in Agricultural and Horticultural Science in the United Kingdom. Cloth. 3s. 6d. (4s.).

Forest Products Research. Paper No. 1. The Movement of Moisture with reference to Timber Seasoning. 1s. 6d. (1s. 7d.).

Paper No. 2. Moisture Movement through Wood (the steady state). 1s. 3d. (1s. 4d.).

Sugar Beet. Progress Report on the De Vecchis Process. 4d. (4½d).

Report on the Manufacture of Power Alcohol from Sugar Beet. 6d. (6½d.).

Tuber and Root Crops as Possible Sources of Power Alcohol. 9d. (10d.).

STRUCTURES IN SEA WATER.

The Deterioration of Structures in Sea Water: First Report. 30s. (30s. 9d.). Second (Interim) Report. 2s. 6d. (2s. 7½d.). Third (Interim) Report. 3s. (3s. 2d.). Fourth (Interim) Report. 3s. 6d. (3s. 7½d.). Fifth (Interim) Report. 3s. 6d. (3s. 7½d.). Sixth (Interim) Report. 2s. (2s. 1d.).

ILLUMINATION RESEARCH.

Technical Papers. No. 1. The Terminology of Illumination and Vision. 9d. (10d.). No. 2. The Transmission Factor of Commercial Window Glasses. 6d. (7d.). No. 3. Light Distribution from Industrial Reflector Fitting (No. 1). 1s. (1s. 1d.). No. 4. Surface Brightness of Diffusing Glassware for Illumination. (*In the press.*)

FISHERIES.

Salmon of the River Spey. Salmon Fisheries No. V. Part II. 3s. 6d. (3s. 7½d.). Salmon of the River Dee. Salmon Fisheries No. IV. Part I. 4s. (4s. 1½d.). Distribution of the Food Fishes in the North Sea, 1923 and 1924, with Notes on their Natural History. 4s. 6d. (4s. 8d.).

Report on Sea Fisheries for the year 1925. 3s (3s. 1½d.). Statistical Tables 1925. 3s. 6d. (3s. 7d.).

BOTANY.

Kew List of Seeds of Hardy Herbaceous Plants and of Trees and Shrubs. 1s. (1s. 1d.). List of Seeds Royal Botanic Garden, Edinburgh. 1s. 6d. (1s. 7d.).

Kew Hand Lists: Coniferæ Cycadaceæ and Gnetaceæ. 3rd. ed. 1s. 6d. (1s. 7d.). Hardy Monocotyledons. 1s. 6d. (1s. 7d.). Herbaceous Plants. 3rd. ed. 2s. 6d. (2s. 7½d.). Rock Garden Plants. 2s. (2s. 1½d.) Trees and Shrubs (excluding Coniferæ). 3rd. ed. 4s. 6d. (4s. 8½d.).

Review of the Work of the Royal Botanic Gardens, Kew, during 1925. 1s. (1s. 1d.).

GEOLOGY.

The Wells and Springs of Dorset. 3s. 6d. (3s. 9½d.). Geology of the Country near Lewis. 2s. 6d. (2s. 8½d.). Summary of Progress of the Geological Survey, 1925. 4s. 6d. (4s. 10½d.). Geology of the Country around Oxford. 4s. (4s. 4d.). Water Supply of Wiltshire from Underground Sources. 4s. 6d. (4s. 9½d.). Concealed Coalfields of Yorkshire and Nottingham. 8s. (8s. 6d.).

MISCELLANEOUS PUBLICATIONS.

First Report of the Adhesives Research Committee. 4s. (4s. 2½d.). Second Report. 3s. (3s. 2d.).

Text-Book of Topographical and Geographical Surveying. 15s. (15s. 9d.).

Gas Cylinders Research Committee (First Report). 7s. 6d. (7s. 8½d.).

Lubricants and Lubrication Inquiry Committee, Final Report. 2s. 6d. (2s. 8d.).

On the Electro-deposition of Iron, with an Appendix containing a Bibliography of the Subject by W. E. Hughes, B.A.(Cantab.). 6s. 6d. (6s. 8d.).

Cleaning and Restoration of Museum Exhibits. First Report. Second Report. 2s. (2s. 1½d.). Third Report. *New ready.* 5s. (5s. 9d.) Illustrated and bound.

The Heating of Rooms. A Comparison of the Costs of Different Methods on the Basis of Warmth Comfort. 1s. (1s. 1d.).

The Domestic Grate. 9d. (9½d.).

All prices are net. Those in brackets include postage.

HIS MAJESTY'S STATIONERY OFFICE

LONDON: Adastral House, Kingsway, W.C.2. *EDINBURGH*: 120 George Street.
MANCHESTER: York Street. *CARDIFF*: 1 St. Andrew's Crescent. *BELFAST*: 15 Donegall Square, W.
Or through any Bookseller.

Supplement to NATURE

No. 2981 DECEMBER 18, 1926

Retrospect.

By Sir J. J. Thomson, O.M., F.R.S.

THE editor has asked me for some personal recollections of the Cavendish Laboratory, and I feel it would be churlish to refuse, though it is difficult to condense the happenings of more than forty years into a reasonable space, and still more difficult to avoid being egotistical. My connexion with the laboratory did not begin until I took my degree in January 1880. Before coming up to Cambridge I had, at the Owens College, under the inspiration of Balfour Stewart, become keenly interested in experimental physics and had done a small piece of research which was published just fifty years ago in the *Proceedings of the Royal Society*. The work for the Mathematical Tripos was, however, too heavy to leave time for experiments in the laboratory. As soon as the Tripos was over I started work at the laboratory, where Lord Rayleigh had just been made professor, and at his suggestion I began using a method, which he designed, an investigation on the ratio of the electrostatic to the electromagnetic unit of electricity. I made also theoretical investigations on applications of generalised dynamics to physics and chemistry, on vortex motion, and on the effects produced by the motion of electrical charges. There was great activity at the laboratory during Lord Rayleigh's time; Glazebrook and Shaw organised courses of instruction in practical physics; and Mrs. Sidgwick, Schuster, Glazebrook, Shaw, Poynting, E. B. Sargant, McConnel, J. A. Fleming, Hart, Miss Harland, and J. H. Middleton were working at various researches.

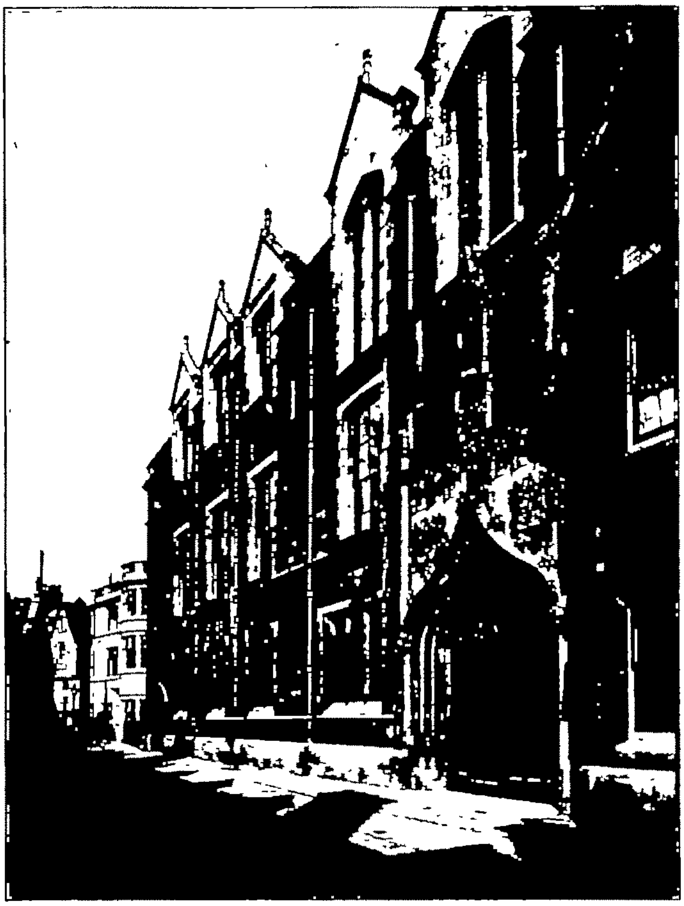


FIG. 1.—General view of part of the Cavendish Laboratory from Free School Lane. The new Rayleigh Wing is seen in the distance.

At the end of 1884, Lord Rayleigh resigned the professorship, and to my great surprise, and I think to that of the rest of the University, I was appointed to succeed him. I heard at the time that one well-known college tutor had expressed the opinion that things had come to a pretty pass in the University when mere boys were made professors. My want of experience was made less harmful than it might have been by the kindness of Glazebrook and Shaw, who continued to take charge of the teaching in practical physics. Immediately after my election to the professorship I began, in collaboration with my old friend Richard Threlfall, one of the most skilful experimenters I have ever met, some experiments on the passage of electricity through gases, and since then I think there has never been a time at which I have not had some experiments in hand on this subject. I had come to the conclusion that whenever a gas conducts electricity, some of its molecules must split up and that it is these particles which carry the electricity. My idea at that time was that the molecule was split up into two atoms, one of which was positively, the other negatively, electrified, and my first experiments were intended to test this idea. It was not until the beginning of 1897 that I discovered that the decomposition of the molecules was of quite a different type from ordinary atomic dissociation. I found then that one of the bodies into which the molecules split up, the one carrying the negative charge, is something totally different from an atom, and has a mass less than a thousandth part of the smallest atom known. I was fortunate enough soon after becoming professor to be able to persuade H. F. Newall, now professor of astrophysics in the University, to come and help in the work of the laboratory, and for some time we worked in collaboration on various researches.

In 1887 a great scientific discovery was made which appealed especially to every one connected with the laboratory: I allude to the detection by Hertz of electrical waves. The existence of these waves is a necessary consequence of Maxwell's electromagnetic theory, but though numerous attempts to detect them had been made, some of them at the Cavendish Laboratory, they had all failed owing to the want of a sufficiently delicate instrument to detect their presence. Hertz, by observing the variations in intensity of the minute sparks which pass between conductors near together when electrical waves pass over them, was able to demonstrate the existence of these waves. The younger school of mathematical physicists at Cambridge, who had been brought up on Maxwell's "Electricity and Magnetism," received Hertz's discovery with the welcome which might be expected from those who found their most cherished convictions confirmed by a series of most beautiful experiments; it established instead of revolutionising our ideas. I well remember the enthusiasm of the undergraduates when I repeated Hertz's experiments in my lectures on electricity and magnetism in 1888. The enthusiasm spread to all the workers in the laboratory, and soon experiments on electric waves were going on all over the building.

Among the Cambridge men doing researches in the laboratory up to 1895—the year of the admission of research students—were, in addition to those already mentioned, Cassie; W. H. Bragg for a short time; Wilberforce, who was a demonstrator until he became professor of physics at Liverpool; Chree, who became superintendent of Kew Observatory; H. L. Callendar, now professor at the Imperial College of Science, who was elected to a fellowship at Trinity College for natural science after having taken first classes in both classics and mathematics, and began at the Cavendish Laboratory those researches on the effect of temperature on the resistance of metals which have revolutionised thermometry; T. C. Fitzpatrick, now president of Queen's College, who for more than twenty years had the charge of the classes to medical students, and in 1904 presented to the laboratory apparatus for producing liquid air—this gave us the means of producing high vacua, and without it many of the most important researches would have been impossible; G. F. C. Searle, to whose devotion and enthusiasm the laboratory owes more than I can express, and whose fertility and ingenuity in designing instructive and ingenious experiments for demonstration in practical physics remains quite unabated; W. C. D. Whetham, later a tutor of Trinity College, who worked at problems on the properties of solution; Sidney Skinner, now principal of the South-Western Polytechnic, who was for many years a demonstrator; J. W. Capstick, until he became junior bursar at Trinity College; J. B. Peace; Alexander Anderson; C. E. Ashford; Miss Freund, and Miss Klaassen. Among our guests from other universities were Sir Oliver Lodge, who worked for one long vacation in collaboration with Glazebrook on the determination of *v*; A. M. Worthington, who made an important investigation on the tensile strength of liquids; while H. F. Reid, of Johns Hopkins, Baltimore, Olearski, from Lemberg, and Natanson, from Cracow, were the precursors of the many distinguished teachers from foreign universities who have honoured us by working in the laboratory.

The year 1895 was an epoch in the history of the laboratory, as then the University decided to admit as research students graduates of other universities whether at home or abroad, and in certain cases students who are not graduates, provided they satisfy the authorities that they are qualified to do research. In October 1895, the first two research students—Rutherford, from New Zealand, and Townsend from Trinity College, Dublin—arrived within a few hours of each other. Did a new system ever have such a good beginning? Rutherford began by working at wireless telegraphy, using a detector which he had invented before leaving New Zealand: it was so successful that the laboratory held for a time the record for long-distance telegraphy, communications being established between the laboratory and the observatory nearly two miles away. Townsend made a very important investigation on the magnetic properties of iron when in chemical combination.

It was fortunate that the new regulations, which brought to the laboratory a large influx of students bent upon research, came just at the time when the discovery of the Röntgen rays gave us a very powerful method of investigating the mechanism of the conduction of electricity through gases. A great many researches had already been made in the laboratory on this subject, and our studies had shown the fundamental importance of certain investigations which were almost impracticable with the means then at our command. The Röntgen rays gave us a means more amenable to purposes of investigation than those hitherto available and made many investigations possible which had before been hopelessly difficult. The investigation of the electrical properties of gases under the action of Röntgen rays soon engaged the attention of many workers in the laboratory. Rutherford, Townsend, McClelland, Langevin, who had come to us from Paris, were all hard at work. C. T. R. Wilson began those researches on condensation which, *ohne Rast ohne Hast,* he has pursued ever since, obtaining results of continually increasing importance for the development of modern physics.

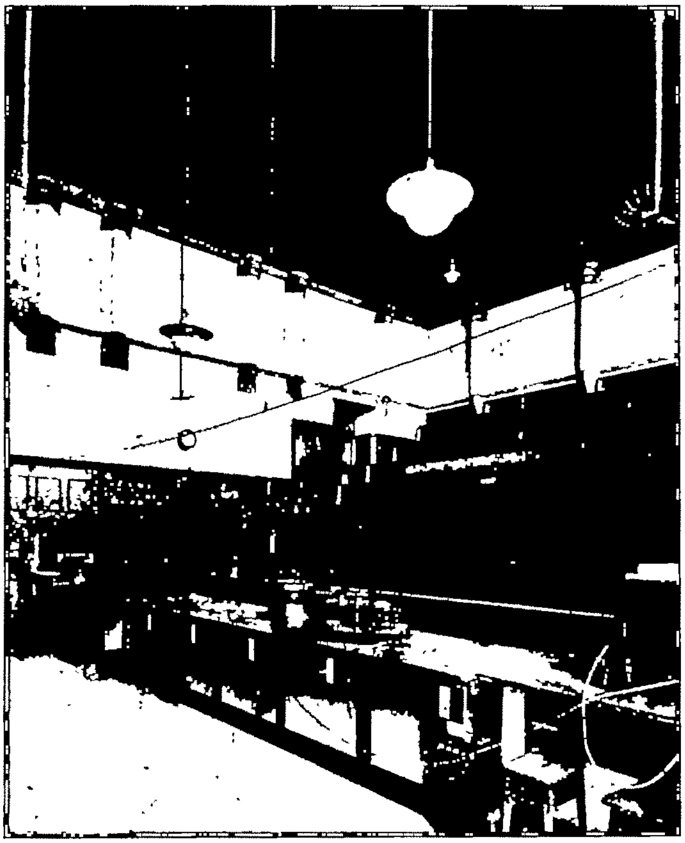


Fig. 2.—Lecture room of the Cavendish Laboratory, designed by Clerk Maxwell. Reproduced from a photograph kindly supplied by Mr. Rollo Appleyard, International Standard Electric Corporation.

It is not, I think, claiming too much to say that these researches played a great part in establishing the theory now universally accepted that the electricity is carried through gases by particles charged with electricity. The properties of these particles were studied in great detail at the laboratory, and they seemed to indicate that they were at least as large as the atoms of the gas in which they were produced. Some experiments which I made at the beginning of 1897 led, however, to the discovery of particles of quite a different order of magnitude. The cathode rays, which proceed from the cathode when an electrical discharge passes through a gas at low pressure, were discovered by Hittorf, and many experiments had been made on them by Goldstein, Varley, and Crookes.

Two widely different views were, however, held as to the nature of these rays. The majority of the German physicists maintained that they were analogous to electric waves, and urged in support that they could pass through thin sheets of metal. The English physicists held that they were charged particles, and brought forward the argument that when the rays entered an insulated vessel they communicated to it a charge of negative electricity. I had for a long time been convinced that these rays were charged particles, but it was some time before I had any suspicion that they were anything but charged atoms. My first doubts as to this being the case arose when I measured the deflexions of the rays by a magnet, for these were far greater than I could account for on any hypothesis that seemed at all reasonable if the particles had a mass approaching even that of the hydrogen atom—the smallest mass then known. I made a series of measurements of the velocity of these particles and the ratio of their mass to their charge. These all showed that the ratio of mass to charge for the cathode particles was less than one-thousandth part of the same ratio for the atom of hydrogen and its electrolytic charge. Thus, unless the electric charge on the cathode ray were at least a thousand-fold that on the electrolytic ion, the mass of the cathode ray particles must be less than that of an atom of hydrogen. Methods were devised by which the charge on these particles could be measured, and it was found to be the same as the electrolytic charge. I could see no escape from the conclusion that in the cathode rays there were particles far more minute than any hitherto recognised. I think the first announcement of this result was made at a Friday evening meeting of the Royal Institution on April 30, 1897.

Later investigations have shown that these particles—the electrons as they are now called—are always of the same kind and form a part of every kind of matter. The number of electrons in the atoms of the different elements was determined by applying a theory of the scattering of these rays by electrons which I had worked out from the valuable measurements by Barkla on the amount of radiation scattered by different gases, and it was found that this number was proportional to the atomic weight of the element and was of the same order as that number This led me to construct a theory of the structure of the atom which had special reference to the chemical properties of the element, for it was shown that such a structure would give a variation of the chemical properties with the atomic weight quite similar to that expressed by Mendeléef's law. Another excursion I made into chemistry was to use the magnetic and electric deflexions of the positive rays to determine the chemical composition of the gas in which they were generated. It proved a useful method, and Dr. Aston has modified and improved it, so that it is now one of extraordinary delicacy and accuracy.

The number of those engaged in research grew very rapidly, and for many years before the War there were always thirty or more researches going on in the laboratory. This put a great strain upon the apparatus and upon the workshop. We have been very fortunate in our chief assistants, and the laboratory owes much to Mr. Sinclair, Mr. Bartlett, and Mr. Pye, and especially to Mr. Lincoln, who has been chief assistant since 1899. Personally, I am greatly indebted to the skill and care of Mr. E. Everett, who has been my private assistant for nearly forty years, and has given me most valuable and able assistance in my investigations.

It is impossible here to mention individually the research workers between 1895 and the beginning of the War: their number is too great. Suffice it to say that three of them have gained the Nobel prize, twenty-two have been elected fellows of the Royal Society, and more than fifty have become university professors of physics. When the War began the usual work of the laboratory stopped. The research workers went either to the front or to laboratories formed for developing and testing methods likely to be of use to the fighting services. Our own workshop was employed in making gauges, and all the research at the laboratory was war-work. Soon after the end of the War my duties as master of Trinity obliged me to resign the professorship. The University was fortunate enough to induce Sir Ernest Rutherford to take the post. At the same time, with great kindness and consideration, they gave me a position which enabled me to retain my connexion with the laboratory which for more than forty years had given me unrivalled opportunities for doing the work I liked best, which has brought me many cherished friends and has created rich memories of kind acts, good fellowship, and goodwill.

James Clerk Maxwell.

By Sir Joseph Larmor, F.R.S.

THE course of evolution of the career of a man of genius is always an interesting, and should be an instructive, study. In the case of Clerk Maxwell the materials are ample, thanks to the care of his two biographers, one of them a classical scholar with Greek predilections, the other his intimate and sympathetic scientific assistant. Their account leaves an impression of the absence of any formal education outside his home life. His father was his chief early friend; his real intellectual initiation was identical with his amusements, mainly concerned with dynamical contrivances such as spinning tops, and extending into explorations in practical hydrodynamics by feats of swimming in the bath. Perhaps the Scottish atmosphere of practical engineering, fanned into interests of pure science by men such as Robison, Kelvin, Rankine, explained the origin of this mental bent; but it does not account for the literary grace and charm of his writing.

Another main formative influence was the Scottish Calvinist theology, in its more humane and devotional aspect, supported by intimate conversance with the phrasing and poetry of the English Bible, which has so often been the well-spring of distinction in literary expression. This Puritan trend, while it treasured the historical formularies of the Scottish Church, was in him far from sectional; it ramified into enjoyment of literature, such as the poetry of Milton, and also the descriptive and evolutional poetry of Tennyson, whose influence was still dominant in the Cambridge of his undergraduate time.

Another phase of Maxwell's thought was made public in the biography, in some occasional papers of metaphysical and religious import, which had been read to a private Cambridge society. At the time of publication, as one remembers, the interest of them was regarded as mainly personal, being outside the analytic severity of the British psychology of that period. But they were discovered by Prof. Hoffding of Copenhagen, and have come back to us, in the English translation of his works, as among the competent pronouncements on the philosophy of Nature.

It is Maxwell's main achievement that he unified physical science, by connecting light and radiation with electricity so as to form one interlocked systematic whole. This advance made the Cavendish Laboratory, from its foundation in 1872, the focus of electrical pure science which it has remained ever since. It must have been remarked by students of his writings how abruptly he left off the development of this electrodynamic and optical theme in the last six years of his life, after the publication of the treatise on "Electricity and Magnetism" early in 1873. For example, no question ever occurred as to the dynamical riddle, then prominent in physical speculation, which was presented by the Fresnel laws of refraction of optical waves: though when Helmholtz, and Lorentz, and J. J. Thomson entered into the study of his theory, they at once recognised independently that the form, at any rate, of these laws was immediately involved, while FitzGerald, going deeper, had already connected the electric theory intimately with the entire *corpus* of the optical theories of MacCullagh.

FIG. 3.—JAMES CLERK MAXWELL, Director 1871–79.

One reason may have been Maxwell's preoccupation with fundamental objections of fact, operating against his views. His dynamical mentor, Lord Kelvin, to whom he largely owed the impulse to the elucidation through kinematic models of deep-seated physical phenomena, had here failed him, and to the end of his days held to the view that the foundations of the electric theory of light were unintelligible, by which he seems to have meant not sufficiently disentangled dynamically, his own fundamental developments on latent momenta notwithstanding. The wide discrepancy between the index of refraction of a substance and the square root of its dielectric inductive constant was such a threshold difficulty of fact, and loomed important in those days when the influence of dispersion was not very fully recognised. The first fundamental service of the illustrious Boltzmann to the theory of his master in research was the measurement of the dielectric constants of gases, resulting in confirmation of Maxwell's law for such simple forms of matter: while the experimental work of Hopkinson on organic compound substances also brought out significant correlations.

Curiously enough, it is now recognised universally, on the initiative of the late Lord Rayleigh, that Maxwell himself had been the pioneer in clear-cut dynamical atomic views of dispersion. He had formulated a fully illustrative scheme, in the guise of a rather detailed examination question in the Cambridge Mathematical Tripos of 1869. This must have implied that the floating dynamical instincts of that time were adequate, at any rate in the view of himself and his co-examiners, for a rapid apprehension and verification of the ideas involved; while the collections of Maxwell's tripos problems, that were treasured and utilised in Cambridge teaching, must have made them not unfamiliar to expert optical students.

There is a cognate question, why in his expositions Maxwell made so slight use of moving electric charges as the originators of the electrodynamic fields which, after the example of Faraday, were his main concern. For the atomic constitution of electricity had been fully established by Faraday's own laws of electrolysis, as Helmholtz afterwards emphasised. The idea of electrons acting on one another through a law of attraction at a distance had been long before placed by W. Weber at the foundation of the reasoned exposition of his fundamental electric measurements. Maxwell himself hovers around the phrase 'atoms of electricity.' He even sets in special prominence the remark of Gauss that what was needed was, above all, some notion of how influence was propagated in time between the sources of the electric manifestations. Gauss confesses that he had not been able to find it; while Maxwell implies that it now lies exposed in his equations of the electrodynamic field. Yet he did not pursue this path. Hertz found no difficulty, in 1887, in determining, on Maxwell's principles, the radiation from a vibrating source such as an oscillating electron. Indeed FitzGerald had already, five years earlier, incidentally determined the nature and amount of the radiation from a rapidly alternating current circuit, that is, from a magnetic vibrator; and on the same occasion he pointed out that a spark from an electric accumulator, discharged through a small resistance, ought to produce electric waves as short as ten metres or less. He thus was well qualified to expound Hertz's epoch-making detection of the Maxwellian waves in free space, in an address to the British Association soon after it was announced.

In other respects also Maxwell had largely confined himself to the medium of electric propagation as a whole, as modified by its content of material atoms and ions in bulk. He had measured, incidentally, with the assistance of Hockin ("Treatise" § 798; more fully in the Memoir[1] of 1864), the transparency of metallic foils such as gold-leaf, and found that it implied effective electric conductance far smaller than the steady value as determined on a bridge. The natural reason for this discrepancy he indicated: also the reason why electrolytes are not opaque; but there he left it, for indeed the relevant experimental knowledge was as yet a blank, while other subjects were pressing on him. We may perhaps add to this the distractions involved in the creation of the Cavendish Laboratory, and the laborious editing and expansion of the Cavendish electrical manuscripts.

In the same context ("Treatise," § 792; more fully in the Memoir of 1864, § 107) he propounds very briefly his law of radiation pressure, now fundamental in physics and astronomy; he tries to estimate the magnitude of the pressure for sunlight, coming to grief in detail over the arithmetic. He perhaps reached the law more by physical instinct than by demonstration. If we imagine a limited train of electric waves reflected back at a perfect conductor, a current sheet is induced on it, and the Amperean force on that sheet constitutes a pressure of the train on the conductor. But the train was originally isolated in space, and will again be isolated with only its direction reversed; thus there is no other source for the pressure exerted by it, on the electrons of the current, but a change, here a reversal, of momentum associated somehow with the radiation. This is the idea developed directly in experiment by Poynting, that a train of radiation is a carrier of momentum. Maxwell associated the pressure with his quadratic stress, in origin purely formal, in the electrodynamic field. Close scrutiny, first in time by Lorentz, reveals, however, an outstanding motional part of the mechanical force which is not absorbed into that stress-tensor, significant though it was; and Poincaré and Abraham remarked that it was just such as could arise from a distribution of momentum in the field, thus without vitiating the stress-representation. The complete forcive on the material content of any region is then expressed as the resultant of this formal electromagnetic stress over its boundary, when there is such stress there, together with the rate of communication of this aethereal momentum throughout its volume: if there is no material content these will balance.

It is, then, the transfer of this postulated momentum of radiation that constitutes radiation pressure on material bodies. The transfer is effected, as above, through Amperean force on the current of electrons. Reversing the argument, radiation pressure, as experimentally confirmed by Lebedew, Nichols and Hull, Poynting, implies momentum in radiation; and its existence to the requisite amount implies a reality, of some kind scarcely yet fully explored, in the Maxwellian quadratic field-stress. An intimate knowledge of the structure of the electron which sustains the stress ought to involve both its own dynamical nature and the structure of the field in which it subsists.

It is not necessary to follow up Maxwell's share in the practical settlement of the scheme of electric units, the essential preliminary to the present electrotechnic age; in that Kelvin was the leader. But we may note his early memoir in determination of the nature of subjective colour, in which he verified with precision the surmise of Young, following on Newton, while Maxwell himself was followed by Helmholtz and by Rayleigh, that all the gorgeous play of colour that is a main glory of our natural world arises from combinations of only three independent elements.

It has been already remarked that Maxwell added little in later life to the essentials of the electric theory. The first edition of the "Treatise" had obviously been thrown hurriedly into the press, in a series of rather disjointed fragments which taxed the ingenuity of dynamical interpretation of his British disciples for years; some additions for the early chapters of a second edition were mainly developments of the usual standard knowledge. But he could still be drawn on the subject. Compare his answer in keen and humorous verse to Tait ("Life," p. 684 (1877), already however in "Treatise" (1873), § 577), who proposed apparently to repeat with a spinning excited dielectric disc Rowland's then recent experiment of the magnetic convection effect of a charged rotating disc, as was afterwards carried through by Rontgen. He wanted Tait to spin instead a copper coil with galvanometer in circuit, suddenly to arrest its motion, and note if there was any result; for that would give "the electric current's true direction," or alternatively let it "be your boast to prove . . . that there is no Electric Fluid." This test for sensible inertia of the electrons, as we would now say, has been carried through to success in America only the other day.

---

[1] The abstract of this memoir (*Roy. Soc. Proc* 13, pp 531-536), accidentally omitted in the "Scientific Papers," is an interesting general exposition of the author's ideas, largely in line with modern points of view

Plenty of electric discussion was, however, going on, especially in the years just after Maxwell's death. It was regarded as a great improvement when Heaviside and Hertz, nearly simultaneously, got rid of his vector potentials as being mere mathematical figments, though with him of heuristic dynamical origin; yet the two resulting circuital relations, as Kelvin called them, had already been formulated long before by Maxwell himself, as a concession to a demand for the essential outcome of his theory, in concise form freed from tentative dynamical implications. But these circuital equations are concerned only with the smoothed-out electrodynamic fields. Ultimate dynamical theory, going back to the sources of the field, has not yet been able to do without their vector potentials. Nowadays the circle has indeed gone round full tilt; we have been familiarised with the point of view that the electric and magnetic fields, so tangible in the world of engineering, are in theory only two partial aspects of one six-vector, itself the (Hamiltonian) gradient of a fourfold vector potential that alone is fundamental in Nature, as presented to our minds.

Maxwell's other main contribution to science, equally monumental, lay in the domain of the molecular kinetic theory of gases; it provided the more severe mathematical occupation of his later years. He had taken over the subject in his early days from Joule and Clausius and their predecessors, in the form of a rough *aperçu* of the phenomena of a crowd of independent moving molecules: he converted it into an exact theory, thereby creating the science of statistical dynamics which dominates modern molecular physics. The root principle of that science is Maxwell's law of distribution of velocity, or of other quality, in a multitude of molecules which has attained a steady state. As results there came to him exact dynamical theories of friction and diffusion and conduction of heat in gases, and analytical developments for rarefied gas arising out of the phenomena revealed by the Crookes radiometer. Here also Boltzmann was in readiness to follow up this train of research. From their memoirs in general statistical dynamics, the law of equipartition of energy among the various modes of molecular freedom stood out as a cardinal result. The problem of how the inadmissible consequences of this law are to be evaded has opened up new regions of physics, practical as well as speculative, which at present tend to dominate the whole field.

A characteristic illustration of his genius was the early enforcement of the averaging character of the processes of thermodynamics, by appeal to the possible achievement of ideal minute intelligences, named Maxwell's demons by Kelvin, who could by merely guiding or sifting interference upset the fundamental principles of that science; this arresting quip carried the new doctrine of the statistical character of natural law for molecular structures into regions of thought where abstract dynamical argument could scarcely have penetrated. His lucid expositions in formal thermodynamics need only be mentioned; in them he appeared mainly as the simplifier of the fundamental advances achieved in the American work of Willard Gibbs, the foundation of modern physical chemistry.

Maxwell spent his summers on his small estate of Glenlair in Galloway, among his own people, living as a Scottish laird. Doubtless it was there, among the solitudes of the hills, that illumination mainly came. In the autumn he usually attended the British Association, where, as one used to hear, his gaiety and humour were looked forward to as enhancing the value of the annual scientific discussions, then at their prime. The writer recalls that, returning to Cambridge as an undergraduate one October, a man of the type of a country farmer came into his compartment of the train at Dalbeattie, remained silent for a time, then remarked with emphasis, as something that concerned the world to know, to this effect: Clerk Maxwell has been taken away, mortally stricken; he will never come home again. He died in 1879 at only forty-eight years of age.

Lord Rayleigh.

By Sir Arthur Schuster, F.R.S

MAXWELL'S health began to fail in the early part of 1879. Troubled by his wife's illness, which weighed heavily upon him, his accustomed good spirits had left him; but there were no signs that he himself was suffering from a mortal disease until his return from the summer holidays, when we were shocked to hear that he had only a few weeks to live. His death was a calamity which might have been fatal to the continued prosperity of the Cavendish Laboratory had Lord Rayleigh not consented to accept the professorship. His hesitation and the pressure put upon him by those who had the interest of the laboratory at heart, are set out in the 'Life' of the father written by the son.

After his election, Rayleigh lost no time in making plans for the conduct of his new duties. I am sorry not to have preserved a letter I received from him asking whether I had any suggestions to make, as I had gained some experience in its working during the two years I had spent in the laboratory. Others received similar requests, but I doubt whether the new director of the laboratory received any useful hints on essential matters.

On his own initiative Rayleigh adopted a definite and novel policy, its essential point being the fostering of a spirit of community among the advanced students. To make a beginning, he desired to identify the laboratory as a whole with some research in which a combination of workers was necessary. The question of electrical units had, at that time, gained practical importance and the subject seemed suitable for a combined attack. There was the additional reason that Maxwell had been connected with the original determination of the Ohm fathered by the British Association, and that the principal piece of apparatus, the rotating coil, was preserved in the laboratory.

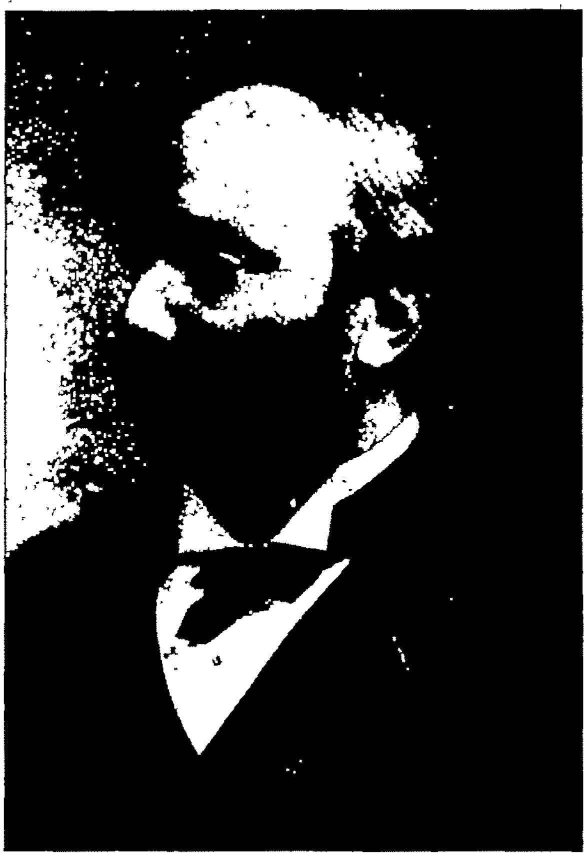


Fig 4.—Lord Rayleigh, Director 1879–84.

Different methods of procedure having led to values which differed more than was desirable, Rayleigh decided to repeat the former work, using the same coil, but paying more attention to what others might have considered minor details. The method by which the rotational velocity of the coil was kept constant was simple and effective, and the same applies to the very ingenious method devised to compare the frequency of the tuning-fork, to which the rotation was referred, with the rate of a standard pendulum clock. When sufficient experience had been gained with the original coil, a new one was constructed giving a result which was decidedly more accurate than any obtained up to that date. Rayleigh was disappointed in his original desire, no volunteers besides myself offering to help, until Mrs. Sidgwick joined us, and the later history of the research is well known.

I may, perhaps, here refer to a personal recollection which has always remained in my mind. During the early stages of the investigation of the Ohm, Lord Rayleigh made the remark to me that this was the first piece of work he had undertaken that required great accuracy of measurement, and he added that he was not at all sure that he would really like it. I replied that I felt sure that the satisfaction of getting another decimal place in a physical constant was a pleasure which would grow on him more and more. Later events, I think, justified my remark.

Persevering in his desire to form a kind of research community within the laboratory, Rayleigh introduced an innovation that may seem trivial, but has been effective in more than one laboratory since. A tea-interval was introduced, during which the different workers could meet and join in informal discussion on scientific problems. Tea was served in a room in which other experiments were kept going, and those who had the privilege of attending these informal scientific meetings will more especially remember the water jets breaking into drops, and the effects of electricity on the appearance presented by them. There were also the spinning colour discs in which we could compare our colour senses.

A good example of Rayleigh's method of work was shown by the little appliance made with card-board, sealing-wax, simple glass lenses, and a prism or two, by which he could determine the relative amount of red and green required by different persons to produce the yellow of a sodium flame. By comparing the results of different observers it was found that, while most persons agreed fairly well in their estimate, there are anomalies which run in families. Lord Balfour and two of his brothers, for example, required a considerably larger proportion of green to get the yellow sensation. With a more elaborate apparatus designed by Rayleigh, I examined, on my return to Manchester, seventy-two persons and found among them four possessing the same peculiarity and one with an anomaly in the opposite direction. Among the four was a woman with two of her three sons. It is a curious coincidence that the colour sense of Clerk Maxwell was, and that of J. J. Thomson is, affected in the same way. An examination of the present director's sight is obviously indicated.

Though not belonging to the Cambridge period, Rayleigh's great work on the weighing of gases should be mentioned, because it was really planned at Cambridge. He frequently referred to the desirability of keeping a research going as a 'stand by,' that is, an investigation which presumably could be continued for a long time and dropped or taken up again as more urgent demands had to be satisfied or a slack time occurred. His choice fell on the weighing of gases, because he was always impressed by the probability of a unity of matter and the likelihood of the correctness in some form or other of Prout's law. Quotations from his address as president of Section A of the British Association giving his views on the subject will be found in the biography written by his son.

During Rayleigh's tenure of office at Cambridge a systematic and very successful instruction in laboratory work was introduced by Glazebrook and Shaw. For this and research purposes a substantial annual income was required, and Rayleigh raised a fund of 1500*l.*, to which he himself contributed one-third.

When he gave up the directorship of the Cavendish Laboratory, it was in a highly efficient state both as a teaching and research institution.

Sir J. J. Thomson, O.M., F.R.S.

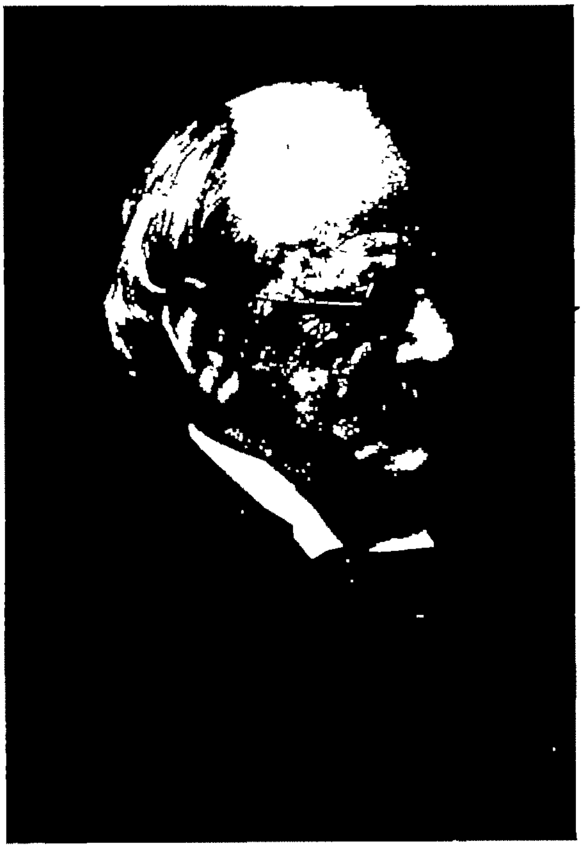
By Sir Oliver Lodge, F.R.S.

HOW much less the world would know if the Cavendish Laboratory had never existed; and how diminished would be the glory even of that laboratory if Sir J. J. Thomson had not been one of its directors! We used to think of him as one of the younger physicists; but now that his seventieth birthday is being celebrated that notion must be given up, even by his seniors. But, whether young or old, we have all venerated him for his brilliant achievements.

The discovery of the electron and the foundation of the electrical theory of matter cannot, any more than other fundamental discoveries, be attributed to any single man: these great advances are the outcome of the work of at least a generation. To them Helmholtz, Crookes, Johnstone Stoney, Sir Joseph Larmor, and in the electrolytic stage even Faraday, have all contributed; and, doubtless, in mentioning some names I am omitting others. But researches into the phenomena connected with the discharge of electricity through gases have been Sir J. J. Thomson's special field; and, as Clerk Maxwell hinted would happen, that branch of inquiry has thrown great light upon the nature of electricity itself. Very few before our time can have supposed that electricity was discontinuous. Maxwell's equations and Cavendish's experiments either postulate or appear to demonstrate continuity and incompressibility. That electricity was a fluid, comparable in any respect to a gas, seemed like a popular superstition. The discovery of a discontinuity in Nature must always have notable consequences; and though we may be willing to grant that ultimately every atomic character will be resolved into a deeper-seated and more fundamental continuity, yet for a long time it will be the business of science to absorb and work out the consequences of every discontinuity that is revealed.

John Dalton was the earliest to emphasise the chemical discontinuity of matter. J. J. Thomson is likewise the first to emphasise effectually the atomic character of electricity. His work is a happy combination of experimental and mathematical ability. He arranges ingenious experiments to display and dissect the phenomena; and at the same time most skilfully applies dynamics to analyse those phenomena in an illuminating and metrical manner. In his hands the magnetic deflexion of cathode rays observed by Crookes, coupled with certain other experiments by C. T. R. Wilson and J. S. Townsend, sufficed to determine the mass and the speed of the electric particles; and when electric deflexion of cathode rays was combined with magnetic deflexion, the determination could be made in a particularly neat and convincing manner. So that when Sir J. J. Thomson gave an account of his researches throughout the years 1897 and 1898, before Section A of the British Association meeting at Dover in 1899 (in the presence of a number of Continental physicists, many of whom had come over that day from Boulogne), the whole world rose to the conviction that a new era had dawned in electrical science. A foundation-stone was then laid for the innumerable researches which have gone on during the present century in every laboratory and library of the world.

The facts are so well known now that it is needless to elaborate them: within thirty years they have become almost ancient history. Naturally the renowned discoveries of Becquerel, Röntgen, and Madame Curie fell into line. The discovery of Zeeman, verifying that the radiating particle was not an atom but an electron, worked out initially by the genius of H. A. Lorentz, fell in also with a classical theory of radiation conforming to ideas promulgated by Hertz and Larmor and FitzGerald; though it is true that certain difficulties and puzzles afterwards arose, in which all physicists, including J. J. Thomson himself, are now deeply involved.



Photo] [*J. Palmer Clarke.*

FIG. 5.—SIR J. J. THOMSON, O M., F.R S., Director 1884–1919

We used to think that Clerk Maxwell had explained to us the nature of light; and so no doubt to a great extent he had; but our theory of the emission and absorption of light has been singularly complicated by the action and reaction between electrons and radiation, to which O. W. Richardson, Barkla, and other experimenters, including Compton, have contributed so much information. Especially have both complication and illumination been enhanced by the discovery of that new discontinuity which now penetrates our treatment of every interaction between ether and matter—the outcome of singularly successful speculative reasoning by Max Planck at the beginning of the present century.

The accuracy with which both the charge and the mass of the electron are now known (largely through the ingenious measurements of Prof. Millikan), and the researches of spectroscopists all over the world, from Kayser and Runge, Schuster and Hicks, Balmer and Rydberg, down to Prof. A. Fowler—illuminated as they are by the discoveries of Rutherford and the brilliant constructions of Bohr—have raised an enduring monument, a sort of cathedral, glorifying the electrical theory of matter. To the completion of that splendid structure, the present generation, and probably many future generations, are contributing and will contribute. All this must be a great satisfaction to the Master of Trinity, who is still so happily engaged in his own researches that he has perhaps scarcely time to bethink himself of the beauty of the edifice which has been raised on his foundation-stone.

Of course J. J. Thomson has done many other things. At a very early stage he secured the Adams Prize for a theory of the behaviour of vortex rings, which may still one day be usefully drawn upon when the hydrodynamical structure of the ether, already begun long ago by Larmor, is seriously undertaken. Again, the electrical theory of matter would be nowhere if we did not know that an electric charge possessed inertia. The resolution of matter into energy, insisted on by the theory of relativity, has as one of its props that early paper of J. J. Thomson's in 1881 (forty-five years ago!), in which he calculated the extra mass conferred on a body by an electric charge; a suggestive idea to which both he and Heaviside contributed the further illuminating fact that that inertia would be increased by locomotion; a prediction which, when verified by Kaufmann, made an electrical or ether-field theory of matter inevitable.

Thomson did not limit himself to metrical determinations about negative corpuscles and cathode rays. He attacked also the positive or matter rays; and thereby developed a fundamental technique of positive-ray analysis, which speedily detected a variant of neon, and then in the hands of Aston defined atomic weights with altogether unexpected precision. This method, brilliantly and pertinaciously applied, has fully upheld the isotopic conception of Soddy (preceded as that was by the unorthodox speculation of Crookes at the Birmingham meeting of the British Association in 1896), and has thereby not only brought to our ken a host of new substances with similar chemical but different physical properties, but also has established in modified form the hypothesis of Prout, that atomic weights are really whole numbers, of which hydrogen is very nearly, though not quite, the common unit.

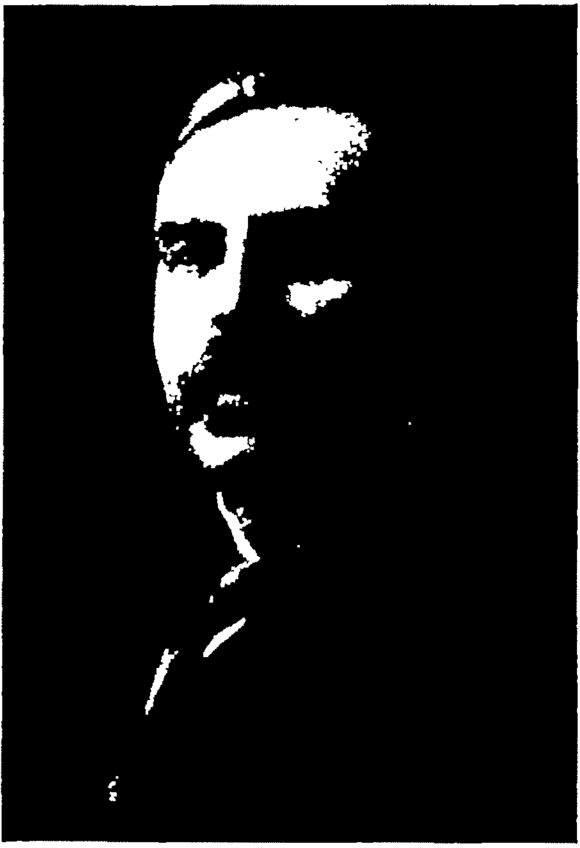
Readers who wish for a more detailed reminder of the steps which have led to these great advances may refer back to NATURE, vol. 91, p. 1, where Prof. Righi of Bologna contributes an article appreciating, from the Continental point of view, the work of Sir J. J. Thomson up to the date 1913.

Students and disciples all over the world could contribute far more details. His own son, the professor of physics at Aberdeen, is one of the brilliant products of the Cavendish Laboratory; and many prominent physicists, such as the present Lord Rayleigh, could testify with intimate knowledge of the work of that laboratory during Thomson's régime. They know the doubts and hesitations which had to be set at rest before the absolute uniformity of electronic charges could be confidently asserted. They know the persistent help given by Mr. Everett, his laboratory assistant for nearly forty years. They are acquainted with the incipient stages of many discoveries. But an older physicist esteems it a privilege to write this brief appreciation of the achievements of one who has worked with unexampled power in the borderland between chemistry and physics, who has introduced into that great science of chemistry revolutionary conceptions the end of which none of us can see, and who is still happily flourishing and active.

Sir Ernest Rutherford, O.M., P.R.S.

By Prof. NIELS BOHR, For.Mem.R.S., University, Copenhagen.

FOLLOWING the kind invitation of the editor to write a few words in appreciation of the work and influence of the present director of the Cavendish Laboratory, I presume that the readers of NATURE will not need any detailed exposition of his achievements. As, however, I am one of those who have had the good fortune to come into close personal and scientific contact with Sir Ernest Rutherford, it is a great pleasure to me to try to describe briefly how we, who are proud to count ourselves among his pupils, regard him.



Photo] [J. Russell and Sons.

FIG. 6.—SIR ERNEST RUTHERFORD, O.M., P.R.S., Director 1919– .

My own acquaintance dates from the period when Rutherford, after years of ardent and successful collaboration with Sir J. J. Thomson in the Cavendish Laboratory, had left Cambridge, and—after his stay at McGill, where his work on radioactive substances had established his fame—in Manchester had founded a school for investigations in radioactivity. This centre attracted young scientists from all parts of the world. In the spring of 1912, on my first visit to Manchester, the whole laboratory was stirred by one of the great discoveries which in so full a measure have been the fruits of Rutherford's endeavours. Rutherford himself and his pupils were eagerly occupied with tracing out the consequences of his new view of the nuclear structure of the atom. It would give only a poor impression of our trust in his judgment for me to say that nobody in his laboratory felt the slightest doubt about the correctness and fundamental importance of this view, although naturally it was much contested at that time. I remember being told by Hevesy soon after my arrival the story circulating in the laboratory of how Rutherford, shortly before his discovery, in a conversation with Moseley expressed the opinion that after all the troublesome investigations of the preceding years—during which he had such faithful assistance from Geiger—one would have had quite a good notion of the behaviour of an α-ray, were it not for the return of a minute number of these rays from a material surface exposed to an α-ray bombardment. This effect, though to all appearances insignificant, was disturbing to Rutherford, as he felt it difficult to reconcile it with the general ideas of atomic structure then favoured by physicists. Indeed, it was not the first, nor has it been the last time, that Rutherford's critical judgment and intuitive power have called forth a revolution in science by inducing him to throw himself with his unique energy into the study of a phenomenon, the importance of which would probably escape other investigators on account of the smallness and apparently spurious character of the effect. This confidence in his judgment, and our admiration for his powerful personality, was the basis of the inspiration felt by all in his laboratory, and made us all try our best to deserve the kind and untiring interest he took in the work of every one. However modest the result might be, an approving word from him was the greatest encouragement for which any of us could wish.

When the War broke out, the little community in his laboratory was dispersed. Having, however, then taken up a lecturing post in Manchester, I had the opportunity in the succeeding years of witnessing the undaunted spirit and never-failing cheerfulness of Rutherford even in the most difficult times. Although the study of the more practical physical problems arising in connexion with the defence of his country took up practically all his time and energy in those years, he could still towards the end of the War find leisure to prepare for, and finally accomplish, perhaps his greatest scientific achievement, the transmutation of an element through the disintegration of the atomic nucleus by impact with α-rays; an achievement which may be said indeed to open up a new epoch in physical and chemical science.

Just at this time Rutherford was, on Thomson's retirement, offered the directorship of the Cavendish Laboratory as his unrivalled successor. I remember on a visit to Manchester during the Armistice hearing Rutherford speak with great pleasure and emotion about the prospect of his going to Cambridge, but expressing at the same time a fear that the many duties connected with this central position in the world of British physics would not leave him those opportunities for scientific research which he had understood so well how to utilise in Manchester. As everybody knows, the sequel has shown that this fear was unfounded. The powers of Rutherford have never manifested themselves more strikingly than in his leadership of the Cavendish Laboratory, the glorious traditions of which he has upheld in every way. Surrounded by a crowd of enthusiastic young men working under his guidance and inspiration, and followed by great expectations of scientists all over the world, he is in the middle of a vigorous campaign to deprive the atoms of their secrets by all the means which stand at the disposal of modern science.

The Cavendish Laboratory: 1876–1900.

By Sir Richard Glazebrook, K.C.B., F.R.S.

It is fifty years since I first entered the Cavendish Laboratory. Eight years previously physics, in the form of questions on heat, electricity, and magnetism, had become a part of the Mathematical Tripos, and in 1869 a syndicate had reported in favour of founding a special professorship to take charge of these subjects, providing him with a laboratory, a demonstrator, and apparatus to make his teaching practical. Two years later, in 1870, the Duke of Devonshire offered to provide the material part of the scheme "so soon as the University shall have in other respects completed its arrangements for teaching Experimental Physics."

Clerk Maxwell became professor on March 8, 1871, and the laboratory was handed over to the University by its donor, the Chancellor, on June 16, 1874, confident, as he said, "that within its walls researches will be carried out which will advance to no small extent the fame of our ancient University." A prophetic statement; for within those walls have worked Maxwell, Rayleigh, Thomson, and Rutherford, men whose names will ever be landmarks in the history of British physics.

To complete the history of the building, a large ground-floor room for the practical instruction of the M.B. students was added in 1893, while in 1906 Lord Rayleigh offered to devote the greater part of the Nobel prize awarded to him to defraying much of the cost of a new wing; this was completed in 1908. In more recent years the erection of the new engineering laboratory has set free buildings and space adjoining the Cavendish, and a further important extension has been added to the laboratory.

To go back, however, some fifty years. In those days students came slowly. W. M. Hicks was the first. Wm. Garnett had become demonstrator on the opening of the laboratory. J. E. H. Gordon was the first to submit for publication the results of a research conducted at the Cavendish in a paper on the magnetic rotation of water, read before the Royal Society in 1875. When I became a student along with W. N. Shaw and Poynting in 1876, Chrystal and Saunder were at work on the verification of Ohm's law; Schuster joined a few months later. W. D. Niven had an investigation in progress, and soon afterwards Donald MacAlister carried out a modification of the well-known Cavendish experiment on the inverse square law of electrical attractions. Poynting began his classical research on the determination of the constant of gravitation during this same period.

Experimental physics was a novel subject at Cambridge. In the Mathematical Tripos of 1876, Lord Rayleigh was an examiner and had set a question on the Wheatstone bridge method of measuring resistance, with an easy rider. I had read carefully much of Maxwell's "Treatise on Electricity and Magnetism," published in 1873, but, alas, had paid no attention to Chapter xi. on "The Measurement of Electrical Resistance." My coach had originally marked it with a large O—omit. It is true he had corrected this later, but I had no idea of what was meant by Wheatstone bridge. My annoyance was great when, on my first visit to the Cavendish, Maxwell himself explained it and I realised the simplicity of the question I had passed over.

In those days there were no organised classes in practical physics. Maxwell set us on to gain acquaintance with some instrument, to adjust it to get it to work and make some measurements. Among my earlier experiences I was told off to measure at regular intervals the E.M.F. of a battery of tray Daniell cells used by Chrystal and Saunder. The instrument with which I had to do this was the large pattern of Thomson's absolute attracted disc electrometer, a horrid monster which few students of to-day have ever seen even in a text-book, and fewer still have used.

However, I soon became absorbed in optical work. Stokes, in his well-known report on optical theories, had described a method of determining the form of the wave surface in a crystal and had applied the method to Iceland spar. He encouraged me to attempt the same for a biaxial crystal and lent me the goniometer he had used. Schuster obtained for me from Hilger a suitable piece of aragonite and the work went on for some time in a dark room at the top of the Cavendish; eventuating in a paper published in the *Philosophical Transactions* for 1878, in which it was shown that Fresnel's wave surface was consistent with experimental results to a very high order of accuracy.

During the progress of the work Maxwell was a frequent visitor, interested in its progress, and ready to help. In the case of a serious difficulty he would remark that others had been asking him questions and he must take time. On one occasion I remember him explaining how thick the crust was in which their

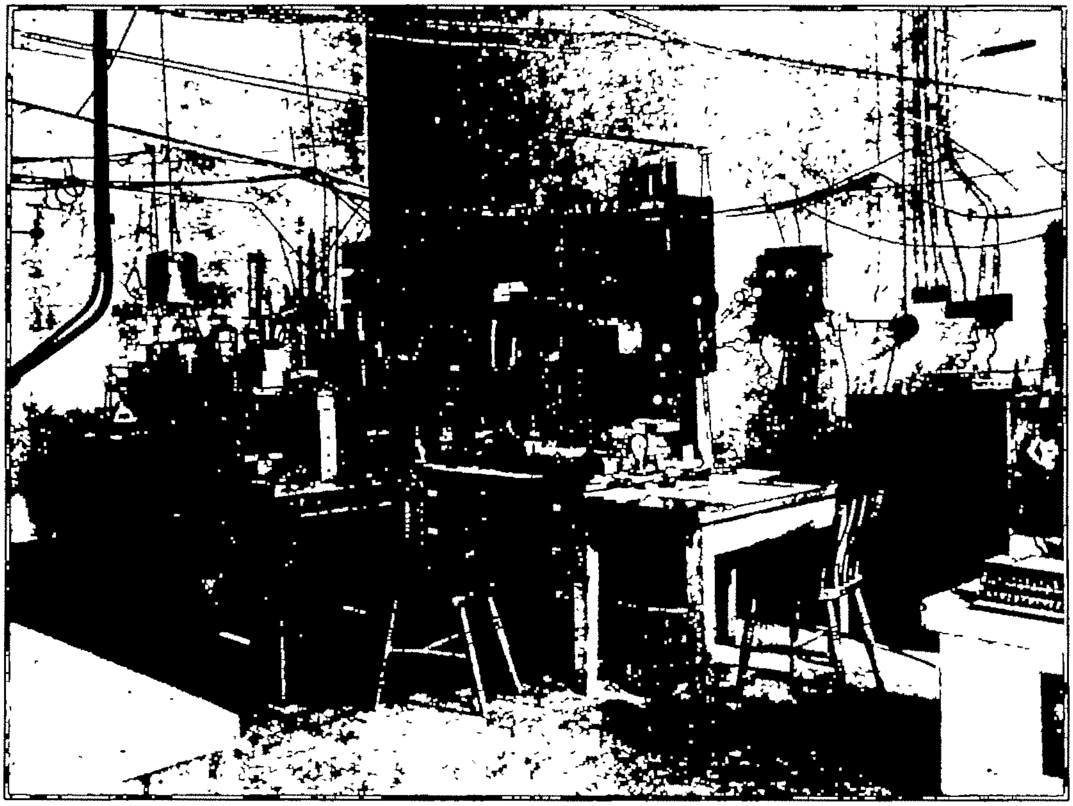


FIG. 7.—General view of Sir Ernest Rutherford's research room. On the extreme left is the electromagnet and microscope used in experiments on the artificial disintegration of some of the elements by bombardment with α-rays. On the extreme right is part of the pillar used by Lord Rayleigh in his determination of the value of the ohm and the ampere. This room was occupied for more than twenty years by Sir J. J. Thomson, for his experimental researches.

questions had encased his brain, but the next day he turned up, accompanied as usual by his dog, with the remark, "If you will alter your arrangements in such and such a way you will find your difficulties disappear," and of course they did.

Those were happy days; there have been many since at the laboratory, but the study of a new subject was full of interest, and the gradual realisation of what experimental investigations with the view of the improvement of material knowledge involved, added much to the pleasure of life and fitted one more and more for the teaching work to come in the future.

In 1879 came a change; Maxwell's health gave way during the Easter term of that year, and after a painful illness he died on November 5. The professorship was continued—it was to terminate originally with the tenure of office of the first professor unless the University determined otherwise—and Lord Rayleigh was appointed on December 12, 1879. He had accepted the post for a limited period—five years—and began work early in 1880. He was anxious from the first to organise regular teaching in practical physics, and appointed Shaw and myself as demonstrators soon after his election. The notice of the work for the Michaelmas term, 1880, after announcing lectures by the professor, by Dr. Schuster on radiation, and by Shaw and myself, continues: "The laboratory will be open daily . . . for those who have had the necessary training. Courses of demonstrations will be given during the Lent term on heat and advanced electricity, and magnetism, and during the Easter term on light, electricity, and sound."

The scheme was something of an innovation in one important detail. Shaw and I were college lecturers, receiving nearly all our remuneration from our colleges; we were among the first to give college lectures in a university building. Hitherto there had been a marked distinction between the lectures of a professor and college teaching; the growth of the natural sciences brought a change. Various colleges still had their own classes and laboratories; at Trinity, Coutts Trotter lectured on physics in college. In physiology and comparative anatomy, however, Foster as Trinity prælector, Frank Balfour and Sedgwick as college lecturers, worked in university buildings. It was clearly out of the question for each college to have its own staff and laboratory in all the new subjects, and so the plan of giving university recognition to college lecturers was gradually evolved, a plan which this year the new statutes have made universal; the formal lectures in all subjects are now given by university officers.

The task we had undertaken was a novel one for us both. Shaw had worked at Freiburg with Warburg and at Berlin under Helmholtz, but at neither place was there organised class teaching in practical physics. My experience had been gained solely as a research student under Maxwell. There were no text-books properly so called. We drew largely on Kohlrausch's "Physical Measurements" and Pickering's "Elements of Physical Manipulation" Pickering at the Massachusetts Institute of Technology had organised a method of instruction which we followed in great measure. There were, it is true, physical laboratories under Wm. Thomson (Lord Kelvin) at Glasgow, Carey Foster at University College, London, Adams at King's College, and Clifton at Oxford. But the time given to practical physics was short, the means of instruction scanty, and there was comparatively little endeavour to teach the principles of physics to a student by means of experiments which he performed himself.

Gradually the system developed; note-books descriptive of each experiment were written, and these in due time became Glazebrook and Shaw's "Practical Physics." The students were taught to describe in their own note-books their work, and enter up their observations; in the advanced class they were expected to read up the theory referred to and work to a high degree of accuracy. The material on which we drew for students was of a very high order. In my class on advanced electricity in 1881, I find the names among others of J. M. Dodds, S. L. Hart, W. B. Allcock, Edward Hopkinson, A. R. Forsyth, R. S. Heath, J. Ryan, and R. Threlfall.

Above all we had the wise counsel and cordial help of the professor: the course was planned and the syllabus arranged after careful counsel taken with him. We could go to him for advice in case of difficulty, otherwise we were free to teach as seemed best and to develop the work in the directions which seemed most desirable. In due time we had efficient helpers, Newall, Wilberforce, Searle, Skinner, Threlfall, Fitzpatrick, Callendar, Whetham, and McConnel, to name only a few, though some of these belong to a later period than that I am now describing.

It was, however, not merely the organisation of teaching which gave interest to the work. The laboratory began to be, to an extent as never before, a centre of new knowledge. A glance at Lord Rayleigh's collected works will show the importance of his output during the five years' tenure of the chair. The experiments of Rowland and Joule had led definitely to the result that the resistance coils constructed by Fleeming Jenkin and Maxwell in 1863 to represent the ohm (10^9 C.G.S. units of resistance) were in error. The Standards Committee of the British Association was reconstituted at Swansea in 1880, and Lord

Rayleigh at once began to take an active part in its work. His first series of experiments with the rotating coil of the original committee, carried out with Schuster, confirmed the fact that there was an error in their determination. Further experiments with a new rotating coil in 1882, and by the method of Lorenz, with the assistance of Mrs. Sidgwick, in 1883, led to definite values from which there has been little variation up to the present. Meanwhile he had arranged that I, as secretary of the B.A. Standards Committee, should undertake to test and issue certificates for resistance coils, and this work went on at the laboratory for the next fifteen years, being ultimately transferred to the National Physical Laboratory.

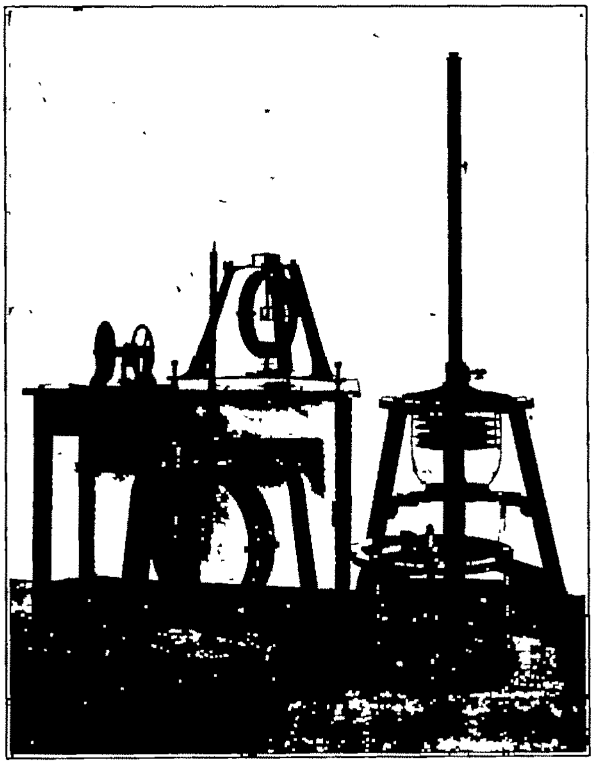


FIG. 8—Some classical apparatus. The coil on the table is the original spinning coil of Maxwell and Fleeming Jenkin used for the determination of the ohm (1864); it is now on loan at the Science Museum, South Kensington. The coil below is the spinning coil of the late Lord Rayleigh, with stroboscopic attachment, used for the determination of the ohm (1882). The coils on the right were made by Chrystal and used by Glazebrook in his determination of the ohm. On the right is Maxwell's apparatus for measuring the viscosity of air at different pressures. A phonic wheel of Rayleigh's stands to the left on the table.

Throughout this period, and indeed until the end of his life, Sir William Thomson was a frequent visitor to the laboratory, enthusiastic always, keenly interested in the experiments in progress, and full of helpful encouragement for us all.

Work on the electrochemical equivalent of silver, and the E.M.F. of a Clark cell, followed quickly. At a later date Lord Rayleigh took an active part in designing the standard ampere balance for the Board of Trade. He acted as president of the International Electrical Conference held in London in 1908 at which the definitions of the International Ohm, Ampere, and Volt were agreed to by delegates representing Great Britain, certain of her colonies, and twenty-two other countries. The results then reached find their main support in his work[1] during the years 1881–1885.

Some of the apparatus used in these and in the earlier experiments of Maxwell is shown in Fig. 8, which is reproduced in "A History of the Cavendish Laboratory, 1871–1910," published by Messrs. Longmans, Green and Co., to which volume I have referred for much in this article. At about the same period the original resistance coils of the B.A. had been brought to the laboratory, and Fleming commenced his long series of electrical researches by a careful intercomparison of these. The Darwins—George and Horace—were at work on the lunar disturbance of gravity. Schuster, in addition to assisting in the electrical experiments, continued his investigations into spectroscopy and radiation. J. J. Thomson's paper—the first dated from the Cavendish Laboratory—"On some Electromagnetic Experiments with open Circuits," appeared in the *Philosophical Magazine* for July 1881. In the previous April his paper on the electric and magnetic effects produced by the motion of electrified bodies had been published; in it he demonstrated that a moving charge will act as though it possessed mass of amount $\frac{2}{3}e^2/a$, where e is the strength of the charge supposed to be treated as a small sphere of radius a. Other papers rapidly followed, while in 1883 a determination of the number of electrostatic units in the electromagnetic unit of electricity was printed in the *Philosophical Transactions of the Royal Society*, and a paper on a theory of the electric discharge in gases in the June number of the *Philosophical Magazine*.

Shortly before his death, Maxwell had called Shaw back from Berlin to undertake work for the Meteorological Council, and thus began, with a paper on the measurement of temperature by water vapour pressure (1883), followed by his report on hygrometric methods (*Phil. Trans.*, 1888), that long series of investigations which has gained him recognition as the leader of modern meteorologists.

My own work on the form of the wave surface of

---

[1] It may be of interest to compare the values for the ohm (10^9 C G S units of resistance) expressed as the length of a column of mercury found at the Cavendish Laboratory in 1882 and 1883 with the most recent values.

1882	Rayleigh	106·26 cm.
1882	Glazebrook	106·25
1883	Rayleigh and Sidgwick	106·24
1913	F. E. Smith	$106{\cdot}24_5$
1920	Grüneisen and Giebe	$106{\cdot}24_6$

biaxial and uniaxial crystals was continued in 1886 by McConnel in his paper on quartz. I was diverted from optical work by the duties which came to me on my appointment in 1882 as secretary of the Electrical Standards Committee. Chrystal, when at the laboratory, had constructed a ballistic galvanometer and wound a pair of large coils for a determination of the ohm by a modification of Kirchhoff's method. With the aid of two of the senior students, Dodds and Sargant, these were set up and a series of determinations made, with the result already given, practically identical with that obtained by Lord Rayleigh. These same coils were used by him for his Lorenz experiments, and the close concordance of the results is of importance as an error in the calculated value of the mean radius of the coils would affect them in opposite directions.

At the end of 1884 Lord Rayleigh resigned and J. J. Thomson became professor. The work of teaching continued on much the same lines. The new professor realised no less fully than his predecessor the value of practical physics not only as an engine of research but also as an instrument of education.

Thomson, assisted by Threlfall, at once began that series of experiments on the discharge of electricity through gases which has occupied him until now. Newall returned to Cambridge and shortly afterwards became demonstrator in succession to Shaw, who in 1887 was made tutor at Emmanuel College. About this time Newall, Threlfall, Cassie, Wilberforce, Fitzpatrick, Callendar, and Chree were at work on various problems, while Olearski and Natanson were the first of the long series of research students attracted to Cambridge by the growing fame of the professor.

An addition of some importance was made to the laboratory teaching in 1888, when practical classes for medical students were commenced. For some time previously a viva voce with instruments had been part of the first M.B. examination, and the introduction of more definite teaching suited for the examination became desirable; Fitzpatrick took charge of this. Meanwhile the other classes continued to increase, and as the teaching of practical physics spread to the schools it was necessary to devise fresh experiments of a somewhat more advanced character. Searle became demonstrator in 1891 and threw himself with great zeal into this work.

In 1895 a change of far-reaching importance was made in the University regulations. Up to that date research students from other universities had no recognised position in Cambridge; some few there had been, admitted to the laboratories by the courtesy of individual professors. From this time onwards graduates of other universities, and in some cases students who were not graduates, could enter the University for purposes of research if they satisfied the proper authorities of their competence. They could obtain a degree at the end of two years if they submitted to the Board of Studies a thesis which in the opinion of the Board was "of distinction as a record of original research." In the October term after these regulations were passed, Rutherford, Townsend, and McClelland came as the first students; their number is now legion.

Rutherford's earliest work was on a detector of wireless waves. Hertz's experimental verification in 1887 of Maxwell's theory of electromagnetic waves had been received with great interest when first published. We knew the theory to be true—it was Maxwell's—and to have it verified by direct experiment had been no small satisfaction to Maxwell's pupils. I well remember some time in 1896 being taken by Rutherford into his room to see his magnetic detector at work receiving a message from, I think, the observatory.

Meanwhile Thomson had continued his work on the passage of electricity through gases, and the discovery of the Röntgen rays in 1895 gave him and the band of students he had collected a powerful method of investigating the subject. In 1897 came the discovery of the electron. Perrin in 1895, and Thomson two years later, had proved that the cathode rays of Crookes consisted of a stream of particles each carrying a negative charge. Thomson in 1897 measured the ratio of the mass of each particle to its charge and also the velocity with which the particles travel. The quantity, m/e, was found to be much smaller than would be the case if m represented the mass of the hydrogen atom and e its charge. Moreover, its value was independent of the nature of the gas in the tube, and he concluded that we have in the cathode rays a condition "in which all matter that is matter derived from different sources such as hydrogen, oxygen, etc., is of one and the same kind; this matter being the substance from which all the chemical elements are built up."

In the same year, 1897, Kaufmann and Wiechert determined independently the value of the ratio m/e, arriving at similar results. Schuster in 1884 had suggested that if the cathode rays consisted of charged particles it was possible to determine the ratio e/m by a method practically identical with that employed later by Kaufmann, and in 1890 published results of experiments which led to limits for the value of e/m for the cathode rays.

In the following year Thomson showed that the charge e carried by one of his corpuscles or electrons was the same as that of an atom of hydrogen, and from this it followed that the mass of the electron is about 1/1800 of that of an atom of hydrogen. The existence of the electron, the fundamental unit of negative electricity, became an accepted fact, and the long series of modern discoveries connected with the names of Thomson, Rutherford, Bohr, and their pupils was the result.

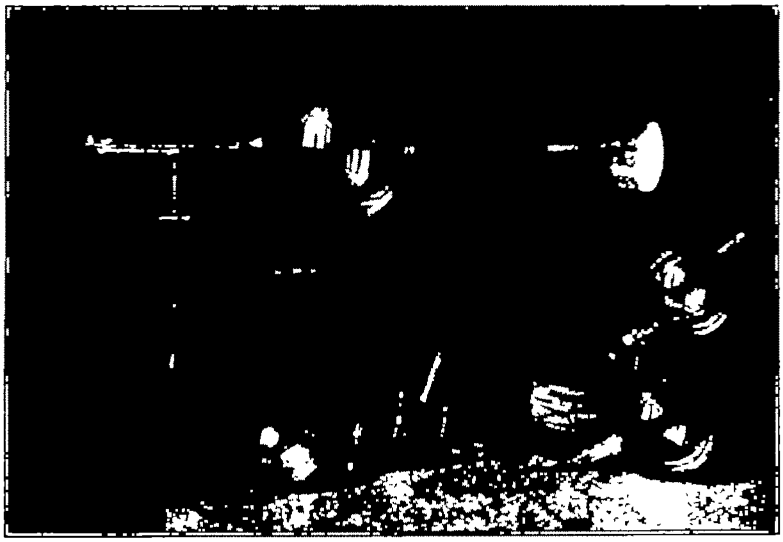


FIG. 9.—Apparatus used by Sir J. J. Thomson in his investigations. The upper tube is an early form of positive ray tube for visual examination of the parabolas. The lower, left hand, tube is one used to show the electrical deflexion of the cathode rays in 1897. By measuring the deflexion of a pencil of rays in an electric as well as in a magnetic field, the velocity and the ratio e/m for the electron were determined. On the right are examples of electrode-less discharge bulbs.

Thomson and his pupils continued this work. McClelland examined the Lenard rays which appear on the opposite side of a thin sheet of metal on which the cathode rays impinge, and showed that they were identical in properties with cathode rays. Stokes had suggested that the X-rays of Röntgen consisted of pulses set up by the sudden stoppage of particles carried in the cathode rays. Thomson investigated the nature of the effects produced by such a sudden stoppage, proving that it would give rise to a thin pulse of very intense electric and magnetic force travelling out from the particle with the velocity of light. He later applied this theory to explain the secondary radiation produced when X-rays fall on matter. Langevin, the first of the foreign students to enter the laboratory under the new regulations, investigated the character of this secondary radiation and published his results in his thesis for the degree of Doctor of Science in Paris.

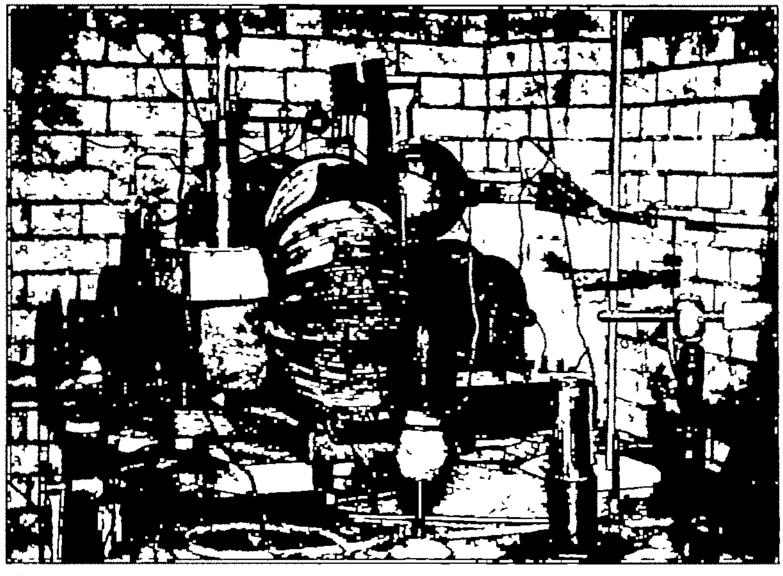


FIG. 10.—Apparatus for the analysis of positive rays by Sir J. J. Thomson's 'parabola' method This was the first made in which the photographic plate could be lowered into position by a vacuum-tight winch. It was in this room, with a slightly modified apparatus, that the duplicate parabolas of neon were first photographed, in 1912.

New knowledge grew rapidly. Rutherford, Townsend, H. A. Wilson, Zeleny, Strutt, and others contributed. C. T. R. Wilson's paper on the condensation nuclei produced in gases by the action of various rays, published in the *Phil. Trans.* for 1899, proved of far-reaching importance. As time went on the influence of the Cavendish researches spread to other universities. Rutherford carried it across the Atlantic to Montreal, Townsend to Oxford, McClelland returned to Dublin, Langevin to Paris, while others came to take their place.

My days at Cambridge closed with my appointment as Principal of University College, Liverpool, toward the end of 1898. Formal connexion with the laboratory had ceased some two years earlier when I had undertaken administrative work for my College. The last experimental investigation I helped to carry out was undertaken along with Lodge, who spent a summer vacation in Cambridge, as an essay to be submitted for a prize offered by Elihu Thomson. The investigation included a determination of v by means of the measurement of the frequency of the oscillations in a circuit of known capacity and inductance, and was published in the Stokes Memorial volume issued in 1899. Up to that time I had been closely connected with the Cavendish for nearly twenty-five years and have written of things I knew. I must conclude now and leave to others more intimately acquainted than myself with the progress of the last quarter of a century to tell in detail what that progress has been. Thomson continued his work until 1918, through the troubled period of the War, when the researches of the Cavendish assisted to the full in the solution of many problems. In that year Dr. Butler, the revered Master of Trinity, died, and Thomson was chosen by the Crown as his successor. He resigned the Cavendish professorship with its charge of the laboratory, and the University created for him a professorship of physics which will cease with his tenure of the post. Rutherford followed as professor, and under his genial direction he and his 'boys' from day to day increase the sum of natural knowledge by their amazing results and add in no small degree to the fame and influence of the Cavendish Laboratory, thus verifying the forecast of its founder more than fifty years ago

---

Research Work in the Cavendish Laboratory in 1900–1918.

By Prof. J. A. Crowther.

The progress of science and the life of a laboratory have little connexion with the artificialities of chronology, and the beginning of the century does not coincide with any natural division in the work of the Cavendish Laboratory. If, for the sake of clearness, we must make a division in what was fundamentally a natural and continuous growth, our most convenient date will be the year 1903, and our obvious landmark the publication of the first edition of Thomson's monumental book, "Conduction of Electricity through Gases." Here we find for the first time a complete and logical account of the solid achievements of the previous eight or ten years of remarkable activity. Here also we find the foreshadowings of the ideas which were to direct and regulate a large part of the work of the succeeding years.

In the main the problems attacked in the years before 1903 were those of the mechanism of the conduction of electricity through gases. Some of these, it is true, were carried over into the succeeding period. Some, perhaps, have not yet been fully solved, but by 1903 the foundations of the subject had been well and truly laid. It had been proved, beyond doubt, that the conductivity imparted to gases by various agents, such as X-rays, the rays of radium, and ultra-violet light was due to the formation of charged particles or gaseous ions in the gas, and many of the properties of these ions had been determined. Rutherford had determined their mobility; Townsend had determined their rate of diffusion through various gases; C. T. R. Wilson had shown that they could serve as nuclei for the condensation of water in a supersaturated space. Thomson had discussed their motion, and shown that in all probability they consisted of single molecules of the gas in which they were formed.

In a closely allied subject Thomson had demonstrated experimentally the existence of the electron, or negative corpuscle as we then called it, and had determined its few simple properties. The measurement of the electronic charge actually falls within the present century, though preliminary experiments had been made somewhat earlier. Determinations were made independently by Thomson and by H. A. Wilson, by somewhat different methods, and were published in 1903. During the same period Zeleny made new measurements of ionic mobilities, which when combined with further measurements on the diffusion of ions by Townsend established conclusively the identity of the charge on a gaseous ion with that on a monovalent ion in solution. These experiments mark the culmination of the first epoch.

When I commenced research work in 1905 the second epoch of activity was already well under way. With the exception of C. T. R. Wilson, who in the advanced laboratory was engaged in imparting to a new generation of students those experimental arts of which he is a master, the first group of workers had all dispersed. Their work, as collected in the pages of "Conduction through Gases," formed our text-book, and was the foundation on which we hoped to build.

It was a very happy, though crowded, community to which I had the honour of being admitted. The space available for research had not been extended since the laboratory was built, and what had been adequate for ten or twelve, the average number of research workers before 1903, was becoming a tight fit now that the numbers had risen to an average of twenty-five. A competent observer records that there was more physics to the square centimetre in the Cavendish than anywhere else in the world, and the resources of the laboratory in the way of apparatus were sometimes severely tested, though I cannot recall that they ever broke down. The oft-repeated legend that we worked entirely with sealing wax and string, though flattering to our technique, has little foundation in fact. The apparatus for the new experiments which we wished to make did not exist. It had to be invented and made on the spot. An adequate workshop, staffed with extraordinarily competent and helpful mechanics, with F. Lincoln as chief, carried us through the worst of our difficulties; while Everett, the professor's private assistant for so many years, was always willing to lend a hand in the worst intricacies of glass-blowing. For the rest there was the spirit of cheery fellowship and good comradeship which extended from the professor to the rawest recruit, and bound us all into a genuine community.

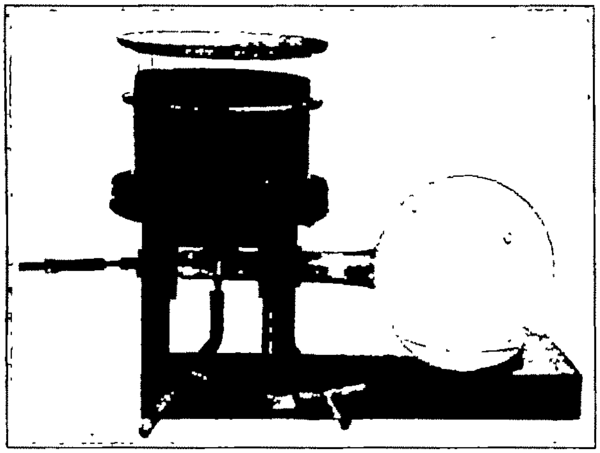


FIG. 11.—Prof. C. T. R. Wilson's original expansion apparatus for making visible the tracks of ionising particles. It was made in the Cavendish Laboratory in 1911 and is the apparatus with which his photographs of the tracks have been obtained.

It is clearly impossible to attempt to give any adequate account of the activities of so many workers, extending for so many years, within the bounds of a single article. A mere list of publications would fill more space than I have at my disposal. I can only outline the general trend of discovery in the laboratory as I saw it, and many excellent pieces of research such as those of Burton on colloids, of Wellisch on ionic mobilities, of Vegard on osmosis, and of C. T. R. Wilson on atmospheric electricity, must pass unnoticed. This is the more unfortunate in that it may tend to accentuate the erroneous impression that the research work of the Cavendish has been entirely specialised and one-sided. This has never been true. Workers with ideas in any branch of physics have always received a warm welcome, and the Cavendish has rarely been without them. The majority of the research workers, however, came to the laboratory as young students, to learn their job, and it was natural and inevitable that their work should be inspired and directed by the genius of Thomson, and should be correlated to the subjects which he had most in mind.

The dominant problem from 1903 onwards was that of the structure of matter, to which the way had been opened by the discovery of the universality of the electron. Thomson's main theoretical contributions to the subject appeared in 1903, 1904, and 1906, and dealt with possible arrangements of electrons to form atomic structures, and the properties—electrical, magnetic, and optical—which might be expected to result from these arrangements. The substance of these papers reappeared, in a somewhat more popular form, in "Electricity and Matter" and the "Corpuscular Theory of Matter." To bring these ideas to the touchstone of experiment was, perhaps, the main preoccupation of the laboratory until the year 1912.

A study of electrical conductors seemed to offer a hopeful line of approach. If the current through a metallic conductor is carried by electrons, which share in the thermal agitation of the molecules, some of them should escape from the surface if the temperature is sufficiently raised. Preliminary experiments on the subject were made by O. W. Richardson so early as 1901, and some of the theoretical consequences were discussed by Thomson in the following year. The subject was hotly pursued by O. W. Richardson in the Cavendish until 1906, and afterwards at Princeton, and has developed into the important branch of physics known as thermionics. Thomson, Horton, and others also made contributions to the subject. The preliminary work necessary to disentangle the genuine effect from the many spurious phenomena which accompany it was tedious and harassing, but important and valuable results were eventually obtained.

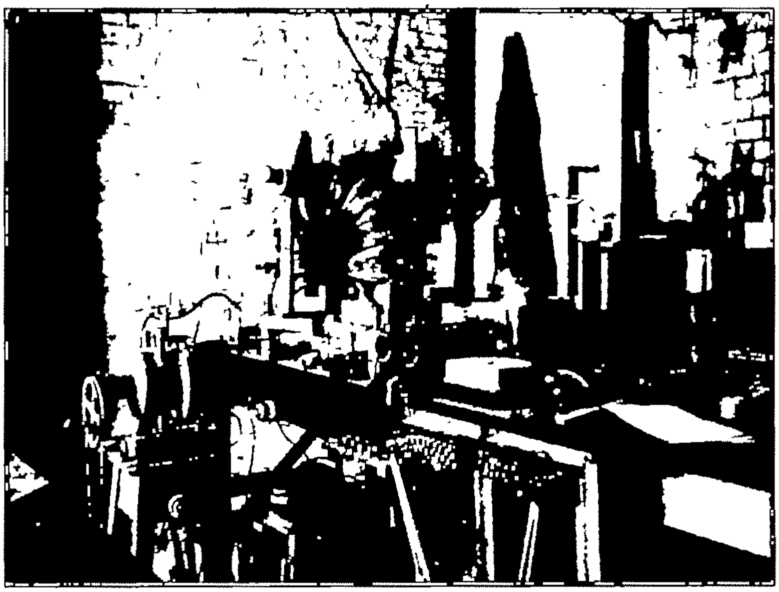


FIG. 12.—The first mass-spectrograph set up by Aston in 1919. This instrument was capable of comparing the masses of atoms and molecules with an accuracy of 1 in 1000. By its means, in five years, more than fifty elements were resolved into isotopes or shown to be simple.

The question of the radioactivity of ordinary materials, which was being investigated in the laboratory about this time by N. R. Campbell and A. Wood, also had its bearings on the main problem. Difficulties were met with in eliminating the effects of penetrating radiations from outside sources and the possibility of small traces of radium in the materials employed, and the results were indeterminate, except in the case of some of the alkali metals, which were found to emit appreciable quantities of β-radiation. Experiments made by Kleeman on the relative ionisation produced by different ionising radiations in gases, by Laby on the total number of ions produced by the complete absorption of the α-rays from uranium in different gases, and by Kaye on the output of X-radiation from targets of various metals, while important in themselves, also had a more or less direct bearing on the main problem of the atom.

In 1906 Thomson returned to the attack and gave the theory of two important methods of estimating the number of electrons in the atom of a given element. One method suggested was to measure the diffusion of a parallel beam of β-particles in their passage through thin sheets of matter. Assuming that the deflexions are due to collisions with the electrons in the atoms through which they pass, a determination of the scattering of the particles should provide an accurate estimate of the number of scattering centres. A second method consisted in measuring the intensity of the scattered X-radiation from a given radiator when subjected to a beam of primary X-radiation. Here again, assuming the correctness of the classical theory of the phenomenon which had already been given by Thomsen, it should be possible to deduce the number of scattering centres from the intensity of the radiation scattered. The experimental working out of both these methods fell to my lot, and kept me occupied from 1906 to 1911. The results showed that the number of electrons per atom was quite small, approximately of the order of the atomic weight, and that the main mass of the atom must be associated, not with its electrons, but with its positive charge.

In the meantime Thomson had himself been investigating the positive charge on the atom by various modifications of the method which had proved so successful with the electron. The results of these experiments on positive rays were published in various papers from 1908 to 1914. The importance of the new method lies in the fact that for the first time atoms could be dealt with as individuals, and not merely in aggregations of many millions. The results of these experiments, together with those of Aston (1919–1925) which led to the discovery of the existence of isotopes and the whole number law for the masses of the atoms, are too fresh in the memory to need further description.

In the meantime new ideas were afloat. The phenomena of secondary corpuscular radiation excited by X-rays, as studied by Innes, and of photo-emission (Hughes and others) were becoming more and more impossible to reconcile with the classical wave theory of light. The theory that the wave front was discontinuous was put forward by Thomson so early as 1907, and experiments to test the matter were made by N. R. Campbell, and by G. I. Taylor in 1909. Laue's discovery in 1912 of the diffraction of X-rays by crystals placed a new weapon in the hands of physicists, and by 1913 W. L. Bragg, working in the Cavendish, had already employed it to measure the distance apart of the atoms in a rock-salt crystal, and to deduce an absolute value for the wave-lengths of various X-radiations. A little earlier (1911–1912), C. T. R. Wilson, by an ingenious modification of his early experiments on the deposition of water vapour on charged ions, had evolved a method of making visible the actual tracks of ionising particles in gases, a method the potency of which has not yet been fully exploited, although it is now in use in many laboratories in all parts of the world. Whiddington, by his experiments on the excitation of characteristic X-radiation by cathode rays (1912), was already approaching the quantum theory of X-ray phenomena. At the commencement of 1914 the stage seemed fully set for a new outburst of activity which should rival even the early days of the laboratory under Thomson.

Alas, however, the world stage was set for quite a different drama, and its research workers found problems for solution far different from those which they had been expecting to attempt. When the laboratory began to fill up again in 1919, it was to learn that its professor had found the double duty of directing at one and the same time a great laboratory and a great college too much for one man's strength and time, and the Cavendish professorship was resigned. This is not the end of the story. Sir J. J. Thomson still continues his theoretical and experimental researches with unabated vigour and success, and under its new chief, Sir Ernest Rutherford, the Cavendish goes on to new problems and new triumphs. But these changes may conveniently mark the end of the present article, which has already exceeded its allotted span, without doing anything like justice to the many old companions and friends by whose side I have worked in the Cavendish laboratory, and whose faces look down upon me from the framed groups upon my study walls. Having worked in the Cavendish they will understand the impossibility of the task I have undertaken, and being Cavendish men they will forgive.

Printed in Great Britain by R. & R. CLARK, LIMITED, *Edinburgh.*

Chance's "Resistance"

THE heat-resisting qualities, the resistance to chemical attack, and the superior finish of

CHANCE'S LABORATORY GLASSWARE

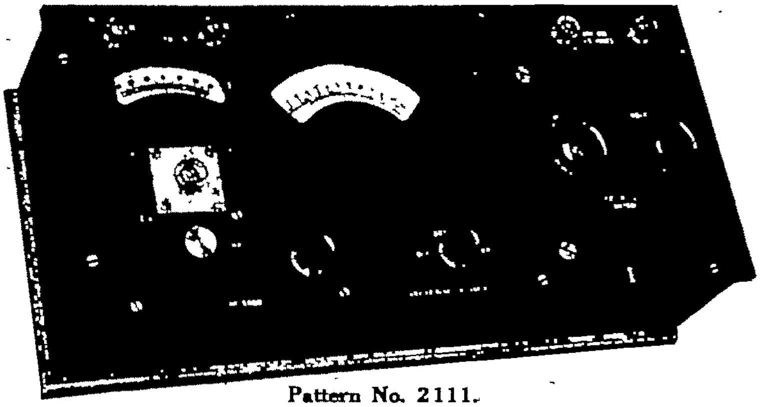
is unequalled by any other make,—British or Foreign. To prove this statement we will forward, on receipt of your Trade Card, a few samples of Chance's "Resistance" Laboratory Glassware. Test it and prove it in your own laboratory. *Stocked by all important Laboratory Furnishers.*

CHANCE BROTHERS and Co. LIMITED
GLASS WORKS SMETHWICK BIRMINGHAM

Laboratory Glassware

GAMBRELL BROS. LTD.

Test Set for Electro-Titration.



Pattern No. 2111.

The Set as illustrated includes a sensitive galvanometer, accurate voltmeter, potential divider, galvanometer key, and battery switch. All these components are mounted on an ebonite panel and protected from dirt and fumes by a polished hard wood case.

Merton Road, Southfields, London, S.W.18.

Phones: {Putney 5641-2 (Instrument).
{Victoria 9958 (Wireless).

Radio Sales Dept. for Wireless Apparatus {76 Victoria Street, London, S.W.1.

MACMILLAN'S STANDARD BOOKS ON PHYSICS

GENERAL AND REFERENCE

TEXT-BOOK OF PHYSICS. By J. DUNCAN, Wh. Ex., M.I.M.E., and S. G. STARLING, B.Sc., A.R.C.Sc. 18s. Also in parts: Dynamics, 6s.; Heat, Light, and Sound, 7s. 6d.; Magnetism and Electricity, 5s.; Heat, 4s. 6d.; Light and Sound, 4s 6d.; Heat and Light, 6s.

A TEXT-BOOK OF PRACTICAL PHYSICS. By PROF. H S. ALLEN, M.A., D.Sc, and H. MOORE, A.R.C.S., B.Sc. 10s. 6d. Part I. Properties of Matter. 4s. Parts II., III., and IV. Sound, Light, and Heat. 4s. Parts I. and IV. 5s. Part IV. 1s. 9d. Parts V. and VI. Magnetism and Electricity. 4s.

CLASS BOOK OF PHYSICS. By SIR RICHARD GREGORY and H. E. HADLEY, B.Sc. 6s. 6d. Parts I. and II. Fundamental Measurements; Hydrostatics and Mechanics. 2s. 6d. Parts I. II., and III. Fundamental Measurements; Hydrostatics and Mechanics; Heat. 3s. Parts I., II., III., and IV. Fundamental Measurements; Hydrostatics and Magnetism; Heat; Light. 4s. 6d, Part III. Heat. 2s. Parts III. and IV. Heat; Light 2s. 9d. Parts III., IV., and V. Heat; Light; Sound. 3s. Part IV. Light. 2s. Parts IV. and V. Light; Sound. 2s. 6d. Parts VI., VII., and VIII. Magnetism; Static Electricity; Voltaic Electricity. 3s.

EVERYDAY PHYSICS. By H. E. HADLEY, B.Sc. Complete, 6s. 6d. Section I. Fundamental Principles, 2s. 6d.; Sections II.-IV. Sound, Heat, and Light, 2s. 6d.; Section V. Magnetism and Electricity, 2s. 6d.

PRACTICAL PHYSICS: FUNDAMENTAL PRINCIPLES AND APPLICATIONS TO DAILY LIFE. By N. H. BLACK and PROF. H. N. DAVIS. 6s. 6d.

LABORATORY EXPERIMENTS IN PRACTICAL PHYSICS. To accompany Black and Davis' "Practical Physics." 4s. 6d.

INTERMEDIATE COURSE OF PRACTICAL PHYSICS. By SIR A. SCHUSTER, F.R.S., and PROF. C. H. LEES, F.R.S. 6s.

MANUAL OF PRACTICAL PHYSICS. By H. E. HADLEY, B.Sc. 4s.

AN ELEMENTARY COURSE OF PHYSICS. Edited by REV. J. C. P. ALDOUS, M.A. 7s. 6d. Part I. Mechanics; Properties of Matter; Hydrostatics; Heat. By REV. J. C. P. ALDOUS, M.A. 4s. 6d. Part II. Wave Motion; Sound; Light. By W. D. EGGAR, M.A. 2s. 6d.

LESSONS IN PRACTICAL PHYSICS. By PROF. BALFOUR STEWART, F.R.S., and W. W. HALDANE GEE, B.Sc. Vol. I. General Physical Processes. 7s. Vol. III. Part I. Practical Acoustics. By C. L. BARNES, M.A. 5s.

GENERAL PHYSICS FOR STUDENTS. By E. EDSER, A.R.C.Sc. 8s. 6d.

APPLICATIONS OF DYNAMICS TO PHYSICS AND CHEMISTRY. By SIR J. J. THOMSON, F.R.S. 8s. 6d.

A HISTORY OF PHYSICS IN ITS ELEMENTARY BRANCHES. By PROF. F. CAJORI, Ph.D. 10s. 6d. net.

DICTIONARY OF APPLIED PHYSICS. By Various Writers. Edited by SIR RICHARD GLAZEBROOK, K.C.B., Sc D., F.R.S. Illustrated. In 5 Vols. 8vo. £3 : 3s. net each. The set of 5 Vols., £14 : 14s. net. Vol. I. Mechanics, Engineering, and Heat. Vol. II. Electricity. Vol. III. Metrology, Meteorology, and Measuring Appliances Vol. IV. Optics, Sound, and Radiology. Vol. V. Aeronautics, Metallurgy, and General Index.

A TEXT-BOOK OF PHYSICS. By PROF. L. B. SPINNEY. 16s. net.

⁂ ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

RADIUM

Sole Agents for the British Empire (excluding only Canada) of the

ANGLO-BELGIAN MINING CORPORATION

THE UNION MINIERE DU HAUT KATANGA (RADIUM SECTION) OPERATING IN THE BELGIAN CONGO

We can supply
RADIUM ELEMENT in all forms
for physical and medical purposes.

A PRACTICAL HANDBOOK

Radium : Its Production and Therapeutic Application

55 pages, 10 plates, numerous figures of applicators, etc.

POST FREE ON REQUEST

Many of the most important institutions in the Empire have purchased Radium from us.

WATSON & SONS
(ELECTRO-MEDICAL) LTD
SUNIC HOUSE, PARKER ST.,
KINGSWAY, LONDON, W.C.2.

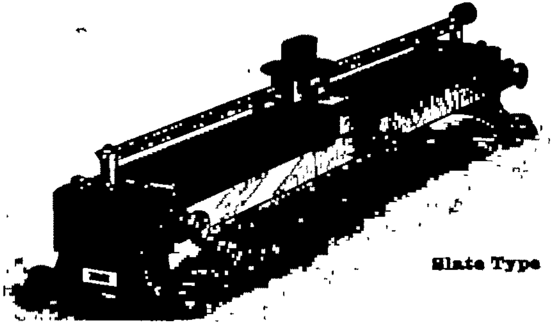
Telephone : Regent 1227. *Telegrams : "Skiagram, Westcent, London."*

ZENITH

REGULATING RESISTANCES

FOR LABORATORY USE

COMPETITIVE PRICES—PROMPT DELIVERIES



Slate Type

CATALOGUE OF ALL TYPES POST FREE.

THE ZENITH ELECTRIC CO. LTD.
(Formerly The Zenith Manufacturing Co.)
Sole Makers of the well-known "ZENITH" Electrical Products
Contractors to the Admiralty, War Office, Air Ministry, Post Office, L C C, &c.
ZENITH WORKS, VILLIERS ROAD,
WILLESDEN GREEN, LONDON, N.W. 2.

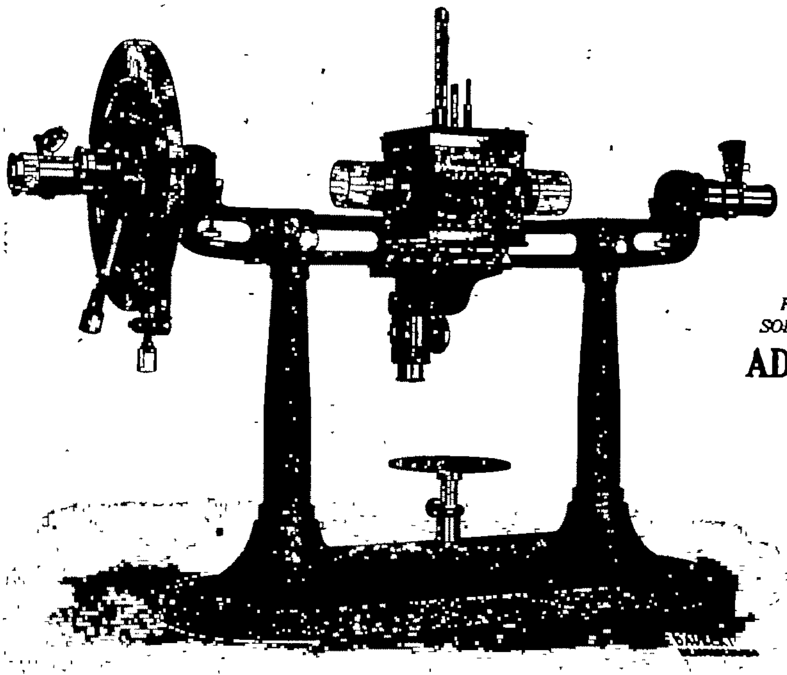
BRITISH INDIA

WINKEL-ZEISS GÖTTINGEN

BRITISH INDIA

POLARIMETERS

SACCHARIMETERS



Instruments with
LIPPICH or LANDOLT
OPTICAL SYSTEMS,
two and three field polarisers
for every type of work in
FACTORY CONTROL,
INDUSTRIAL, MEDICAL,
CHEMICAL & BIOLOGICAL
LABORATORIES

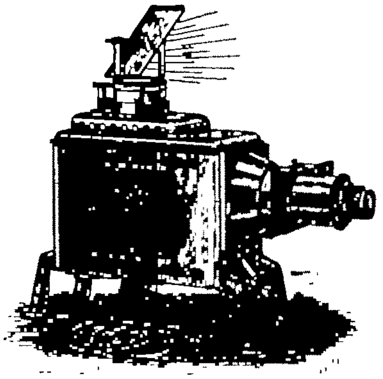
Full particulars and Rupee prices on request to the
SOLE DISTRIBUTORS FOR BRITISH INDIA

ADAIR, DUTT & CO. LTD.
(Incorporated in England)
Stephen House,
Dalhousie Square East,
CALCUTTA
and
Exchange Building,
Ballard Estate,
BOMBAY

Head Office : 47 Victoria Street,
London, S.W.1, where Government
indents may be sent.

JANUS EPIDIASCOPE

(Patented in Germany, England, and in other countries.)



With 500-Watt Incandescent Lamp
for the projection of
LANTERN SLIDES AND PAPER PICTURES
(postcards, book-illustrations, or any other
opaque articles)
VERY EASY TO USE
Gives brilliant pictures up to 8 × 8 feet
The best Lantern
FOR SCHOOLS, UNIVERSITIES, LECTURERS, ETC.

ED. LIESEGANG, DÜSSELDORF (Germany)
Founded 1854 Postbox 124

NOTICE

In consequence of the Christmas Holidays, NATURE for next week—December 25—will be published on **Thursday** instead of Friday.

Office of NATURE, St. Martin's Street, W.C.2

NOTICE

The Publishers of NATURE will be pleased to send on receipt of a postcard a list of the Steel and Photogravure Portraits contained in the "Scientific Worthies" series.

ST. MARTIN'S STREET, LONDON, W.C.2

TO KEEP IN TOUCH WITH SCIENTIFIC MATTERS
IT IS NECESSARY TO SEE "**NATURE**" REGULARLY

A subscription would be an Excellent Christmas or New Year Gift.

Subscription rates

Inland		***Foreign***
£2 12 0	*Year*	£2 17 0
£1 6 0	*Half-year*	£1 10 0
13 0	*Quarter*	16 0

All Subscriptions are payable in advance.

Cheques and Postal Orders
should be made payable to
Macmillan & Co., Ltd

Please send me "NATURE"
for months, for which I
enclose remittance value

Name . . . . .

Address . .

Date

THIS FORM MAY BE HANDED TO A BOOKSELLER OR NEWSAGENT, OR SENT DIRECT TO MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.

MICROSCOPIC STAINS

Specially made for Bacteriological and Histological work.

The B.D.H. Standard Stains are tested histologically before they are issued. They can be relied upon to give the correct reaction for each stain.

Applications are invited for a copy of our Price List and Booklet upon Clinical Pathology and the use of Stains.

THE BRITISH DRUG HOUSES, LTD.

Makers of Fine Chemicals,

Graham Street, City Road, London, N.1.

Chemical Works: Wharf Road, London, N.1.

Max Kohl A.G.

Chemnitz A1 (Germany)

Manufacturers of

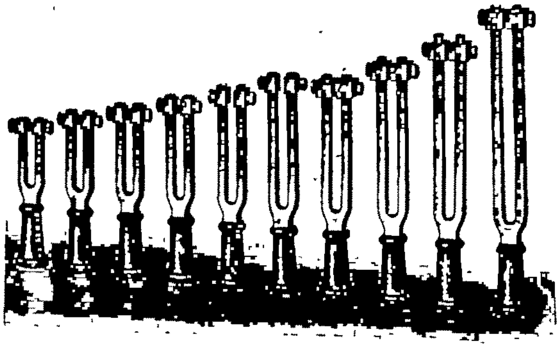
Physical Apparatus

Laboratory Furniture

Induction Coils · Oil Air Pumps

Experimental Switchboards

Projection Apparatus



Tuning Forks with Sliding Weights

Special Lists on request

On choosing a Loud Speaker

NO one would ever think of choosing a car without a great deal of thought and reflection. Yet how many people will buy a Loud Speaker without previously considering which type is suitable for their particular conditions? Haphazard choice of a Loud Speaker in fact has led to more dissatisfaction with radio than any other cause.

When buying a Loud Speaker consider these points:

1—TONE

First among the essentials of good reproduction is tone. Absolute freedom from distortion and a perfectly life-like rendering of every phase of the broadcast—orchestral and vocal, is necessary. It is upon this that Brown success has been founded.

2—VOLUME

It is essential that a Loud Speaker should be capable of giving a varied volume to meet individual needs; but whether the volume be great or small there must be no trace of distortion. There are very few Loud Speakers capable of rendering with real purity an unlimited amount of volume.

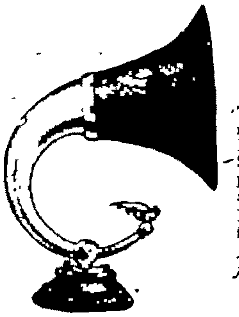
3—NAME

You may be shown Loud Speakers which *look* as good as the Brown, yet at much lower prices. Compare them, though, on quality of reproduction with any Brown—you cannot be other than impressed with the result. The name Brown stands for all that is best in radio reproduction—pure, unsurpassed tone combined with adequate volume.

¶

Illustrated here is the world-famous Brown "Q." It is universally acknowledged to be the height of Loud Speaker perfection.

Price £15 : 15s.



¶

There are nine models in the Brown Loud Speaker range—priced 30s. to £15 : 15s.

Headphones, too, from 20s. to 30s

Ask your Dealer for a Catalogue.

LET YOUR FRIENDS LISTEN!

Brown

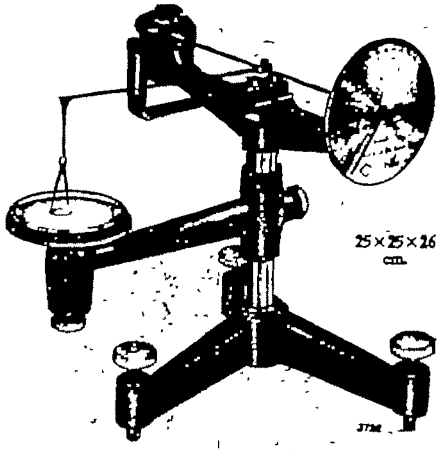
S. G. BROWN, LTD.

Western Avenue, N. Acton, W.3

Retail Showrooms: 19 Mortimer Street, W.1; 15 Moorfields, Liverpool; 67 High Street, Southampton. *Wholesale Depots:* 2 Lansdown Place West, Bath; Cross House, Westgate Road, Newcastle; 120 Wellington Street, Glasgow; 5-7 Godwin Street, Bradford, Howard S. Cooke & Co., 59 Caroline Street, Birmingham; N. Ireland: Robert Carmany, Union Chambers, 1 Union Street, Belfast.

G.A. 6603.

SURFACE TENSION APPARATUS



This apparatus has been designed by Dr. P. L. du Noüy for rapidly and accurately determining the surface tension of liquids. The method is simple, requires only a small quantity (about 1 c.c.) of the substance being tested, and is applicable to practically all kinds of liquids. The instrument is readily standardised with pure water at 20° C.

Further
particulars
on
application

CAMBRIDGE
INSTRUMENT CO LTD
WORKS:- LONDON & CAMBRIDGE
Head Office & Showrooms:- 45, GROSVENOR PLACE
LONDON, S.W.1
AMERICAN COMPANY:
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

"SURVEYING INSTRUMENTS"

by R. M. ABRAHAM, M.I.E.E., F.R.A.S.

A Book for the Surveyor and Scientific Explorer. 320 pp. 238 illustrations. 7/6

(Postage, Gt. Britain or Abroad, 6d.)

"It is a book which should be consulted by every surveyor who wishes to use his instruments to the best advantage."
NATURE, May 22, 1926

C. F. CASELLA & CO. LTD.
49 & 50 Parliament Street,
London, S.W.1

HOPKIN & WILLIAMS, Ltd.
16 & 17 Cross St., Hatton Garden, London, E.C.1
Works: Ilford, Essex.
Telegrams: "Cerium, Smith, London."
Telephone: Holborn [illegible] and [illegible].

The Leading British House for
CHEMICAL REAGENTS
PURE, FINE, AND RARE CHEMICALS

Manufacturers of Guaranteed
Chemical Reagents for Analysis and Research.

Made and supplied to standards and specifications described in the publication

"Analytical Reagents: Standards and Tests."

Compiled by
EDMUND WHITE, B.Sc. (Lond.), F.I.C.
Published by
HOPKIN & WILLIAMS, LTD.
NEW EDITION, 1925.
CLOTH BOUND. INTERLEAVED.
Price 1/6 post free from the Publishers.

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

years in buildings so primitive that one of the Austrian ministers himself described them as "a European scandal."

No wonder, then, that our students went to foreign universities! I believe the first of our scientific men who brought us some of the English research method in natural science was Prof. Boh. Brauner, our distinguished chemist, who studied at Owens College, Manchester (1880–82), and is well known to readers of NATURE.

Thirty years ago I had the opportunity to begin some research at Cambridge at the Cavendish under the guidance of Prof. J. J. Thomson. We were about eleven research students, and made quite a family party, meeting every day at tea-time in the professor's room. Prof. Thomson's discourses on these occasions, on the work going on in the laboratory, and his method of investigation, together with his clear and instructive mode of lecturing, his papers and books, made a great impression upon my whole future life. As a private lecturer at the University of Prague, where I trained young teachers in physics, and some years after, as professor of experimental physics at the Technical High School at Brno, I tried to follow my great teacher.

The laboratory work in our physical institutions at Prague and Brno, the spreading of English scientific literature throughout our libraries, our new text-books of physics, for both colleges and high schools, and especially the progress in new editions of books of practical physics, show clearly how we in Czechoslovakia have followed Sir Joseph Thomson's inspiring example.

Twenty years ago my friend Dr Záviška, professor in the Bohemian University, worked at the Cavendish, and his scientific work and method of teaching through these years are proofs of the inspiring guidance of the great director of the Cavendish Laboratory.

I am very happy to send this modest message of our deepest thanks, and appreciation of Sir Joseph Thomson's influence upon the progress of physical science in our country, on the occasion of the celebration of his seventieth birthday.

Prof. KARL PRZIBRAM,

Radium Institute, Vienna.

While deeply indebted to the editor for giving me the opportunity of joining in the world-wide chorus of congratulation in the columns of NATURE, I should feel abashed if it were not possible for me to say that I am "a citizen of no mean city"—the city of Doppler and Loschmidt, of Stefan and Boltzmann.

It is obvious that a centre of learning that boasts of such names on its roll of honour would offer fertile ground for the new ideas so lavishly given to the world by Sir J. J. Thomson. Yet, apart from certain researches on ionic mobility and condensation, which were, so to say, imported directly from Cambridge, this Thomsonian influence on Viennese science is difficult to trace in detail, not because it is too slight, but, on the contrary, too universal; it is, to-day, all-pervading, like the air we breathe.

To the world of science in general, J. J. Thomson stands out as one of the great pioneers who, beginning in the last decades of the nineteenth century, blazed the trail for the new physics. But to the awe and veneration due to such a leading genius there is added for those who, like myself, were privileged to enjoy the genial hospitality of the Cavendish Laboratory years ago, a warmer, more personal feeling: it is the yearning for those unforgettable old days in Cambridge and for that band of inspired workers with J. J. Thomson as their centre.

Prof. A. SOMMERFELD, For.Mem.R.S.,

University of Munich.

May I be permitted to mention an activity of Sir J. J. Thomson's which has almost been lost in the shadow of his later brilliant successes, but nevertheless constitutes a characteristic feature in the record of this investigator; I refer to his "Recent Researches in Electricity and Magnetism"—the so-called third volume of Maxwell. He is dealing here with the good old mathematical physics, the actual formal treatment of special physical problems. Both in Maxwell's "Treatise," and in J. J. Thomson's continuation of it, these are found in equilibrium, so to say, with the new and specifically Maxwellian ideas, but in recent times they have been in danger of being suppressed under the weight of modern interests. It was thus that J. J. Thomson at first continued the great school of mathematical physics which arose in Cambridge under Green and Stokes. In this way he laid for himself and his students the solid foundations on which the researches on the electron could be built.

Modern physical theories are transient, the mathematical methods eternal; if they seem temporarily to be asleep, they revive again in previously unsuspected regions. This is illustrated in the theory of relativity, where the Riemann geometry suddenly sprang into physical life, and it is now illustrated in the quantum theory, which has recently come under the sway of the boundary condition problems of classical mathematical physics.

We hope that the physics of the future will not be lacking in men like J. J. Thomson, masters at once of physical problems and mathematical methods.

Prof. P. ZEEMAN, For.Mem.R.S.,

University, Amsterdam.

"*From the point of view of the physicist, a theory of matter is a policy rather than a creed; its object is to connect or to co-ordinate apparently diverse phenomena, and above all to suggest, stimulate, and direct experiment.*" —J. J. Thomson, "The Corpuscular Theory of Matter," p. 1, 1907.

The invitation to contribute a message to NATURE on the occasion of Sir J. J. Thomson's seventieth birthday, is one which I gladly accept, though I realise how difficult it will be to formulate in a few lines the feelings of admiration Sir Joseph's influence on physical science provokes in all parts of the world where science is flourishing. Whenever any one personally acquainted with Sir Joseph reads his name, they see in their mind's eye his powerful head and characteristic appearance, inspirations for an artist on various occasions.

It is a delight to inspect the photographs taken from time to time in the Cavendish Laboratory during J. J. Thomson's tenure of the directorship and representing the professor surrounded by his research students. The influence Thomson has exercised upon his generation is nobly illustrated by these pictures. It is remarkable that so many of his former pupils are now filling important posts in other learned institutions and that several of them are in the very first rank of physicists. The photographs honour the great teacher, and at the same time set in a clear light the exceptional ability of the British mind to see the root of things.

A paper of great importance, "On the Electric and Magnetic Effects produced by the Motion of Electrified Bodies," appeared in 1881. Thomson showed that the magnetic field set up by an electrified particle in motion increases the apparent mass of the particle. Indeed, he gave us the first formula for the electro-dynamic mass The investigation is a most remarkable example of early genius, its author being at the time only twenty-five years of age. Unintentionally, Thomson was preparing himself for his grand work on the true nature of the cathode rays and the isolation of the electron.

The profound mathematical insight of Thomson we can admire in his "Applications of Dynamics to Physics and Chemistry," published 1885–1887, forerunner of Hertz's "Prinzipien der Dynamik," written at a time when the mirage of a real kinetic theory of matter was firmly believed in.

Before the last-mentioned investigations were published, Thomson was giving a great deal of his attention to experimental work in the laboratory, and apparently he did so more and more. Thomson's papers reveal the talents of the experimenter and of the mathematician, combined in a most remarkable and happy way. Unfortunately this combination, which enables their possessor to penetrate into the hidden depths of Nature, is very rare.

During a period of forty-five years, the results of Thomson's restless mental activity and originality have been given to the world in a series of investigations happily summarised in several books published as the subjects became ripe for description. They all exhibit the clearness and conciseness which are characteristic of Thomson's writings. I refer here not only to the fundamental work on the "Conduction of Electricity through Gases," but also to the delightful smaller books "The Discharge of Electricity through Gases"; "Electricity and Matter"; "The Corpuscular Theory of Matter"; and "The Electron in Chemistry"

Thomson's researches are often directed on questions relating to the deep and hidden nature of matter and electricity. He counts the number of electrons in the atoms; he arranges with his fertile imagination the electrons in coplanar rings inside a sphere of positive electricity; he gives us suggestions toward the explanation of the periodic law of the chemical elements; he gives us his views on the structure of light, and boldly explains some great difficulties of the old wave theory by his speckled wave front. A charming episode in the midst of these difficult investigations is the discovery of the isotopes of neon by Thomson's parabola method.

We hope that physics may still for many years benefit from Sir J. J. Thomson's labours.

Prof JOHN ZELENY,

Yale University, New Haven, Connecticut.

Science knows no national boundaries. An important discovery made in one laboratory soon becomes common knowledge and has its stimulating effect upon investigators throughout the world. The influence of any individual scientist upon research work in countries outside of his own is dependent therefore to a large extent upon the pioneer character and importance of his investigations. Greatly indebted as physical research in the United States is to Sir Joseph Thomson on such grounds alone, there are special reasons why his influence has been even greater than this measure would indicate

In the first place, during Sir Joseph's incumbency of the Cavendish professorship at Cambridge, physical research in the United States expanded enormously and spread to many institutions where previously little or none had been done. The inspiration that produced this growth was supplied in part by the few centres in our country where research was already thriving, and this influence must not be under-estimated. But the eyes of the scientific world were upon Sir Joseph and the Cavendish Laboratory, because from this source in rapid succession new ideas were being brought to light that were making a very deep impression on scientific thought. It was inevitable that this activity should spur men on to do research work and to choose as the field of their endeavour the one that was yielding such remarkable results.

Another important channel through which Sir Joseph's influence was disseminated in the United States was through those of our men who in this period worked under his direction in the Cavendish Laboratory. Many of these men already held influential positions in our universities, and on returning imparted to an increasing circle the enthusiasm for research which they had absorbed at the fountain-head.

Mention must be made, too, of the beneficial effect upon our research men of Sir Joseph's visits to the United States and of the lectures he gave there. Large numbers were thus not only able to hear him explain his most recent theories but also to benefit greatly from an intimate discussion with him of their own problems

Those of us who had the rare privilege of working with Sir Joseph at the Cavendish Laboratory count the years spent there as among those that we cherish most. We lived in an atmosphere sparkling with new thought. We enjoyed a free and happy comradeship. New ideas and interpretations of experimental results had to stand the test of friendly but none the less vigorous criticism. We experienced the thrill of being present when important discoveries were in the making, and day by day we were permitted to observe the working of Sir Joseph's penetrating and resourceful mind

Over and above all is the fact that this great man is wonderfully human. One cannot forget his many interests, his kind heart and lovable nature, his humour, the cheerfulness he radiates, his hospitality, and his readiness to serve others. To know him is to have for him a reverence and affection that but grows with the years.

The Jolly Electron.

Sung to the Tune of "The Jolly Miller," at the Physical Society Club.

1. There was a jolly electron—alternately bound and free—
Who toiled and spun from morn to night, no Snark so lithe as he;
And this the burden of his song for ever *used* to be:—
"I care for nobody, no, not I, since nobody cares for me."

Chorus.

And this the burden of his song for ever *used* to be,
"I care for nobody, no, not I, since nobody cares for me."

2. Though Crookes at first suspected my presence on this earth,
'Twas J. J. Thomson found me—in spite of my tiny girth.
He measured first the "e by m" of my electric worth;
I love J. J. in a filial way, for he it was gave me birth!

Chorus.

But this the burden of my song, etc.

3. 'Twas Johnstone Stoney invented my new electric name,
Then Rutherford, and Bohr, too, and Moseley brought me fame;
They guessed (within the atom) my inner and outer game,
You'll all agree what they did for me,
I'll do it for them, the same!

Chorus.

But this the burden of my song, etc.

4. Then Wilson, known as 'C. T. R.,' his camera brought to bear,
And snapped me (and the Alphas too) by fog-tracks in the air.
We like that chap! For a camera snap is a proof beyond compare;
A regular star is C. T. R., we'd follow him anywhere!

Chorus.

But this the burden of my song, etc.

5. So whether I rest as static charge, or rove in the ether free,
Or whether I settle in nuclear state, perched up on a proton's knee,
Or whether I spin my quantum yarns, in a spectroscopic key,
I'll love the 'Physicals' all the time, since all of 'em dote on me.'

Chorus.

But this the burden of my song for ever *used* to be,
"I care for nobody, no, not I, since nobody cares for me."

R. A. S. PAGET.

The Cavendish Laboratory as a Factor in a Counter-Revolution.

Sir NAPIER SHAW, F.R.S.

NOW that Parliament in its wisdom has once more made the University of Cambridge responsible for the teaching of its students, the wheel has come round full circle and we may fairly indulge in a retrospect about the teaching of science. The story may begin with 1851, when reforms were introduced largely at the instance of the Prince Consort, who had been elected Chancellor in 1847. There is an early pencilling in *Punch*, by John Leech, representing the election day with a placard of the opposition "Boats no Botany." It is astonishing how placidly an undergraduate can go through his course unconscious of living in a time of momentous change. The final statutes for the University of the 1851 Commission are dated 1858; but for the first time, in 1851, the class lists record the results of a Moral Sciences Tripos and a Natural Sciences Tripos, both quite new. Previously, dating back to 1824, there had been a Classical Tripos; but before 1851 it was limited to candidates who had already obtained honours in the Mathematical Tripos. The published class lists of that educational instrument go back to 1747–48 and form the connecting link between the triposes* of to-day and the academic system of the Middle Ages when the University was paramount.

In my undergraduate days there were still some notable relics of that system. Within the structure of the central University building, the Library, there were a Divinity School, a Law School, and an Arts School, each arranged like a court of justice. There was a Medical School also; but already it possessed a separate building with a museum and dissecting-room.

The schools were originally arranged for the candidates for honours to 'keep' their 'acts' for degrees in the faculties of Divinity, Law, Arts, and Medicine, with moderators for judges, proctors for police, and University students for the general public. The candidate sat upon his tripos as proponent of a thesis in theology, law, medicine, or philosophy, with opponents to take sides in a public disputation. That had been the medieval plan for deciding upon the relative merits of the candidates. Since the beginning of the sixteenth century there had been Regius professors in divinity, law, and physic, who could act as moderators for their faculties. There was also a Regius professor of Greek who might have been regarded as dean of the general faculty of arts or philosophy; but the colleges had captured the right of moderation in that faculty before the end of Queen Elizabeth's reign, and moderators were nominated by the colleges in turn, according to a fixed rota.

The colleges had also assumed responsibility for the education of their students in preparation for the final act The University had only to decide the relative merits of the candidates from different colleges. It accepted for matriculation, without examination, the candidates presented by a representative of a college in person. The colleges had their own curricula and provided their own teaching upon which they based their right to certify candidates as worthy of degrees.

The college curriculum was still in vogue in my time; it consisted of lectures on classical and mathematical subjects which were combined in one annual examination upon the results of which prizes were awarded. The subjects were in fact selected with an eye to the University examinations, which at that time and developed into a system. Physical science formed no part, except in so far as physical subjects were included in the comprehensive subject of mathematics.

It must be remembered that what was called mathematics in the third quarter of the nineteenth century was the direct successor of the arts or natural philosophy of the schoolmen. Latin was the language of the arts, and the colleges taught Latin. There was no professorship of Latin in the University until 1869. From 1663 there was a Lucasian professor of natural philosophy. Isaac Barrow was the first, Newton the second. From 1680 there was a professor of moral philosophy. Before the end of the eighteenth century there were in addition two professors of astronomy, professors of chemistry, modern history, Arabic, botany, geology, and natural and experimental philosophy, all of whom may have looked to the curriculum in arts for their students.

With the development of mathematics after Newton, 'arts' became concentrated in natural philosophy. The Act in the schools gave insufficient scope for adequate testing and a written examination was instituted, which carried off the name of the tripos and became the Mathematical Tripos; but when I was introduced to it its range was by no means restricted. It included statics, dynamics, hydrostatics, optics (geometrical and physical), spherical astronomy, lunar and planetary theories, hydrodynamics, sound, waves and tides, elasticity, heat, electricity, and magnetism. The last three were in a sense new; the University had restored the original comprehensive range of natural philosophy by adding them as additional subjects, and appointed an additional examiner for them. James Clerk Maxwell was the first.

Thus the range was very wide; but the teaching was not coterminous with the subjects named. From the nature of the examination, it became limited to the mathematical extracts from the original contributions of accepted authorities. There were, in fact, in the colleges some survivals of an experimental method in the shape of an unused skeleton or the residue of an Atwood's machine; but the philosophy and history of the sciences were disregarded. I remember an example. We had to be examined in thermodynamics. P. G. Tait had written a book about it. Tait was a first-class talker and disputant; his book has three chapters; the first two were interesting and polemic, the third was thumb-nail mathematics. We were instructed to confine our attention to the third—to 'cut the cackle' and come to the differential equations.

Thereby I am reminded that in the period from 1865 until 1875 there was an effervescence of text-books in pure and applied mathematics, the like of which can never have been seen before or since. They were mostly bound in green, and judging from the survivals in my own library, the firm of Messrs. Macmillan and Co. must have been mainly responsible for the output. It was also a period of the greatest exaltation of the private tutor, in connexion with which the names of Hopkins and Routh will be remembered. Routh had an astonishing faculty for enabling pupils to absorb the mathematical juice of the great crop of text-books, so that the amount of information appropriated in the course of three years is now almost beyond belief. To those of us who had some experience of practical physics and chemistry at school or at home it was an invaluable discipline. What it could mean to those who had not, I cannot guess.

Then came Nemesis. The University, or somebody else, realised that all this tremendous appropriation of the mathematical secretions of the workers in natural philosophy without any experiment was not exactly healthy. There was indeed a chemical laboratory, and the Lucasian professor at the time was an experimentalist, so was the Jacksonian professor; but practical astronomy in my experience was one visit to the Observatory to be shown the adjustments of the transit instrument and the mural circle—we might be asked about those in the tripos, but not about stars.

The new idea of restoring the experimental study of natural philosophy found expression by the Duke of Devonshire, Chancellor of the University, in the foundation of the Cavendish Laboratory Michael Foster had been brought to Cambridge by Trinity College about the same time as prælector in physiology, and a laboratory was found for him somewhere.

The early days of the Cavendish Laboratory were of peculiar interest. People who have since distinguished themselves worked there at their leisure: George Chrystal, Sir Donald MacAlister, W. M. Hicks, Sir Arthur Schuster, and Sir Richard Glazebrook. There were lectures by the professor and more elementary lectures by his demonstrator, W. Garnett; but there were no practical 'classes,' though the Natural Sciences Tripos included a practical examination. So the last quarter of the nineteenth century may indeed be aptly called the age of the practical class in science. Any one who visited the University now would scarcely suppose it possible that fifty years ago there were no classes in practical work.

It may perhaps be said now that there are too many; and indeed it is scarcely an exaggeration to write that the only thing to do with any system of education that has become established is to change it. No plan can be permanently successful; at least no scheme of examination can be.

Sir Richard Glazebrook and I made a text-book and, as we thought, a very good one. It was designed to enable a class of students to inform themselves about the physical nature of things by using different aggregations of the miscellaneous collection of apparatus at the Laboratory.

I sometimes wonder how many of those experiments we had ourselves performed when we described them in such detail. But with the examination before them, our students and their successors have insisted on doing them all, and perhaps from their point of view they were right; but the result is wrong. The experiments were designed and described as a short cut to something better.

Nevertheless, the practical work in science, of which the Cavendish Laboratory is typical, furnished demonstrations not only of experimental physics but also of the University's care for teaching. The example has been followed, expanded, and improved until this term, under the new statutes, the University has recaptured from the colleges the right to teach its students the arts, as well as divinity, law, and medicine, a right which it surrendered in the spacious days of Queen Elizabeth.

News and Views.

PHOTOGRAPHS of the 'Pithecanthropus skull' recently obtained at Trinil in Java by Dr. Heberlein have now been received by Dr. Dubois of Haarlem. At the time of the discovery it was positively announced to be of the pithecanthropus type, but Prof. Elliot Smith has received a cablegram from Dr Dubois in which he says, "Photographs received show *caput humeri stegodon*" The second pithecanthropus skull thus turns out to be a pleistocene elephant! Much disappointment will be felt at this pronouncement, which, however, does not come entirely as a surprise. The information received in England from America soon after the first announcement made it clear that the discovery was not likely to prove so important as at first indicated The more complete statement of the character of the find and the conditions in which it was obtained—it was not found *in situ* as at first stated, but was obtained from the inhabitants of the village, and it was also said not to be a complete skull—pointed to the need for suspending judgment on the importance of the find. The wide publicity given to the discovery serves to emphasise the dangers of over-hasty dissemination of news through the ordinary channels of the press without effective and well-informed supervision such as might be afforded through the medium of a centralised scientific news service

THE RIGHT HON. NEVILLE CHAMBERLAIN, Minister of Health, presided at the reopening ceremony of the Wellcome Bureau of Scientific Research and the Museum of Medical Science on December 8. In the unavoidable absence abroad of the founder, Mr. Wellcome, Dr C M. Wenyon, Director of the Bureau, received the guests. Mr Chamberlain, in the course of his remarks, dwelt on the great advances made by medical science in the course of the last century, largely due, in his opinion, to the improvement in the means of imparting knowledge to those interested throughout the world. He considered that the motive actuating Mr. Wellcome in founding the Bureau was a conception of the two greatest factors which help mankind to overcome the infirmities to which all, in some degree or other, are subject; these two factors are research and education. Research is carried on not only at the Bureau, but also at the Wellcome Physiological and Chemical Research Laboratories; education is subserved by the Museum of Medical Science, to which all interested are welcomed, where, moreover, teachers are permitted to give demonstrations to their students.

SIR WALTER FLETCHER, Secretary of the Medical Research Council, followed Mr. Chamberlain with an address on "Research and Citizenship." After referring to the admirable scientific work of the staff of the Bureau, he turned to the consideration of the means by which research has been in the past and is at present financed Many brilliant investigators have been enabled to pursue their work owing to the accident of possessing private means or owing to the liberality of some friend or private institution. It is only within the last twenty-five years that the State has made grants in aid of research work, with the establishment of such institutions as the National Physical Laboratory in 1900 and the Medical Research Council (then a Committee) in 1913. Business firms have forwarded scientific work in three ways. Private fortunes made in commerce have been devoted to the endowment of research. Manufacturing firms have set up their own research laboratories; and although the investigators are not always free to publish the results of their work, yet the public are indirectly benefited by the increased efficiency of the firms in question. Finally, a few firms have adopted the plan of setting up research laboratories and leaving the workers as free to follow their own line and publish their results as men in any university laboratory. In Great Britain, the Wellcome Bureau is an example of the latter method of endowing research; abroad, the work of Langmuir and Coolidge in America and of Sørensen in Copenhagen has been made possible by similar endowments from commercial firms. The proceedings were terminated by Mr. Chamberlain declaring the Bureau and Museum open, and the guests then accompanied him and Dr. Wenyon on a tour of the halls and laboratories.

IN an address on "International Interests in Raw Materials" to the Royal Society of Arts, which is published in the Society's *Journal* for November 26, Sir Thomas Holland laid stress on the importance, for economic as well as military reasons, of making a precise estimate of the mineral resources of the British Empire A large number of minerals are essential for the maintenance of civilisation, and many of them cannot be replaced in the functions for which they are used. Minerals are wasting assets, and their consumption is annually accelerating to such an extent that a partial famine for some important substances will confront the next generation. The United States has recently inaugurated a systematic inquiry into its stocks of essential minerals on lines of precision and thoroughness that will leave little doubt as to resources available. For the British Empire the matter is at least of equal importance. The Mineral Resources Bureau collects figures of production and movement, but that is a small part of the problem. To make a complete or even partially complete survey, private sources of information must be tapped. The specialist in the course of his professional practice must have acquired information which, in the aggregate, would be of immense value even if the results were published only as totals for each considerable section of the British Empire.

ON October 27, Dr. R. J. Tillyard, chief of the Biological Department, Cawthron Institute, Nelson, New Zealand, delivered the Trueman Wood lecture before the Royal Society of Arts, upon "The Progress of Economic Entomology (with special reference to Australia and New Zealand)"; and this is published in the *Journal* of the Society for November 12. Dr. Tillyard points out that the main problem of economic entomology is how to intervene scientifically, in the most successful manner, in order to prevent the huge losses caused by insects to man's food supply and forests. The past thirty years have witnessed an immense development of what we may term the chemical method of attack, and the technique of the latter has been revolutionised during the last few years, particularly in America. Special reference is made to the commercial use of aeroplanes for dusting large areas of vegetation, and Dr. Tillyard expresses the hope that Great Britain will not be long in following Germany and Russia, which have already conducted promising trials with regard to the possibilities of this new line of attack. He deals very fully with biological control and emphasises the fact that three organisms are involved in the problem, namely, (1) the plant, (2) the insect attacking the plant, and (3) the parasite or predator of that insect. Occasionally we have also to consider secondary or even tertiary parasites of the parasite or predator.

THE possibilities of biological control are being explored in Australia and New Zealand, and the recent very striking success achieved by the introduction of the Chalcid parasite ***Aphelinus mali*** from North America into New Zealand, for controlling the woolly aphis of apple, is an example of it. The re-exportation of this same parasite into Australia is also proving highly beneficial in the latter country. The biological control of imported weeds which have so far resisted all other means of eradication is also discussed. The possibilities of introducing insect enemies of such weeds from their countries of origin into lands where the weeds have become established are worthy of the fullest exploration. Experiments of this nature, however, need to be carried out with adequate safeguards, under expert guidance, lest such insects turn their attention to cultivated plants and thereby become new evils rather than benefactors as originally intended. The work that is being carried out in Australia on prickly pear control by means of introducing Opuntia-feeding insects to prey upon that plant is particularly noteworthy. It appears that this problem is nearer solution than hitherto by means of the biological control exercised by insect enemies on this formidable pest. The importance of attempting likewise the control of blackberry, gorse, and other noxious weeds in New Zealand through the utilisation of certain insect enemies is also stressed by Dr. Tillyard, and his scheme for meeting the problem is outlined.

THE League of Nations' Committee on Intellectual Co-operation has published an important memorandum by Madame Curie, the eminent physicist, on the question of international scholarships for the advancement of the sciences and the development of laboratories. Madame Curie directs attention to the ever-increasing specialisation in the equipments and programmes of laboratories and the increasingly complex organisations of their staffs, and urges that fellowship and scholarship schemes should be so framed as to fit in with and take advantage of these conditions. To do so they must have due regard to two essential necessities: advanced workers, who have already made their names by scientific work, must be given the means of continuing their work; all candidates anxious to devote themselves for some time to science must be given a chance of developing their talents on the sole condition that they are recommended by their tutors or have obtained satisfactory university degrees.

WITH such a scheme, a complete foundation would accordingly control scholarships of two grades: for research fellows and for probationary scholars (two or three times as many). It would, further, provide grants to laboratories amounting to perhaps a quarter of the amount of the scholarships, to enable them to meet the increase of expenditure resulting from increase in the number of workers. Each probationary scholar would be assigned by the director of the laboratory to one of the research groups in which a vacancy is expected. A research fellow would work independently on a subject chosen by himself with the approval of the director or set for him by the director. The memorandum concludes with proposals, which have been adopted by the committee, for an inquiry into national and post-graduation scholarships and the best means of organising a system of international scholarships. Lord Balfour's research sub-committee of the Imperial Conference might well devise and provide for financing some such scheme for minimising the obstacles in the way of interchange between research workers in different parts of the British Empire and so meeting, to some extent, the competition of the magnificently equipped and endowed laboratories in the United States for the best brains of the Empire.

IT is surprising that, notwithstanding the advances made in recent years in the study of phonetics and the methods of recording spoken sounds, there is still no agreement as to the form of script to be used in recording the spoken languages of India, although the question has often been discussed. With the example of America before us, it should be possible for something to be done. In the United States a script has been evolved adequate to meet all the needs of recording a group of languages of considerable phonetic difficulty. The languages of India should present far fewer stumbling-blocks This question is again raised with special reference to the Munda group of languages by Mr. P. O. Bodding in the *Journal and Proceedings of the Asiatic Society of Bengal*, vol. 25, part 1, where he insists upon its urgency, now that changing conditions are beginning to affect the habits of the people. He quotes a number of errors which, as a matter of practice, arise through an imperfect method of recording the language, while from the scientific point of view the importance of an accurate method of recording the spoken sounds has been greatly enhanced by the extension of the comparative study of linguistics. A question of such moment as this would seem to call for action on the part of some influential body, such as the Asiatic Society of Bengal, before it is too late and these languages have been profoundly modified by contact with the outer world.

IN many physical theories—as, for example, in the atomic theory of gases or in J. J. Thomson's corpuscular theory of light—the theory of probability plays a leading part In a paper read by Mr. G F O'dell on December 2 to the Institution of Electrical Engineers on certain aspects of automatic telephone working, this theory is also largely used when discussing purely technical matters The problems considered were those arising when provision has to be made for more than one telephone call at one time. In automatic exchange working, when the caller removes his receiver, his 'preselector' hunts for a disengaged first selector. On his dialling the first digit, the first selector steps up to the corresponding level and then hunts until it finds an idle second selector. On the receipt of the second digit, the second selector rises and searches for an idle final selector, which in turn responds to the third and fourth digits. In addition to the subscriber being actually engaged, there are three places in this chain of events at which the call may be 'lost' or delayed In order to discuss the theory, telephone engineers find it convenient to define a 'telephone traffic unit.' This unit is the average number of calls in progress simultaneously during a specified period. It is simply a number and has no physical dimensions. One of the problems discussed by Mr. O'dell was the best method of arranging switching plant to the best advantage. This necessitates using the theory of probability. Another problem the solution of which forms the basis of the design curves in common use in the United States is to find the grade of the service. This is measured by finding the proportion of the traffic lost when a given volume of traffic, measured in traffic units, is offered to a definite group of switches. Mr. O'dell showed that telephone engineers fully realise the help that an advanced knowledge of mathematics can be to them. He also developed an analogy between 'trunking' problems and those which arise when discussing the performance of heat engines. It is thus shown how one branch of applied theory can help another.

THE present year marks the centenary of the founding of *Crelles Journal fur die reine und angewandte Mathematik* or Crelle's Journal, the oldest organ of mathematical research in Germany surviving to the present day. Of earlier mathematical journals, only the French *Journal de l'École Polytechnique*, founded in 1794, has enjoyed a longer period of continuous publication. The earlier volumes of Crelle were enriched by papers from Gauss, Abel, Jacobi, and Steiner, while many of the more distinguished Continental mathematicians have contributed to its pages in more recent years. Among Englishmen, Cayley, with eighty papers, was the most frequent contributor. It is the intention of the editors to celebrate the centenary worthily by issuing two commemoration volumes (157 and 158) in which will be shown, in the true perspective of distance, the part played by this journal in developing the science of mathematics during the last hundred years.

PROF. J H. PRIESTLEY, of the department of botany, University of Leeds, is to give a course of post-graduate lectures and demonstrations to students of the departments of botany and bio-chemistry of the University of Berkeley, California, during the spring of next year. Prof. Priestley will deal with the subject of developmental anatomy. His lectures will include some account of the work done in the botanical department at Leeds upon the structure, function, and distribution of the endodermis; the structural features associated with the phenomena of etiolation; and the problem of phototropism. Prof H. H. Dixon, of Trinity College, Dublin, has similarly been invited to lecture at the University of Berkeley in the summer months of 1927.

A SERIES of violent earth-shakes disturbed the Rand on the morning of December 7, and in the Wolhuter gold mine there were two rock-bursts which caused the death of four persons. The earth-shakes seem to be due to the collapse of the surface-rocks over disused mining tunnels In the early days of the mines, no earthquakes were noticed in the Rand, but in 1905 they began to occur and soon increased so much in frequency that in 1910 a seismograph was erected in the Johannesburg observatory. During the next fourteen years, 5427 local shocks were recorded. It was noticed that they occurred in series, and most frequently in the dry season. This led to greater care being used in timbering and re-filling abandoned tunnels, and during the last two years local shocks have decreased in number (*Volcano Letter*, October 31, 1926, issued by the Hawaiian Volcano Research Association).

THE seventeenth annual Exhibition of the Physical Society and the Optical Society to be held on Tuesday, Wednesday, and Thursday, January 4, 5, and 6, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, will be open in the afternoon from 3 P.M. to 6 P M. and in the evening from 7 P.M. to 10 P.M. On January 4 at 8 P M. Prof. E. N. da C. Andrade will reproduce with contemporary apparatus a physical lecture of the early eighteenth century. On January 5 at 8 P.M. Dr. C. V. Drysdale will lecture on "Progress in Electrical Instrument Design and Construction," and on January 6 at 8 P.M. Mr. J. L. Baird will give a lecture on "Television." Some seventy firms are exhibiting apparatus, and in addition there will be a group of non-commercial exhibits, including demonstrations of famous historical experiments in physics, recent research and effective lecture experiments. Tickets, which can be obtained from the secretaries of related scientific societies or direct from Prof. A. O. Rankine, Imperial College of Science and Technology, South Kensington, S.W.7., are required for January 4 and 5, but on January 6 the Exhibition will be open to the general public without tickets.

THE issue for November 15 of *Power Plant Engineering* contains a short illustrated account of the remarkable high-voltage laboratory erected at Stanford University, California. The laboratory has been erected by the University with the aid of some of the big electrical firms to ensure the continuance of the research work of Dr. Harris J. Ryan. The main building of the laboratory is 173 feet long, 60 feet wide, and 65 feet high, and in this are installed the six specially designed transformers, each of which is rated at 350,000 volts high tension, 2300 volts low tension, and each of which weighs 22 tons. These have been constructed so that they may be used in every manner of connexion for the whole range of voltages single-phase or three-phase, up to 2,100,000 volts single-phase and 1,200,000 volts three-phase. The work of the laboratory was inaugurated on September 17, when before an assemblage of men of science a 2,100,000 volt spark was discharged between points 20 feet 1 inch apart.

WE much regret to record the death, on December 11, of Sir William Tilden, F.R.S. Sir William, who was formerly professor of chemistry and dean of the Royal College of Science, London, and emeritus professor in the Imperial College of Science and Technology, South Kensington, had reached the age of eighty-four years.

LORD D'ABERNON has accepted the chairmanship of the Industrial Fatigue Research Board, to which he has been appointed by the Medical Research Council. Mr. William Graham has relinquished the chairmanship of the Board under the pressure of other public work, but will remain a member of the Board.

IT is stated in *Science* that Prof. J. J. Abel, professor of pharmacology at Johns Hopkins University, is to receive the Willard Gibbs gold medal for 1926 awarded by the Chicago section of the American Chemical Society. Prof. Abel's work has been largely in the field of glandular extracts; he isolated epinephrin as a pure crystalline body from the suprarenals, and recently he has announced the preparation of insulin in crystalline form.

IT has now been decided to close the fund raised to signalise the long services of Prof. A. G. Perkin to science and to the University of Leeds. Prof. A. G. Perkin, it will be remembered, has recently retired from the chair of colour chemistry and dyeing. Those who desire to be associated with the purpose of the fund are asked to send their subscriptions to Prof. A. F. Barker, The University, Leeds, at an early date.

THE twenty-fifth anniversary of the historic wireless experiments conducted by Senatore Marconi between the Poldhu wireless station in Cornwall and St. John's, Newfoundland, which resulted in the transmission and reception of wireless signals between the old and the new worlds for the first time, fell on Sunday, December 12. Senatore Marconi's achievement in 1901, only six years after his earliest experiments at his father's house in Bologna, Italy, marked an epoch in the development of wireless communication and firmly laid the foundations of the long-distance wireless communication which to-day covers the whole world.

THE following lecture arrangements at the Royal Institution before Easter next year have been announced. The Christmas Course of six lectures for juveniles will be delivered by Prof. A. V. Hill, on "Nerves and Muscles: How we Feel and Move," commencing on December 28 at 3 P.M. On Tuesdays, at 5.15 P.M., beginning on January 18, there will be two lectures by Prof. R. Whytlaw-Gray on smokes as aerial disperse systems, six by Prof. Julian Huxley on problems of animal growth and development, two by Dr. G. Shearer on X-rays and the chemical molecule, and two by Prof. J. W. Cobb on some properties of coke. Thursday afternoon lectures, at the same hour, include three lectures by Sir William Bragg on acoustical problems treated by Lord Rayleigh; three by Prof. John Garstang on the progress of Hittite studies; two by Mr. J. Guild on colour measurement and standardisation; and two by Mr Harold J. E. Peake on the beginnings and early spread of agriculture. Saturday afternoon lectures at 3 P.M. include four by Sir Ernest Rutherford on the α-rays and their application to atomic structure. The Friday evening meetings will begin on January 21, when Sir William Bragg will deliver a discourse on Tyndall's experiments on magne-crystallic action. Succeeding discourses will probably be given by Prof. E. P. Cathcart, Mr. T. L. Eckersley, Dr. Ernest Law, Sir Josiah Stamp, Prof. D'Arcy Thompson, Sir Herbert Jackson, Dr. George Macdonald, Mr. E. Hatschek, Prof. C. T. R. Wilson, Sir Ernest Rutherford, and other gentlemen.

WE have received the annual report of the Laboratory of the Joint Board of Research for Mental Disease, City and University of Birmingham, of which the late Sir Frederick Mott was honorary director. Determinations of the iodine content of the thyroid gland have been made in various conditions, and show that septic infection and tuberculosis cause considerable variation. Investigations have been pursued on basal metabolism in conditions of conscious and unconscious contraction and relaxation of muscles, on changes in the central nervous system as a result of the administration of hypnotic drugs, and on the permeability of the membranes of the brain to the bromine ion after administration of sodium bromide.

THE topographical survey of the colony of Sierra Leone is at length to be put in hand. Up to the present no satisfactory map of this part of British

Africa has been available. A year ago the financial position of the country justified the formation of a new survey department, of which the first annual report has now appeared. It has been decided to aim at a one-inch scale for the whole colony, which will entail 111 sheets. A start is to be made in the central and southern parts of the Northern Province. A school for training native surveyors has been started, but in order not to delay the work, trained surveyors have been temporarily transferred from the Gold Coast. A large scale cadastral survey of Freetown is in hand and well advanced.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A research student at St. Mary's Hospital Institute of Pathology and Research—The Secretary of the Institute, St. Mary's Hospital, Paddington, W.2 (December 20). A research assistant in the Department of Pharmacology of the University of Sheffield, to help in an investigation on cancer, and a laboratory attendant with experience of physiological or pathological and chemical technique for the same institution—Prof. E. Mellanby, The University, Sheffield (December 22). A demonstrator in chemistry at Guy's Hospital Medical School—The Dean, Guy's Hospital Medical School, London Bridge, S.E.1 (December 29). An adviser in agricultural chemistry in the University of Manchester, under the scheme of the Ministry of Agriculture and Fisheries—The Registrar, The University, Manchester (January 20). Lecturers in organic chemistry, physical chemistry, and biochemistry at the Indian Institute of Science, Bangalore, India—The Director (January 30). A professor of physiology in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (January 31). A senior lecturer in philosophy in the Transvaal University College, Pretoria—The Registrar, Transvaal University College, Pretoria (January 31). A professor of anatomy in the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (February 26). A professor of philosophy at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (March 12).

Our Astronomical Column.

THE COMET GRIGG-SKJELLERUP.—Mr. G. Merton read a paper on this comet at the meeting of the Royal Astronomical Society on December 10. The identity of the comet found by Skjellerup in 1922 with that found by Grigg in 1902 was first suggested by Crawford and Meyer. Mr. Merton has made it a practical certainty. He gets practically the same mean motion in 1922 from the observations in that year alone (they extended over three months, so the value is trustworthy) as by combination with those of 1902. The comet is due to return to perihelion on May 10, 1927; Mr. Knox Shaw is now searching for it with the large reflector at Helwan. It may be expected to be found not later than February. It approaches within 17 million miles of the earth in June; Comet Pons-Winnecke makes a still nearer approach (some 4 million miles) near the end of June.

INTERNATIONAL LONGITUDE DETERMINATIONS.—Dr. J. Jackson gives in the *Observatory* for November an interesting account of the extensive scheme of longitude determination by radio signals which has been in progress during October and November.

The observatories of Algiers, Shanghai, and San Diego (California) form the principal chain, but some fifty other observatories are co-operating. The use of travelling wire micrometers practically eliminates personal equation, and enables longitude differences to be determined without interchange of observers. Dr. Jackson obtained star observations on seventeen nights between September 27 and November 1, the transit instrument being reversed on each star to eliminate collimation. The Shortt clock has such a regular rate that its error can be interpolated for days without star observations. Thirty-four series of time signals are sent out daily from five stations; all except Saigon were regularly received at Greenwich.

THEORY OF SUNSPOTS.—An important contribution to the theory of sunspots and the sun's general circulation is made by Prof. V. Bjerknes in the *Astrophysical Journal*, September 1926, under the title "Solar Hydrodynamics." For the details of the theory reference must be made to the paper in question, but a short outline of the main points may be given as follows. On the assumption that a sunspot is a vortex decreasing in intensity from the photosphere downwards, their low temperatures are explained from general hydrodynamical and thermodynamical principles.

The results deduced are in accordance with the accepted temperatures of sunspots and the probable velocities of the gases involved in the vortex. A preliminary account of this part of Bjerknes' investigation was given in NATURE, March 27, p. 463. The well-known properties of sunspots (their usual occurrence in pairs having opposite magnetic polarities, the progression of the spot zones towards the equator during the 11-year cycle, the magnetic-polarity cycle of 22 years, etc.) are explained by making the following suppositions. In each of the sun's hemispheres, northern and southern, there are two zonal vortices, having opposite rotations and surrounding the sun approximately as parallels. Wherever part of either vortex rises and cuts the photosphere, a typical bipolar pair of sunspots makes its appearance. As part of a scheme of general circulation, these two zonal vortices revolve around each other in a period of 22 years, being brought alternately near to the surface of the photosphere in latitudes about 40°, progressing equatorwards in the course of 11 years, and descending again into the interior near the sun's equator. The scheme of general circulation is one demanding a condition of what is known as stratified circulation.

Renewed investigations are required on the part of observers to determine any possible systematic movements which may be shown by sunspots, faculæ, calcium and hydrogen flocculi, and prominences. The systematic drifts suggested by the theory are apparently too slow to be observed spectroscopically (cf. *Astrophysical Journal*, **32**, 80, 1910, where St. John compares the mean wave-length of K_2 and K_3 near the sun's poles and at the equator for detection of systematic movements).

Prof. Bjerknes' paper is also discussed, together with remarks bearing on the question of observed systematic motions of spots and faculæ, by 'W. M. H. G.' and 'H. W. N.' in the *Observatory* for December.

Research Items.

THE VALUE OF TRADITION.—In the course of a discussion of the value of tradition in Polynesian research, which appears in the *Journal of the Polynesian Society*, vol 35, No 3, Dr P. H. Buck (Te Rangi Hiroa) gives some remarkable examples of the manner in which Maori traditions are corroborated from outside sources, legendary and other. The Maori tradition states that their ancestors made voyages between the Sandwich Islands and their own Hawaiki or Tahiti of the Society group The traditional sailing directions from Ahuahu (Oahu, Sandwich Islands) to Aotearoa (North Island, N.Z) give a bearing south from Maui-tahu and Maui-pae to Hawaiki and from Hawaiki to New Zealand a little to the right of the setting sun In Hawaiian tradition in the directions for the voyage to Tahiti, the North Star is left directly astern. Further, Maui-tahu and Maui-pae are probably the twin islands of Lanai and Kahoolawe, Hawaiian tradition makes Ko-ola-i Kahiki the point of departure for Hawaiian voyagers to Tahiti, and this has been identified as a point on Kahoolawe Even more striking is the evidence of the magic calabash Hawaiian voyagers to Tahiti on passing the equator lost the North Star and picked up the Southern Star On their return they picked up the Northern Star and sailed in a north-easterly direction (owing to the prevailing wind) until they judged the star was the same height as in Hawaii. They then turned and sailed due west, checking the height of the star each night, in the early days no doubt by eye, but later by the magic calabash This calabash was fashioned into a primitive form of sextant with which the star was sighted on an elevation determined in Hawaii. An examination of one of these calabashes has shown that it is mathematically accurate, the angle being 19°, and Hawaii being in lat. 19° N.

DEFORESTATION AT PUEBLO BONITO.—After six seasons' excavations on the important site of Pueblo Bonito in New Mexico, it is now possible to arrive at some definite conclusions as to the causes which led to the gradual decline and final abandonment of this once populous centre of prehistoric Pueblo culture The population, some twelve hundred in number, was agricultural, living on the produce of the fields, once fertile, but now barren According to a Bulletin of the Smithsonian Institution, the expedition of the National Geographic Society, under the leadership of Mr. Neil M. Judd, archæologist of the Smithsonian Institution, in the course of its excavations has found an ancient arroyo completely filled up which has been traced for a considerable distance Its original bed was found at a depth of 18 feet, and on it were fragments of pottery made during the third and greatest building period of the Pueblo Further, it appears that the inhabitants used pine logs to roof the 800 rooms of their great dwelling The nearest pine woods are at present forty miles away, but evidence was discovered that pine had at one time grown in the canyon. It may therefore be concluded that the present sterility of the soil was brought about by the destruction of the pine forests which once surrounded the site, baring the soil to wind and water and allowing the spring rains essential for the crops to drain off into the arroyo, which then became wider and deeper. The fertility of the fields then became less, and the population decreased owing to migration as the food supply diminished, until the twelve hundred inhabitants had dwindled to a few families. The increase in the number of defensive works in each successive building period suggests that marauding raids helped to drive the inhabitants from their homes The excavations of 1926 show that there were four main periods of construction covering a period of about a thousand years. Differences in architecture and pottery indicate that two distinct populations in friendly relation inhabited the site at one time Later arrivals of a more advanced culture made Pueblo Bonito the most famous and important settlement of the south-west, but they were the first to abandon the site.

DETERMINING THE SEX OF CARRIER PIGEONS.—I. Iwata (*Jour Coll Agr*, Imp Univ Tokyo, vol 73, No. 4, 1926) points out differences, which enable the sex of carrier pigeons to be distinguished at various stages of growth In very young birds (from the time of hatching to the 24th day) the dorsal rim of the cloacal opening is more developed than the ventral in the male, while in the female the reverse is the case In older birds, after they have left the nest to the time of pairing, the wall of the cloaca of the male exhibits six internal elevations, whereas in the female five elevations are present and the anus is seen close to the postero-median elevation In general, too, the opening of the male cloaca is more tightly closed than that of the female In adult birds (more than six months old) the cloacal opening of the male is usually pentagonal in outline, and at its centre is the anal opening, also usually pentagonal The adult female cloaca presents a more or less triangular opening, the external skin at the posterior border of the cloaca projecting into the cloacal space along the short base of the triangle. By this time, however, the general appearance and behaviour of the birds is usually sufficient to indicate their sex Another point of difference is that in birds more than 120 days old the male presents a whitish line along the median portion of the dorsal side of the beak, between the nasal protuberances, which is wanting in the female

NEMATODES FROM JAPANESE FROGS AND TOADS.—K. Morishita records (in vol. 1, No. 1, Section 4 (Zoology), *Jour Fac Sci.*, Imperial Univ. Tokyo, 1926, which is a continuation of *Jour. Coll. Sci.*, Imp Univ. Tokyo) eight species of nematodes found during the examination of about a thousand frogs and toads. These nematodes include a new species of Hedruris, the female of which adheres to the wall of the duodenum of frogs and the spiral turns of the body of the male envelop the female; a new species of Spiroxys also from the duodenum of frogs (the genus Spiroxys has hitherto been recorded from tortoises); and a new species of Spinitectus from the stomach of *Rana nigromaculata*, the four previously known indubitable species of Spinitectus having been found only in fresh-water fishes of Europe and America.

GROUPING OF FORMS IN SCENERY.—In a paper in the *Geographical Journal* for November, Dr. Vaughan Cornish discusses the conditions of harmonious grouping in natural landscape and illustrates his theme from various aspects of scenery by land and sea. The reason for rearrangement, or composition, which the landscape painter adopts, arises largely from the fact that disharmonies of form occur in purely natural scenery, and the eyes find perfect satisfaction in the landscape only when there is a broad angle of outlook free from obtrusive disharmony. Dr Cornish points out that the generally expressed opinion that purely natural surroundings are always harmonious is due to the co-operation of the senses From descriptions of several mountain views he shows that ranges of the Alpine type provide the finest forms of mountain skyline The roughly pyramidal peaks are of sufficient size to appear important at the greatest distance at which atmospheric conditions allow visibility On nearer approach, the distant view of a row of pyramids gives place, as a rule, to a pyramidal complex bending upwards to a culminating peak: yet nearer, this vanishes and is replaced by a number of visually independent pyramids. The eye always finds harmony in the pyramidal form. Other features of scenery are discussed in this interesting paper.

PLEISTOCENE PLANTS FROM NORTH CAROLINA.—The study of Pleistocene plants has not made so much progress in America as in Europe, but Dr. E. W. Berry has recently made an interesting and important contribution to the subject (*U.S. Geol. Survey Prof. Paper* 140-*C*, 1926, p. 97) Beautifully preserved plant remains have been found in three (Wicomico, Chowan, Pamlico) of the five terrace plains which can be traced for long distances along the Atlantic coast of North Carolina and the adjoining States. The species recognised number 48, including two conifers, the remainder being Angiosperms; 11 are classed as extinct species new to science, several of these being regarded by the author as doubtful, but he feels confident that two or three are definitely new. The most abundant forms are the bald cypress, river birch, beech, various oaks. More than half are plants living in wet habitats, and may represent elements of the vegetation of estuary streams. None of the species can be regarded as a definitely northern form, though the terrace deposits contain boulders of considerable size which may have been brought down by river ice. On the other hand, the present distribution of some of the species suggests that the climate may have been somewhat milder than at present. The author considers that the present major floristic regions of North America were already well marked at the end of the Tertiary period, and he adds a map illustrating his views on the probable directions of post-glacial plant dispersal.

UPPER WIND VARIATIONS—A Memoir entitled "The Variance of Upper Wind and the Accumulation of Mass," by Mr. Lewis F. Richardson, Mr. Denis Proctor, and Mr. Robert C Smith, vol 1, No. 4, has just been issued by the Royal Meteorological Society (price 2*s* 6*d*. to non-fellows of the Society). The memoir contains a collection of statistical facts concerning deviations of wind from its mean The distances range from 1 km. to 100 km., deviations so large as or larger than gusts and smaller than cyclones. The effect of height on the variation is said to be very different in different circumstances, but on the average it is not much changed with height Morning and afternoon in summer have different variances, that in the afternoon being usually much the greater, when the stations were 11 km. or 12 km. apart, but at 28·5 km. separation the distinction was not clear. The greater variance on summer afternoons is explained as an effect of the increased turbulence due to the decreased statical stability of the air. Other values relative to variance are given, and the memoir is of a high scientific order.

RECENT FUNDAMENTAL WORK IN PHYSICS.—The address entitled "The Last Fifteen Years of Physics," which Prof. R. A. Millikan delivered at the annual meeting of the American Philosophical Society in April, is reproduced in Part 2 of the *Proceedings* of the Society for 1926. Sixteen of the twenty-one fundamental discoveries of the past thirty years fall within the last fifteen years, and there seems no sign of diminution of the rate of progress in the near future. Amongst the more recent discoveries may be mentioned that of isotopes by positive ray analysis, that of the excited atom, which Prof. Millikan thinks may be the foundation of a new era in science, the interpretation of the fine structure of spectral lines as due to changes in quantum numbers, the bridging of the gaps in the spectrum between electromagnetic and long heat waves and between ultra-violet light and X-rays, and the recent discovery that, by assuming every electron has unit angular momentum, we get an explanation of doublets to replace that previously provided—unsatisfactorily however—by an assumed change of mass of the electron with speed. His own discovery of cosmic rays of enormous power hitherto unknown—one of the most important and stimulating—gets an all too modest notice of nine lines.

ELECTRICAL CONDUCTIVITY OF CYANOGEN BROMIDE.—According to the theory of 'pseudo atoms' put forward by Grimm, it is possible to regard atoms possessing the same total nuclear charge as similar. If this idea is true, the cyanogen radical is like the sodium atom, and therefore its fused salts should conduct electrically. This reasoning led G. Glockler to study the electrical conductivity of fused cyanogen bromide (m p 52°). Details of the preliminary experiments and an approximate value for the specific conductivity are given in the *Proceedings of the United States National Academy of Science* for August 1926.

HYDRION CONCENTRATION AND PHOTOGRAPHIC EMULSIONS.—The effect on the sensitiveness of a gelatine emulsion of adding a little acid or alkali during its preparation has long been known in a general sense, and Messrs S O Rawling and J. W. Glassett, of the British Photographic Research Association, have sought to find more exactly the effect of changing hydrion concentration during the washing and digesting stages (*Journal of the Royal Photographic Society*. November 1926). The range of *p*H values studied extends from 5 to 9. They find that with samples of gelatine having widely different photographic properties, and emulsions precipitated in the presence or absence of ammonia, the photographic sensitiveness obtained after digestion is greater as the hydrion concentration is increased. With any one emulsion, on prolonged digestion, a steady value is obtained and maintained for a time which is different for each different *p*H value employed. The grain size and appearance seem to be unaffected, and in most cases, if digestion is continued long enough, the development velocities and shape of the characteristic curve of the emulsion also are independent of the hydrion concentration during digestion.

OXIDATION OF PHOSPHORUS VAPOUR.—In an examination of the oxidation of phosphorus vapour at low pressures, Chariton and Walta (*Zeit. fur Phys.*, p 547, October 1926) have found that, for a given vapour pressure of the phosphorus, there exists a definite critical pressure of oxygen below which no reaction takes place. They also found that this critical pressure was lowered by the addition of small quantities of argon, and at the same time the light emitted during the reaction was decreased in intensity. As a working hypothesis, the authors assume that the critical pressure of oxygen is that pressure above which each active centre is able to produce other active centres. Consequently, the argon atoms added may be considered to assist in the formation of active centres by means of 'collisions of the second kind,' and hence the reaction may proceed in the presence of less oxygen. It is found that when such centres are produced artificially, by electric discharge or by means of a glowing wire, the critical pressure of oxygen is lowered.

Atmospheric Electricity.[1]

THE director and staff of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington have of late years given much attention to atmospheric electricity, and have published several conclusions of much interest, the evidence for which is contained in the volume before us. Thus, although it includes a variety of other interesting matter—magnetic, meteorological, and instrumental—we shall confine our present remarks to the subject of the potential gradient of atmospheric electricity, a subject dealt with by Messrs Bauer, Ault, and Mauchly, especially the last mentioned.

Perhaps the most remarkable conclusion, due to Dr. Mauchly, is that re-stated on p. 402: "At least the greater part of the diurnal variation of the potential gradient over the oceans is due to a wave which progresses according to universal rather than local time. . . . All potential-gradient observations at sea tend to give values which are lower than the mean of the day if made in the forenoon of the Greenwich civil day, and values higher than the mean of the day if made in the afternoon of the Greenwich day."

The main evidence for this conclusion is a series of 24-hourly data from 59 Greenwich days, given on pp. 390-391. Details of the actual observations appear on pp. 212-265.

The natural way of checking Dr. Mauchly's conclusion would be to group the observations according to longitude. If we do so, taking 30° zones centering respectively at 0°, 30° E., etc., we find that there are only four zones—those centering at 180° E., 210° E., 240° E., and 270° E.—for which there are more than four days' observations. In an element so variable as potential gradient, uncertainties are sure to be large unless a considerable number of days is employed. Diurnal variations have thus been calculated only for the four zones stated, the 'days' available numbering respectively 9, 14, 9, and 10. Diurnal variations were also calculated for two groups each of five days from the 270° zone, and finally for the whole 42 days included in the four zones. Space allows us to mention only a few of the details, the hours referring to Greenwich civil time.

Zone.	Daily Mean.	Minimum.		Maximum.		Range.
E.	v/m.	h.	v/m.	h.	v/m.	v/m.
180°	128	2	112	20	152	40
210	106	3	93	19	136	43
240	124	6	100	15	156	56
270	133	0	113	19	165	52
270*a*	145	4	117	19	194	77
270*b*	122	23	101	12	160	59
42 days	121	3	105	19	148	43

The inequality derived from the 42 days accords with Dr. Mauchly's conclusion that potential gradient at sea tends to be below the mean in the Greenwich forenoon, and the times it gives for maximum and minimum, 19 h. and 3 h., are in general accord with his. But the 42 days results refer only to a limited part of the ocean, and the results from the different zones differ amongst themselves. In the case of the 270° zone the results from the two groups of days are widely different, and the inequality from the whole 10 days shows a prominent secondary maximum and minimum at 12 h. and 14 h. respectively.

When we look more closely into the data two unsatisfactory features appear. About 12 per cent. of the hourly values for the 59 days are interpolations; for the observations of 1921 the percentage is 21. In the majority of cases the interpolations represent arithmetic means from two observations separated by two hours, but in other cases they are of a more questionable character. For example, for 'day' 52 the earliest and latest observations available refer respectively to 18 h. on one Greenwich day and to 13 h. on the next. These appear as 13 h. and 18 h. on the same day, and data are interpolated for 14 h., 15 h., 16 h., and 17 h. as if this were the case. The probable existence of a progressive change in the 24 hours is neglected.

The second unsatisfactory feature is the total disregard of n.c. changes. Usually only 24 successive hourly values were obtained, and it is impossible to say what the n.c. change really was. So far as the run of the figures enables us to judge, it was usually very sensible, and sometimes very large. We have, for example, the following data assigned to three successive hours, 259 | 165, 184; 166 | 51, 53; 118, 139 | 266; 313, 300 | 150. In each case the entries which immediately precede and follow the vertical line represent respectively the latest and the earliest of the observations taken during the 'day.' If the hour at which the 'day' began was quite irregular, and if there were a very large number of days, uncertainties would naturally largely cancel out. But such cancellation cannot be assumed when the number of days is limited, and several of the inequalities, the results of which appear above, were apparently seriously prejudiced.

In the case of 210° E. longitude three n.c. discontinuities lead to an apparent excess of 160 *v/m* at 18 h. over 17 h., the excess in the aggregate from the whole 14 days being 182 *v/m*; and two n.c. discontinuities cause an apparent excess of 157 *v/m* at 19 h. over 18 h., the excess in the aggregate from the whole 14 days being only 92 *v/m*. Thus the maximum at 19 h. in the inequality from the 14 days may have been entirely due to the neglect of n.c. changes. As it so happens, these n.c. discontinuities in the case of the four zones considered were almost entirely confined to the (Greenwich) afternoon. Only one serious n.c. discontinuity appeared in the (Greenwich) forenoon. It led on 'day' No. 3 to an apparent fall of 98 *v/m* between 1 h. and 2 h., and was probably responsible for the hour at which the minimum occurred in the 180° zone. The effect of this discontinuity is not wholly negligible even in the case of the 42-day inequality. In spite of it, a remarkable feature stands out, namely, a close approach to constancy in the voltage from 1 h. to 6 h. G.M.T. Hourly means during the six hours vary only between 105·5 *v/m* at 3 h. and 108·7 *v/m* at 1 h. This suggests a diurnal variation, which is either very small or largely dependent on local time.

The results now obtained should not be regarded as disproving Dr. Mauchly's conclusions, but they unquestionably do suggest that further observations on somewhat different lines are required to justify any final conclusion. A term in the diurnal variation following universal time is not perhaps improbable *a priori*. The earth's surface varies notably in different zones, and there may be regions, *e.g.* the Himalayas, which exercise a dominant influence on the diurnal flow of the air-earth current on land. But even if a term depending on universal time exists, there may be even at sea terms of equal or greater importance depending on local time. The ideal arrangement to investigate the matter properly would be to have three similar ships—which need not be non-magnetic—with similar apparatus, observing simultaneously at three limited areas about the same latitude, the two extreme areas being about

---

[1] Researches of the Department of Terrestrial Magnetism, vol. 5: "Ocean Magnetic and Electric Observations, 1915–1921." Washington, D.C. Published by the Carnegie Institution of Washington, 1926. Pp. vii+430, with 15 plates and 31 figures in the text.

180° apart, and the third midway. Each ship should observe in succession at each area for a month or two, as continuously as possible. In any case, an overlap of two or three hours should be secured for each 'day's' observations.

The relation of potential gradient to sunspots has been dealt with by Dr. Bauer in various recent papers which have been discussed in NATURE. Dr. Mauchly refers on pp. 405-406 to the bearing of the ocean observations on this point. He says: "The mean values for each 3-month period . . . show throughout the years beginning with 1915, first an increase to 1916 or 1917, and then a gradual and consistent decrease to the end of 1921. This is so closely in accord with what has been observed at land stations, where reliable or undisturbed data of required extent are available, as to leave no doubt regarding the reality and universality of this phenomenon" (*l.c.* p. 405); and again: "in all latitudes for which there were sufficient observations . . . the mean values observed on cruise VI (mean epoch 1920·8) were from 15 to 20 per cent. lower than those observed in cruise IV. (mean epoch 1916·2)" (*l.c.* p. 406). These statements should, however, be taken in conjunction with the following two: "It should be noted that all potential gradient values shown in the graphs and tables of this report are of the order of 20 to 25 per cent. greater than those given in the author's earlier papers" (*l.c.* p. 397); and "At that time (1920), owing to various causes brought on by the War, there had been no final determinations of the instrumental constants to be used for reducing to absolute values the results of the . . . observations made aboard the vessel" (*l.c.* p. 387). Apparently all the observational data depend on reduction factors got out during expedition No. VI., and these are apparently assumed to have been unchanged since 1915. Those having experience in these matters may perhaps be pardoned a doubt whether the factors used in Dr. Mauchly's earlier papers were so much in error as he now supposes.

The general subject of sunspot influence is considered in more detail by Dr. Bauer himself, pp. 361-384. The following statement (*l.c.* p. 381) embodies his present opinions: "The general conclusion from the investigations, based on land and ocean results . . . is to indicate with a high degree of probability that during the cycle of 1913-1922 the atmospheric potential gradient increased with increasing sun-spottedness by at least 20 per cent. of its mean value for the cycle between the years of minimum and maximum sun-spottedness. The same statement applies with regard to measures of the diurnal variation and of the annual variation of the potential gradient." These conclusions are based on the results obtained by the *Carnegie* at sea and on the published data of the Ebro, Eskdalemuir, and Kew observatories. The methods employed seem practically the same as in Dr. Bauer's earlier papers on the subject. No notice seems to be taken of the criticisms which have appeared in NATURE, and no further vindication is supplied of the omission of the results from Potsdam, which gave a small decline in potential gradient with increased sun-spottedness. The reason assigned for disregarding Potsdam is alleged uncertainty as to the reduction factor. But uncertainty on this ground has been denied by the Potsdam authorities, and it seems scarcely likely *a priori* to have been more serious than in the case of the ocean observations which Dr. Bauer seems to have no doubts about.

As considerable use is made of the amplitudes and phase angles of Fourier coefficients by both Dr. Bauer and Dr. Mauchly, it may not be amiss to point out that the calculation of these coefficients from data in which large n.c. changes exist and have not been eliminated is unsatisfactory from the mathematical point of view. Unless the n.c. change is very small as compared with the daily range the effect of its neglect may be serious, especially in the case of the waves of least amplitude.

C. CHREE.

The Formation of Lactic Acid in Muscle.

A VERY important advance in our knowledge of this fundamental process has been made by Prof. Meyerhof in continuation of his well-known researches on the subject. Last January he announced (in *Die Naturwissenschaften*, 14, Heft 10) that he had succeeded in extracting the enzyme responsible for the production of lactic acid from carbohydrates in muscle, and gave an account of its properties. He has now carried matters a step further (*Die Naturwissenschaften*, 14, 32) and has been able to penetrate much more deeply into the mechanism of the change. The enzyme, obtained by extracting the finely divided muscle with isotonic potassium chloride solution at -1° to -2° and then centrifuging, readily forms lactic acid from starch and glycogen at a rate about two-thirds of that of the spontaneous formation of the acid in minced muscle. It is separated by ultra-filtration into a heat-labile inactive residue and a stable filtrate—the previously known coenzyme—which reactivates this residue. The coenzyme can be obtained either from muscle or yeast, and its addition greatly increases the amount of lactic acid producible from an excess of glycogen. The hexoses and the disaccharides are scarcely attacked, whereas lactic acid is freely formed, and at nearly the same rate, from glycogen, starch, and various degradation products of starch.

Hexosediphosphoric acid, the monophosphoric ester obtained from it by partial hydrolysis (Neuberg), and the isomeric monophosphoric ester from yeast juice (Harden and Robison) are all attacked. This decomposition of hexosephosphoric acid into equivalent amounts of lactic acid and phosphoric acid is, however, independent of the presence of the coenzyme which is necessary for the decomposition of glycogen and starch.

The production of lactic acid, either from glycogen or glucose, is preceded by the formation of a hexosephosphoric acid, and the reason why glycogen is the more easily acted on appears to be that a reactive hexose is formed from it which is more readily esterified than glucose in its stable form.

Meyerhof, hoping to be able to accelerate the action on the hexoses, turned to yeast—that unfailing storehouse of physiological surprises—and met with astonishing success. By precipitating autolysed yeast with 50 per cent. alcohol he obtained a new activator—different from zymase, coenzyme, and insulin—which, when added to the mixture of muscle enzyme and the hexoses, increases the rate of lactic acid formation until it amounts to several times that of its production from glycogen and 10 times that of the spontaneous production of lactic acid in minced muscle. The decomposition of glycogen, on the other hand, is scarcely affected.

At the same time the esterification of the phosphoric acid is still more accelerated, and the result is that during the first 15-30 minutes there is a rapid accumulation of hexosephosphoric acid, which continues so long as both hexose and free phosphoric acid are present. The rate of production of the acid then falls rapidly, and is followed, when the supply of both hexose and phosphoric acid is exhausted, by a stage in which a slow production of lactic acid and phosphoric acid in equivalent amounts takes place. The hexosephosphoric acid formed is approximately equivalent in amount to the amount of lactic acid produced.

This state of affairs presents, as will be seen, the most complete analogy to what occurs in alcoholic fermentation, with the difference that in one case the product is lactic acid and in the other alcohol and carbon dioxide. There is the same great acceleration in the rate of the reaction, accompanied by the accumulation of hexosephosphoric acid, the same drop in the rate when the free phosphoric acid is exhausted, and the same succeeding slow rate of change. As in the case of alcoholic fermentation, fructose reacts much more rapidly than glucose. There seems to be no doubt that the same fundamental change is in progress in the two cases.

Meyerhof believes that the hexosephosphoric acid produced is converted whilst *in statu nascendi* into the final products—lactic acid or alcohol and carbon dioxide (or some precursor of these) and phosphoric acid.

As, however, the rate of esterification is greater than that of decomposition, some of the phosphoric ester becomes stabilised in the less reactive form in which it can be isolated.

In the intact yeast cell and the natural muscle there is no accumulation of hexosephosphoric acid, "probably because, as the result of an accurate co-ordination, the whole of the labile ester produced is fermented, and not only about one-half of it, as in the extracts."

This explanation scarcely accounts for the approximate equivalence between the amounts of hexose decomposed and converted into the stable ester, and there is doubtless more yet to be learned on this point.

The striking similarity established by Meyerhof between the changes of carbohydrates in muscle and in the yeast cell is seen to be much closer than has been believed. The remarkable phenomena accompanying alcoholic fermentation are now duplicated in the case of lactic acid production, and it may reasonably be expected that most of the fermentative decompositions of the sugars will be found to be initiated in a similar manner.

It is a great achievement to have pushed the analysis of the production of lactic acid so far, and further results of this line of investigation will be awaited with the greatest interest.

ARTHUR HARDEN.

A Royal Collection of Scientific Instruments.

AN interesting historical document is described by Mr. Robert S. Whipple in "An Old Catalogue and what it tells us of the Scientific Instruments and Curios collected by Queen Charlotte and King George III." (Reprinted from the *Proceedings of the Optical Convention, 1926*. Part 2.) The catalogue, which has been preserved at the Kew Observatory, was prepared in 1770 or a few years later. A reproduction of the first page of the catalogue is given, the complete catalogue (319 entries), and a "Catalogue of Presents by Sundry Persons" (77 entries) being printed as an appendix to the paper.

Whilst the first catalogue is confined wholly to scientific apparatus and instruments, a large proportion being of the educational or teaching type, the 'presents' are mainly of the 'natural history' type, including such objects as 'a dried cat,' 'a lizzard in spirits,' 'fosils from Virginia,' 'two Batavia rats,' 'two spiders from Bardadoes,' etc. In the latter list the names of the distinguished donors are given.

Before describing the contents of the collection, Mr. Whipple gives an account of the foundation of the King's Observatory at Kew for the purpose of observing the transit of Venus in 1769. Some of the instruments included in the catalogue were used in the observations, and the original notes (preserved in the Library of King's College, London) by Dr. Demainbray recording the observations are published, it is believed for the first time. King George III. acted as an assistant during the observations. Queen Charlotte and the Princes Ernest and George of Mecklenburg-Strelitz were present, and others taking part were Col. Desaguliers, Rev. Geo. Wollaston, Stephen Rigaud, Justin and Benjamin Vulliamy, Jeremiah Sisson, and John Cuff.

Full details are given of the instruments used and of the observations made. It is interesting to read that "His Majesty the King who made his Observation with a Short's Reflecting Telescope, magnifying Diameters 170 Times, was the first who saw the Penumbra of Venus touching the Edge of the Sun's Disk." There is a note afterwards to the effect that "his Majesty thinks he saw it before he gave his Signal to Doctor Demainbray, who attended at the Regulator. And that Mr. Sisson (fearful of giving a false Alarum) waited an Instant before he caused Mr. Cuff to ring the Bell."

The collection of instruments and apparatus as specified in the Queen's Catalogue, with other objects afterwards acquired, remained as a national collection in the Kew Observatory until 1841, when the Government decided to discontinue the maintenance of the Observatory. Mr. Whipple gives in detail the circumstances leading to this decision, and the consequent distribution of the collection to various institutions and individuals.

Some of the instruments and apparatus which went to King's College, with a request that "they should be preserved together as a whole" (forming the George III. Museum), are described and illustrated. The present locations of some of these, as well as of instruments which went to other institutions, are given.

Of the larger instruments included in the Catalogue, perhaps the best known to the general public are the large eight-feet mural quadrant by Jeremiah Sisson, and the observatory clock by Benjamin Vulliamy. These have been exhibited for many years in the Science Museum at South Kensington. Of the transit instrument, which went to Armagh Observatory, only the object-glass and the mahogany stand for lifting and reversing the telescope are still in existence, the object-glass being used at present for testing planes. The lens and some parts of the five-feet "astronomical sector in dome," as well as the six-inch telescope (probably that used by the King in 1769) made by Short in 1745, are still preserved at Armagh.

Mr. Whipple gives interesting evidence of the circumstances in which the valuable old microscopes were acquired by the late Sir Frank Crisp from the George III. Museum. The King's College authorities, though aware of the great historical value of the instruments, agreed to the transference only after much pressure, and "having been given the assurance that the Crisp collection was destined for the nation." Mr. Whipple adds: "The fact that the assurance was not fulfilled illustrates the importance of entrusting instruments or other objects of historical interest to a National Museum."

Since this interesting and valuable paper was read at the Optical Convention last April, the George III. collection, which was then still at King's College, has been transferred on loan to the Science Museum.

D. B.

University and Educational Intelligence.

CAMBRIDGE.—A valuable bequest of works of art, including a collection of the finest Italian majolica, has been left to the Fitzwilliam museum along with 10,000*l*., as an endowment for the purchase of works of art, by the late Right Hon. F. Leverton Harris, of Gonville and Caius College.

Dr R. R. Marett has been appointed to the Frazer lectureship in anthropology.

It is proposed to abandon the examinations for the diploma in horticultural science, it having proved impracticable to acquire adequate facilities for the teaching.

Mr. E G. D. Murray has been elected to a research fellowship at Christ's College.

SYDNEY.—The following appointments are announced: Mr. John Anderson (Edinburgh) to be professor of philosophy in succession to the late Prof. B. Muscio; Dr. W. S Dawson, of the Maudsley L.C C. Hospital, Denmark Hill, London, to be professor of psychiatry in succession to Sir John Macpherson; Mr. H. Finnemore (Guy's Hospital Medical School), to be lecturer in pharmacy in succession to Mr. S. H. Stroud; Dr T. Iredale, of Armstrong College, Newcastle-on-Tyne, to be lecturer in chemistry, in succession to Prof J. A. Schofield.

THE University College of North Wales, Bangor, announces in its Calendar for 1926-27 the opening of new War Memorial Laboratories for all the science departments, excepting applied electricity. This development was rendered possible by the help of the Council of the North Wales Heroes' Memorial Fund, the total subscriptions to which, including an initial gift in 1917 of 20,000*l*. by Sir R. J. Thomas, amount to nearly 100,000*l*. The interesting historical summary given in the preface to the Calendar recalls the remarkable unanimity with which all classes of the community contributed to the establishment of the College forty years ago. Never before, it says, in so short a period, have so many persons, either in England or in Wales, subscribed towards a movement for the promotion of higher education. In the first twelve months more than 30,000*l* was subscribed by nearly 8000 donors. The total sum subscribed towards the College since its establishment is 407,735*l*. One of the two main types of approved schemes of study for the B.A. (pass) degree is known as the scheme of civic studies, the general aim of which is to emphasise the more definitely humanistic side of the subjects in the arts curriculum and cultivate a more intelligent appreciation of national life.

THE directors of the Commonwealth Fund of New York City, which was founded in 1918, awarded in 1925 and 1926 a number of Commonwealth Fund Fellowships to British graduates for study in selected American universities. Entries last year numbered 178, and the committee of award states that the general level of attainment was higher than that of 1925. A maximum of twenty fellowships are awarded each year, and candidates must be of British birth who are domiciled in Great Britain or Ireland, and less than thirty years of age. Personality, health, and character are taken into account as well as intellectual ability. With the exception of purely clinical work in medicine, which is not considered likely to be promoted by the type of travelling fellowship offered, there is no limitation as to subject of study. In 1927, for the first time, the committee of award will be empowered to appoint three "Extra Fellowships," which are intended for candidates from British Dominions who have studied in British universities or such as hold appointments in Colonial administrative or educational service. The annual value of a Commonwealth Fund fellowship is about 600*l*. Further information can be obtained from the secretary of the Committee, Commonwealth Fund Fellowships, 50 Russell Square, London, W.C.1.; applications on the prescribed forms must be completed and reach him by February 19.

THE report of Battersea Polytechnic for 1925–26, though registering a slight increase in comparison with the preceding year's record of work done, directs attention to the fact that its valuable plant would be more fully utilised but for the raising of the fees against residents of Surrey (Wimbledon and Croydon), owing to which the technical college has suffered a continuous decline in the number of its day students since 1920–21. Judged by the list of academic honours gained in 1925–26, the Polytechnic has achieved very considerable success in the field of higher education in science. It includes three doctorates, three degrees of M.Sc., and twenty-five B.Sc. In the Chemistry Department a substantial amount of original research work was done, and led to the three doctorates and to the Meldola medal awarded by the Institute of Chemistry. Among the subjects in which there are specialist courses in this Department are paper testing and making, chemical engineering, soaps and detergents, mineral oils and waxes, catalytic hydrogenation and secondary constituents of plants. The Department of Hygiene and Public Health, which trains candidates for such posts as health visitor and sanitary inspector, has expanded largely in the past three years, as has likewise the Training College of Domestic Science, now the largest of its kind in Great Britain, which sends out teachers and organisers to all parts of the Empire and to foreign countries. For some time past all day students, in whatever department of the Polytechnic, who have satisfactorily completed the full course, have obtained employment.

"UNIVERSITY extension" in the United States includes (1) instruction in agriculture and home economics provided with the aid of Federal subsidies through the land-grant colleges, and (2) very varied activities of universities and colleges in other fields to which the name "General University Extension" has been applied. A report on this latter group of activities by the Dean of Extension of the University of Texas has been published by the Bureau of Education as Bulletin, 1926, No. 5. The progress of extension of leading universities impels the writer of the report to the conclusion that "before many decades have passed all Americans, both old and young, will have the advantages of university training and university service at their very doors." President Birge, of the University of Wisconsin, the pioneer in America in extension work, holds that it is essential not only for individual progress on the part of students, but equally "as a means of preventing the crystallisation of social groups." Among the extension activities which have shown exceptional development in the past two years are radio courses. It has been proved that courses of instruction in foreign languages, social sciences, etc, can easily be given by this method, which combines the lecture with written reports. One university enrolled 1636 radio-course students belonging to more than half the States and to Canada, the enrolment fee being one dollar, and entitling the student to receive mimeographed study material. Some of the other branches of extension work are described as community drama, home-reading courses, graduate medical lectures, labour education, community institutes. The total number of students enrolled in extension and correspondence courses in 1923–24 was 141,000.

Contemporary Birthdays.

December 17, 1853. M. Émile Roux, For.Mem.R.S.
December 17, 1861. Mr. Edward Heron-Allen, F.R.S.
December 18, 1856. Sir J. J. Thomson, O.M., F.R.S.
December 19, 1852. Prof. A. A. Michelson, For.Mem.R.S.
December 20, 1876. Dr. Walter Sydney Adams.
December 22, 1862. Dr. Vaughan Cornish.

DIRECTOR of the Pasteur Institute, Paris, a foreign member of the Royal Society of London, and Copley medallist, Dr. Émile Roux was born at Confolens. Early in his career he worked in Pasteur's laboratory, and in the course of time became his collaborator in pathological research. In 1889 Roux delivered, on behalf of M. Pasteur, whose health did not allow attendance, the Royal Society's Croonian lecture, on the subject "Les Inoculations Préventives."

Mr. E. HERON-ALLEN is a Londoner, and was educated at Harrow. He has written many papers on the Foraminifera, including one published in the *Philosophical Transactions* (1915), entitled "Bionomics of the Foraminifera." In 1916–18 Mr. Heron-Allen was president of the Royal Microscopical Society. He has done original work in many departments of natural history, and is, in addition, an authority on Persian literature.

Prof. MICHELSON was born at Strelno, Germany. Entering and graduating at the U.S. Naval Academy, he joined the Nautical Almanac Office, Washington; afterwards he studied at the Universities of Berlin, Heidelberg, and the École Polytechnique, Paris. From 1889 until 1892 he was professor of physics at Clark University, Worcester, Massachusetts, leaving to become professor and head of the Department of Physics in the University of Chicago. A foreign member of the Royal Society of London, he was awarded the Copley medal in 1907. In that year he was also Nobel laureate in physics. Prof. Michelson was a pioneer in the construction of interferometers, and his optical inventions have rendered possible the reproduction of accurate metric standards, which are now widely used. He has received many foreign recognitions; he is Hon. Sc.D., Cambridge, and an associate of the Royal Astronomical Society, which awarded him its gold medal in 1923. Prof. Michelson was added to our roll of "Scientific Worthies" in NATURE of January 2, 1926.

Dr. W. S. ADAMS was born at Antioch. He was sent to Dartmouth College, Hanover, U.S.A., and afterwards to the University of Chicago. Appointed an assistant at Yerkes Observatory, he removed in 1901 to fill a similar post at Mount Wilson Observatory, California, becoming Director in 1923. A member of the National Academy of Sciences, Washington, he is one of its Draper medallists. The Royal Astronomical Society awarded Dr. Adams its gold medal in 1917 for his investigations in stellar spectroscopy. Last year his observations on the spectrum of the companion of Sirius enabled him to confirm Einstein's prediction of the gravitational displacement of spectral lines, and also Eddington's calculations of the very high density of white dwarf stars.

Dr. VAUGHAN CORNISH, a zealous geographer, was born at Debenham, Suffolk. He was educated at St. Paul's School and the Victoria University, Manchester. In 1900 the Royal Geographical Society allotted him the Gill Memorial Award for extended researches on sea-beaches, sand-dunes, and wave-form in water. President of Section E (Geography) at the Liverpool meeting of the British Association in 1923, he gave an address on the British Empire regarded as a maritime organisation. He is the author of "The Great Capitals: an Historical Geography" (1923).

Societies and Academies.

LONDON.

Optical Society, November 11.—J. W. T. **Walsh** and W. **Barnett**: The effect of slightly selective absorption in the paint used for photometric integrators. A sensibly non-selective internal coating for photometric integrators is very difficult to produce and still more difficult to maintain. When lamps of different colour temperatures are compared in an integrator with an internal coating which shows selective absorption in, say, the blue, the values of candle-power obtained for the lamps of lower colour temperature will be too high, and vice versa. A simple method is given for calculating the magnitude of the effect for sources having a spectrum approximating to that of a black body. In work on normal type electric lamps, to an accuracy of 1 to 2 per cent., a quite noticeable coloration of the light may be produced by the sphere (either on account of paint or window selectivity or both) without the necessity for making any correction to the measured values of candle-power.—Conrad **Beck**: An accurate method of ascertaining the position of the focal point of an optical system. The method consists essentially in placing a diaphragm with two slit apertures behind the object-glass to be tested, the directions of the slits being at right angles to one another, and finding the position where the images form a symmetrical cross. Results of measurements by this method of the zonal aberrations of apochromatic microscope object-glasses are given.

PARIS.

Academy of Sciences, November 15.—Georges **Perrier**: The regular triangulation of Morocco. Outline of geodesic work done in Morocco since 1910, with key map.—F. E. **Fournier**: Effects useful or detrimental to the velocity of ships.—Charles **Moureu**, Charles **Dufraisse**, and Marius **Badoche**: Autoxidation and antioxygen action (XX.). Catalytic actions of a new series of nitrogen compounds. General observations on the nitrogen compounds. Details of the study of the catalytic properties of thirty-seven new nitrogen compounds.—H. **Douvillé**: The marbles of Sarrancolin and of Saint-Béat in the Central Pyrenees.—Jean Baptiste **Senderens** and Jean **Aboulenc**: The etherification of the hydroaromatic alcohols. Cyclohexanol, heated with 2 per cent. sulphuric acid (concentrated or diluted) does not give cyclohexyl oxide, but a mixture of cyclohexene and its polymer. Similarly, a mixture of cyclohexanol and a fatty alcohol fails to give a mixed ether. On the other hand, the hydroaromatic alcohol and an aromatic alcohol under the same conditions gives a mixture containing benzyl ether and the mixed ether.—Camille **Sauvageau**: The development of *Colpomenia sinuosa*.—A. **Calmette**, J. **Valtis**, and M. **Lacomme**: The intra-uterine transmission of the tubercle virus from mother to infant. In the course of some grave tuberculous infections, the passage of the tubercle virus from mother to fœtus during gestation is less exceptional than has hitherto been supposed.—Bertrand **Gambier**: The deformation of surfaces and the method of Weingarten.—E. **Goursat**: Observations on the preceding communication.—**Potron**: The fundamental theorems of the theory of finite continuous groups of transformations.—R. **Wavre** and A. **Bruttin**: A continuous transformation and the existence of an invariant point.—J. **Delsarte**: Rotations in functional space.—E. F. **Collingwood**: A theorem on integral functions.—S. **Saks**: The differentiation of the area of surfaces.—G. **Vranceanu**:

Non-holonomial spaces.—Jean **Chazy**: The field of gravitation in the interior of a hollow sphere in rotation in the relativity theory.—H. **Beghin** and P. **Monfraix**: The realisation of a damped zenithal gyrostatic compass.—R. **Swyngedauw**: The slipping of belts.—J. F. **Saffy**: The influence of prolonged maintenance, at a red heat, on the resilience of some metals used for exhaust valves. Measurements of resilience of four samples of chrome-steel of different composition are given. These steels had been submitted to a temperature of 600° (in one case to 850°) for varying periods (maximum twelve weeks), before taking the measurements. An austentitic chrome-nickel steel retained a practically constant resilience, even after twelve weeks and at 850° C. This steel is markedly superior to other steels for use in valves of internal combustion engines.—R. **Mazet**: The formation of liquid jets.—Robert **Lévi**: The theory of universal and discontinuous action.—**Sauger**: Energy extensions of the Newtonian potential.—A. **Guillet**: The value of the constant of time most favourable to the direct electrical maintenance of an oscillatory movement.—L. **Caignard**: The variation of the dielectric constant of benzene with pressure. The high frequency oscillations used in the measurements had a wave-length of 6425 metres, the electric field applied to the dielectric 650 volts per cm., maximum pressure, 22 atmospheres. At constant temperature the dielectric constant is a linear function of the pressure.—G. **Gamow**: L. de Broglie's theory of waves of phases.—C. **Mihul**: The structure of the spectrum of oxygen of the second order.—D. K. **Yovanovitch** and Al. **Proca**: The slow β-rays of mesothorium-2.—Maurice **Lecat**: Azeotropism, particularly of binary systems with closely chemically related constituents. An attempt to measure the tendency of two substances to form a mixture of constant boiling point, with special reference to the chemical nature of the two constituents. Numerical data are given for twenty-eight binary mixtures forming constant boiling mixtures.—F. M. **Ostroga**: Chrome-cobalt steels. From the point of view of the influence of the temperature of heating and velocity of cooling on the constitution of these alloys, the chrome-cobalt steels show a sensibility at least equal, if not superior, to that of chrome-nickel high-speed steels.—J. **Cournot** and R. **Pages**: Studies of the viscosity of copper and its alloys.—E. **Tassilly** and R. **Savoire**: The spectrophotometric determination of nitrites and nitrates by diphenylamine sulphate. With the instrument used (Ch. Féry spectrophotometer) the useful range is from 0·1 to 5 milligrams of N_2O_5, with a possible error of 0·1 mgm.—J. A. **Le Bel**: The stereochemistry of the ethylene derivatives. The experimental results in a recent note by Dufraisse and Gillet afford a confirmation of the theoretical views of the author.—**Lespieau** and **Deluchat**: 1,7-Octadiine. This hydrocarbon, $HC:C-(CH_2)_4-C:CH$, has been isolated, starting with dibromobutene, and its compound with silver nitrate prepared.—E. **Raguin**: The presence, to the north-east of Vanoise, of schists assimilable to those of the Tertiary Flysch.—Octave **Mengel**: An apparent analogy between the Alpino-Dinaric and Pyreneo-Iberic border. Common origin of the Alpine lakes and ancient Pyrenean lakes.—L. **Picard**: The Cenomanian of Carmel (south-east of Haifa).—Henri **Coupin**: The rôle of fleshy pericarps.—E. **Chemin**: A new species of Colaconema on *Asparagopsis lamifera*.—René **Souèges**: The embryogeny of the Papaveraceæ. The development of the proembryo in *Papaver Rhœas*.—E. **Chemin** and R. **Legendre**: Observations on the existence of free iodine in *Falkenbergia Doubletii*. Free iodine has been found by M. Sauvageau in *F. Doubletii* collected at Guéthary and at Cherbourg. The authors have examined specimens from Brest and from Glénans, but no free iodine could be detected. Weak acids, even carbonic acid, set free iodine, which hence would appear to be present as a labile compound other than iodide. O. **Munerati**: Observations on the seed yield of beetroot in the first year.—Lucien **Daniel**: Intermittent heredity in the Jerusalem artichoke.—Adrien Davy de **Virville**: The influence of submersion on the mode of development of a moss: *Aulacomnium androgynum*.—J. **Dubar** and G **Thieulin**: An attempt at the determination of the static refraction of the eye of the dog and cat.—Mme. Marguerite **Lwoff**: A mode of asexual reproduction in a Hydra of the family of the Tubularidæ.—Louis **Roule**: The displacements of *Orcynus thynnus* (or *Thunnus thynnus*) in the western basin of the Mediterranean.—L. **Lutz**: The soluble ferments secreted by the Hymenomycetes fungi: simple antioxygen actions.—V. **Omeliansky** and Mlle. M. **Kononoff**: A method of culture of the bacillus causing the retting of flax.—N. **Bezssonoff**: The true specific régime of experimental scurvy. Heated milk contains an appreciable proportion of vitamin C, and this is the cause of its varying effects on guinea-pigs. An alternative diet is suggested which gives more definite results.—L. **Ambard** and F. **Schmid**: The treatment of respiratory syncope by inhaling carbon dioxide. An arrest of respiration in a dog produced by a dose of chloralose, on which artificial respiration was without effect, was immediately removed by causing the animal to inhale a mixture of air and carbon dioxide. It is suggested that in many cases this method possesses advantages over artificial respiration.

VIENNA.

Academy of Sciences, October 21.—A. **Kailan**: The chemical effects of the penetrating radium radiation. The rays from 110 milligrams of a radium preparation were passed through 1 mm. of glass and allowed to act for more than 1000 hours on uric acid, on pyridin, on anilin, on nitrobenzol. Slight changes were noticed.—F. **Holzl**: Organic acids and bases in non-aqueous solution. Conductivity measurements were made.—S. I. **Mayr**: Free albumin crystals in the endosperm of the seeds of *Loranthus europaeus*.—R. **Weiss** and W. **Knapp**: Triphenylmethanes the benzene rings of which are interconnected.—S. **Loewe** and E **Spohr**: Detection and determination of contents of the female oestral hormone in the female organs of the vegetable kingdom. Experiments were made on mice and rats with extracts prepared from the flowers of the yellow water-lily and from willow catkins.—P. **Ludwig**: Tensile strength, cohesion, and danger of fracture. The fundamental factor in brittleness depends on the ratio of rigidity of form to tensile strength.—R. **Rotter**: The condensation of unsaturated compounds with diazomethane. Condensation of diazomethane with carbon disulphide and xyloquinone.—R. **Seka** and H. **Sedlatschek**: Complex compounds of pyromellithic acid anhydride.—G. **Klein**: Assimilation of nitrates by moulds.—N. A. **Puschin** and B. **Vaic**: Equilibrium in binary systems which contain guaiacol as one of the constituents.

October 28.—F. **Heritsch**: The tectonic 'window' [a break in a sheet-fold or overthrust layer, through which lower rocks are exposed] at Felsbach.—R. **Seka** and K. **Sekora**: Reduction products of dinaphtanthracene-diquinone.

Official Publications Received.

BRITISH AND COLONIAL.

Aeronautical Research Committee: Reports and Memoranda. No. 1014 (Ae. 217): An Extension of the Vortex Theory of Airscrews with Applications to Airscrews of small Pitch, including Experimental Results. By C. N. H. Lock, H. Bateman and H. C. H. Townend. (A. 3. d. Airscrews, 71 and 86.—T. 1867.—T. 2112.) Pp. 40+9 plates. 1s. 6d. net. No. 1018 (Ae. 219): Experiments on the Air Forces on Rotating Cylinders. By Dr. A. Thom. (D. 1. Special Technical Questions, 121.—T. 2022.) Pp. 8+15 plates. 6d. net. No. 1036 (M. 45): The Constitution and Age-Hardening of some Ternary and Quaternary Alloys of Aluminium containing Nickel. By Kathleen E. Bingham. Work performed at the National Physical Laboratory for the Engineering Research Board of the Department of Scientific and Industrial Research. (B. 1. a. Metals, 54.—T. 2250.) Pp. 21. 1s. net. No. 1039 (Ae. 226): Stresses in a Stiff-Jointed Polygonal Frame under a System of Loads Perpendicular to the Plane of the Frame. By J. F. Baker. (B. 2. 9. Strength and Design. General 70.—T. 2220.) Pp. 9+7 plates. 9d. net. (London: H.M. Stationery Office.)

Department of Commercial Intelligence and Statistics, India. Agricultural Statistics of India, 1923–24. Vol. 2: Area, Classification of Area, Area under Irrigation, Area under Crops, Live-Stock, and Land Revenue Assessment in certain Indian States. Pp. viii+87. (Calcutta: Government of India Central Publication Branch.) 1 rupee; 1s. 9d.

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 1, No. 4: The Development of the Vascular System in the Human Embryo prior to the Establishment of the Heart. By Dr. Donald M'Intyre. Pp. 77-113+3 plates. 5s. 6d. Vol. 55, Part 1, No. 5: Development of Cavia; Implantation. By Dr. Norman Maclaren. Pp. 115-123+3 plates. 2s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 6: The Determination of Available Phosphoric Acid of Calcareous Soils. Part i: Inapplicability of Dyer's Method to Highly Calcareous Soils; Part ii: Extraction of Phosphoric Acid of Calcareous Soils with Salt Solutions; Part iii: Potassium Carbonate Method for Estimation of Available Phosphoric Acid of Highly Calcareous Soils. By Surendralal Das. Pp. 67-104. (Calcutta: Government of India Central Publication Branch.) 12 annas; 1s. 3d.

Hull Museum Publications, No. 143: Notes on Yorkshire Ammonites. By Dr. L. F. Spath. Pp. 72. (Hull.) 1s.

Aeronautical Research Committee: Reports and Memoranda. No. 1030 (Ae. 223): Experiments with a Family of Airscrews, including Effect of Tractor and Pusher Bodies. Part 4: On the Effect of placing an Airscrew in various Positions with the Nose of a Streamline Body. By H. Bateman, H. C. H. Townend [illegible] T. A. Kirkup. (A. 3. d. Airscrews, 68.—T. 2218.) Pp. 27+11 plates. 1s. 3d. net. No. 1034 (Ae. 227): The Efficiency of an Airscrew. By H. Glauert. (A. 3. d. Airscrews, 93.—T. 2236.) Pp. 11+6 plates. 9d. net. No. 1040 (Ae. 230): The Accuracy of the Vortex Theory of Airscrews in the Light of recent Experimental Work and its Application to Airscrew Design. By H. Glauert and C. N. H. Lock. (A. 3. d. Airscrews, 91.—T. 2271.) Pp. 16+9 plates. 9d. net. (London: H.M. Stationery Office.)

Quarterly Journal of the Royal Meteorological Society. Edited by a Committee of the Council. Vol. 52, No. 220, October. Pp. 331-448. (London: Edward Stanford, Ltd.) 7s. 6d.

Canada: Department of Mines: Victoria Memorial Museum. Museum Bulletin No. 41, Biological Series No. 10: Birds of Western Canada. By P. A. Taverner. (No. 2058.) Pp. ii+380+84 plates. (Ottawa: F. A. Acland.) Paper, 75 cents; cloth, 1 dollar.

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 2, No. 1, November. Pp. 90. (Cambridge: At the University Press.) 12s. 6d. net.

The National Institute of Agricultural Botany. Seventh Report and Accounts, 1925–26. Pp. 20. (Cambridge.)

Proceedings of the Prehistoric Society of East Anglia. Edited by G. Maynard. Vol. 4, Part 2 (for 1923–24). Pp. xii+133-247. 10s. net. Vol. 5, Part 1 (for 1925). Pp. xi+90. 10s. net. (Ipswich: W. E. Harrison.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Vincent, for the Year 1925. Pp. iv+44. (Trinidad, B.W.I.) 6d.

Livingstone College. Annual Report and Statement of Accounts for the Year 1925–26. Pp. 24. (Leyton, London, E 10.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Lucia, 1925. Pp. iv+22. (Trinidad, B.W.I.) 6d.

Tide Tables for the Pacific Coast of Canada for the Year 1927: including Fuca Strait, the Strait of Georgia, and the Northern Coast; with Data for Slack Water in the Navigable Passes and Narrows and Information on Currents. Issued by the Tidal and Current Survey Branch of the Hydrographic Survey, in the Department of Marine and Fisheries of the Dominion of Canada. (Twenty-seventh Year of Issue.) Pp. 72. (Ottawa: F. A. Acland.)

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirtieth Session adopted at the Annual Meeting of Governors held on the 19th October 1926. Pp. 79. (Glasgow.)

Aeronautical Research Committee: Reports and Memoranda. No. 1028 (M. 48): Report on Study of Mechanical Properties of Silicon-Aluminium Alloys, Parts 1 and 2. By J. D. Grogan. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (M.C. 165; L.A. 47.) Pp. 16+6 plates. 1s. net. No. 1042 (A. 4): An Investigation on Wing Flutter. By R. A. Frazer. (D. 1. Special Technical Questions, 171.—T. 2282.) Pp. 23+4 plates. 1s. net. (London: H.M. Stationery Office.)

International Federation of University Women. Bulletin No. 8: Report of the Fourth Conference, Amsterdam, July 28 to August 2, 1926. Pp. 176. 1s. 6d. Pamphlet No. 3: What Dutch University Women do in Holland and the Colonies. Pp. 32. 8d. (London.)

FOREIGN.

Stanford University Publications: University Series. Biological Sciences, Vol. 4, No. 1: The Fossil Fishes of the Miocene of Southern California. By David Starr Jordan. Pp. 51+21 plates. 1.50 dollars. Biological Sciences, Vol. 4, No. 2: Studies on Growth. Part 1: The Point Binomial and its Derivatives, by Prof. L. G. M. Baas-Becking; Part 2: Experimental Data—Application of the Theory, by Prof. L. G. M. Baas-Becking and Leland S. Baker. Pp. 53-135. 1 dollar. Biological Sciences, Vol. 4, No. 3: Bones of the Ethmoid Region of the Fish Skull. By Prof. Edwin Chapin Starks. Pp. 137-233. 2 dollars. Geological Sciences, Vol. 1, No. 1: The Marine Shells of the West Coast of North America. By Ida Shepard Oldroyd. Pp. 247+57 plates. 4 dollars. (Stanford University, California.)

Department of the Interior: U.S. Geological Survey. Bulletin 783-B: Summary of Recent Surveys in Northern Alaska. By Philip S. Smith, J. B. Mertie, jr., and W. T. Foran. (Mineral Resources of Alaska, 1924-E.) Pp. ii+151-166. (Washington, D.C.: Government Printing Office.)

Proceedings of the National Academy of Sciences of Philadelphia. A new Genus and Species of Phosphorescent Fish, Kryptophanaron Alfredi. By Charles F. Silvester and Henry W. Fowler. Pp. 245-247. Fishes from Florida, Brazil, Bolivia, Argentina and Chile. By Henry W. Fowler. Pp. 249-285. (Philadelphia, Pa.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 1, Part 5: Studies in Overvoltage. Part i: Hydrogen Overvoltage. By Tadashi Onoda. Pp. 223-247. 0·70 yen. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 1, Part 3: Fossil Shells from Sado. By Matajiro Yokoyama. Pp. 249-312+6 plates. 1·60 yen. Vol. 2, Part 1. The Tajima Earthquake of 1925. By Dr. Bundjirô Kotô. Pp. 75+8 plates. 2·50 yen. (Tokyo.)

U.S. Department of Agriculture: Weather Bureau. Monthly Weather Review, Supplement No. 26: An Aerological Survey of the United States. Part 2: Results of Observations by Means of Pilot Balloons. By Willis Ray Gregg. (W.B. No. 900.) Pp. v+60. (Washington, D.C.: Government Printing Office.)

Report on Norwegian Fishery and Marine Investigations. Vol. 3, No. 7: Quantitative Investigations of Plankton at Lofoten, March-April, 1923–1924. Preliminary Report, by Birgithe Ruud. Pp. 30. (Bergen: A. S. John Griegs Boktrykkeri.)

Obras completas y correspondencia científica de Florentino Ameghino. Volumen 5: Paraná y Monte Hermoso. Edición oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 534. (La Plata: Taller de Impresiones Oficiales.)

CATALOGUES.

Tech 926: "Universal Technical" Microscope. Pp. 6. (London: James Swift and Son, Ltd.)

Stu. 926: Microscopes for Students and other Workers in the Biological Sciences. Pp. 14. (London: James Swift and Son, Ltd.)

Diary of Societies.

SATURDAY, DECEMBER 18.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.—Discussion on paper by T. S. Durham on Thin Seam Mining.—Prof. G. Hickling: The Chemical Relations of the Principal Varieties of Coal.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. C. Rootham: Henry Purcell and his Contemporaries (I).

MONDAY, DECEMBER 20.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (Informal Meeting) (at Cleveland Technical Institute, Middlesbrough), at 7.—W. R. Cooper and others: Discussion on Some Electrical Problems.

CHEMICAL INDUSTRY CLUB, at 8.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Prof. J. W. Gregory: The Fjords of the Hebrides.

TUESDAY, DECEMBER 21.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—H. W. Macrosty: Inflation and Deflation in the United States and the United Kingdom, 1919–25.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering Club, Wolverhampton), at 7.30.—F. Randle: Radiator Design.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—T. M. Service: High Elastic Limit Steel for Shipbuilding and Marine Work.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Capt. T. A. Joyce: Excavations at Lubaantun, 1926.

PUBLIC LECTURE.

SUNDAY, DECEMBER 19.

GUILDHOUSE (Eccleston Square), at 3.30.—Miss Maude Royden: The Debt of Theology to Science.

CONFERENCE.

DECEMBER 30 TO JANUARY 7.

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College).

SATURDAY, DECEMBER 25, 1926.

CONTENTS.

PAGE
Taxonomy in Biology. By W. T. C. 901
Biological Synthesis: Hopes and Obstacles. By Prof. J. S. Huxley 902
Fuel Utilisation 905
A Popular Work on Tides. By J. P. 907
The History of Fishing. By H. B. 907
Our Bookshelf 908
Letters to the Editor:
The Fayum Lakes.—G. W. Grabham. . . . 911
Lane-Photograph taken with a Long Slit.—Usaburo Yoshida and Kenzo Tanaka 912
The Crystalline Nature of the Chief Constituent of Ordinary Coal.—Cyril S. Fox; Dr. Marie C. Stopes 913
Adsorption of Dyes to Silver Halides.—S. E. Shepherd 913
The Genetics of Evening Primroses and Mice.—Prof. T. D. A. Cockerell 914
Mathematical Proof *versus* Observation — Prof. Wm. H. Hobbs 915
The Oscillations of Superposed Fluids.—Prof. H. Lamb, F.R.S. 915
Rainfall Interception by Plants.—Lieut.-Colonel E. Gold, F.R.S. 915
Allotropy. By Prof. A. Smits 916
Sea-birds: Their Relation to the Fisheries and Agriculture. By Dr. Walter E. Collinge . . 920
Obituary:
Prof. C. J. Eberth By Prof. R. T. Hewlett . 921
News and Views 922
Our Astronomical Column 925
Research Items 926
Stress and Rhythm in Speech. By Dr. J. W. Jeaffreson 928
Dutch Pendulum Observations in the Atlantic and the Pacific. By Dr. J. J. A. Muller . . . 930
The Burning of Carbonic Oxide 932
University and Educational Intelligence . . . 932
Contemporary Birthdays 933
Societies and Academies 934
Official Publications Received 935
Diary of Societies 936
Recent Scientific and Technical Books . . Supp. iii.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Taxonomy in Biology.

WHEN Peter Camper, the great Dutch anatomist, was proposed for election as a foreign member of the Linnean Society of London in 1788, he wrote refusing in very emphatic terms to be associated with a society which bore the name of the founder of modern systematic biology. The incident is typical of an attitude towards the systematist on the part of those cultivating some of the other branches of biology which did not begin with Linnæus, and has by no means ended to-day. There is, however, one branch of biological research the dependence of which on the work of the systematist cannot be overlooked. The economic biologist, at any rate, must begin by finding out the names of the species of animals or plants with which he is dealing. Without their names he cannot profit by the experience of the past, nor can he transmit his results for the benefit of the future.

It is not surprising, therefore, to find that in a recent discussion before the Association of Economic Biologists on "The Place of the Systematist in Applied Biological Work,"[1] all the speakers emphasised the fundamental importance of systematics. Dr. James Waterston, in opening the discussion, gave a description of the work of the systematist which deserves to be thought over. "He finds in nature communities or groups of similar individual organisms which he calls species, and he makes it his business to arrange these and to summarise the salient facts about them in the simplest and most intelligible form." While the basis of his arrangement must be morphological, neglecting neither external form nor internal anatomy, he may also get help from other fields of work and take account of the results of the geneticist or the physiologist.

This is excellent if not quite exhaustive, but some of the later speakers in the discussion seemed to imply that the only help the economic biologist could get from the systematist was an answer to the question 'What is the name of this?' This estimate of the value of the systematist's work is widely held if it is not often frankly expressed. A distinguished biologist once told the present writer that the search for a natural classification was no part of a systematist's business. His job was identification, not classification, and he had only to devise some kind of key or card index which would enable the organisms to be quickly and easily sorted into species. If he cared he might amuse his leisure by speculating on the affinities of these species, but, so far as the really scientific branches of biology were concerned, an artificial classification was as good as, and might even be better than, any other.

---

[1] *Annals of Applied Biology*, vol. 13, No. 3, August 1926.

The idea underlying the view thus drastically expressed would seem to be that since the categories of the physiologist, the ecologist, the geneticist, and so on, often cut across the divisions of the most natural (that is, phylogenetic) classification we can devise, taxonomy is without interest or importance for workers in these other fields. It would not be difficult to show that this conclusion is far from being justified for any branch of biology. For the present, however, it is enough to point out that the economic biologist, although identification is his primary need, cannot afford to neglect the help that he may get from the improvement of classification.

In the course of the discussion mentioned above, Mr. J. C. F. Fryer pointed out that "the ability to place an organism in its correct group would often yield invaluable clues as to its biology and the part it might be playing in the problem in hand." In other words, the chances are that an organism will approach, in its habits and reactions, those that come nearest to it in morphological characters. A parrot may have the feeding habits of a hawk and a kingfisher may live in a waterless country and feed on lizards, but these exceptions must not obscure the fact that in defining the systematic groups of parrots or of kingfishers we are also defining, although somewhat less strictly, bionomic groups. A crab may live on land or have a direct development, but as a rule an animal with the morphological characters of the Brachyura may be expected to have aquatic habits and to hatch as a zoea larva. On merely practical grounds, therefore, the card index idea of biological systematics is inadequate.

On the other hand, the systematist, if he is to deserve the consideration of his scientific colleagues, must not allow himself to become immersed exclusively in the minor problems of specific distinction, although these may often be as fascinating as any crossword puzzle. The natural system of classification may seem, for some groups of organisms, to defy discovery, but each step towards it holds the promise of added usefulness in possibly remote fields of research.

We may close, as we began, with a story, but it is to be hoped that this one is apocryphal. Once upon a time, it is said, a young zoologist wrote a paper, which he sent to the Royal Society. The title of the paper ran somewhat thus, "On the development of a certain system of organs and its bearing on the classification of the group of animals in which it occurs." In due course the author received notice that the paper had been reported on favourably and would be accepted for publication provided that he removed from the title the reference to classification!

W. T. C.

Biological Synthesis: Hopes and Obstacles.

The Physiology of the Continuity of Life. By Prof. D. Noël Paton. Pp. x+226. (London: Macmillan and Co., Ltd., 1926.) 12*s*. net.

THERE never was a greater opportunity for successful and fruitful synthesis in science than exists now in respect of general biology. At last we know the main outlines of the laws of most vital phenomena—comparative morphology, physiology, embryology, *Entwicklungsmechanik*, cytology, heredity, evolution, ecology. Never in the past has there existed the possibility which exists to-day—the possibility of erecting a unified science of biology, in the same sense in which there has existed for some time a unified science of physics, in which each advance in each separate branch means an advance in the whole, and not merely another step down an isolated track.

When I saw the title of Prof. Noël Paton's book I hoped that he would give us a valuable synthesis in that broad field of biology concerned with reproduction. But I must at the outset confess that those hopes are far from being realised. Indeed, the book is in many ways a step in the wrong direction. In other fields than the author's special one, notably in regard to heredity, it attempts to destroy those principles which have already been established, and betrays an unfortunate lack of acquaintance with the essentials of many of the problems involved. On the other hand, within his own special field, and notably in dealing with the interrelations of the endocrine organs and their effects on reproduction, we feel all the time that general principles are lurking in the background, but that for some reason the author has not made them evident.

The major part of the book is 'biological,' in the current sense, as against physiological *sensu restricto*, and discusses types of reproduction, inheritance, sex and its determination, the theory of the germ-plasm, and the inheritance of acquired characters. The most noteworthy feature of this section is the author's determined attack upon neo-Mendelism, including the whole factorial idea and the chromosome theory. Prof. Paton dismisses all such with the blessed word 'static,' and seeks to substitute more 'dynamic' conceptions, in terms of what he calls *hereditary inertia* and *definite lines of metabolism*. His main attack, however, rests upon an elementary, but very fundamental, misapprehension.

The simplest way for me to substantiate this statement will be to begin with a brief outline of the position to which Mendel, Bateson, Morgan, and Goldschmidt, to mention only the four outstanding names, have brought the factorial theory of heredity. It is as follows. The hereditary constitution of at least all higher organisms consists of a number of units (factors or genes), each of which may exist in a number of forms (allelomorphs); these genes exist in definite proportions, and are arranged in a definite order; the whole gene-complex is divided up among the separate chromosomes, which in Drosophila have been shown to correspond to the linkage-groups established by genetic experiments. The mode of action of a particular factor is not something absolute or unalterable. It depends (*a*) upon the totality of other factors with which it is associated (theory of chromosomal and genic balance—which is not even referred to by Paton); and (*b*) upon the environmental conditions. The analogy between, on one hand, the hereditary constitution and its component factors, and on the other, an organic molecule and its component atoms, is complete, except that we have not yet been able to obtain single factors in isolation.

It should be noted that Mendel's and Morgan's theories concern almost exclusively the *distributive* mechanism of heredity, whereby new hereditary combinations arise; Morgan himself laments our comparative ignorance as to the methods by which factors come to exert their influence during ontogeny.

On this last point, however, others have brought forward evidence to show that some factors at least are concerned with qualitative differences in metabolism (*e.g.* factor for yellow colour in mice causing, in addition, adiposity in single dose, death *in utero* in double dose; factor for wrinkled condition of peas causing a different condition of the reserve carbohydrates); or with quantitative differences in rate of some definite metabolic process (Goldschmidt's multiple series of sex-factors in Lymantria; Ford's factors affecting rate of melanin-production in Gammarus).

Now Prof. Paton makes the extraordinary error of assuming that to adopt the Mendelian idea is to suppose that the effect of a factor (or of a chromosome, as in sex-determination) is always identical. After this, it is naturally simple for him to demolish the Mendelians —only, unfortunately, it is not the Mendelians he is demolishing, but imaginary beings of his own creation. Every standard text-book of genetics (I have verified it for those of Morgan, Goldschmidt, Baur, Babcock, and Clausen, and Crew) makes a special point of explaining that the fundamental assumption of Mendelism is the constancy of *factors*; while the *characters* affected by factors naturally *cannot* be constant, since they are always the product of the hereditary constitution interacting with a varying environment.

Prof Paton (p. 103) states that "if chromosomes are the determining factor [as regards sex] the characters should be clear-cut and distinct," and there should never be intersexuality: p. 100, "on the chromosome theory of sex-determination the lability of sex is most difficult to understand": p. 45, "There is good evidence to show that factors other than the chromosomes act in determining the line of development." (This last truism, accepted by every geneticist, is aimed at the factorial hypothesis!)

Prof. Paton's misunderstandings may perhaps best be illustrated with reference to linkage. He speaks of linkage as a 'hypothesis.' This it is not; it is a name invented to cover the *fact*, which any one can verify, that certain characters and factors stay together more often than they segregate.

Again (p. 107): "Suppositions as to crossing-over as well as 'cross-exchange' itself have in themselves something quite improbable. Especially remarkable are the facts that their exchange is said to take place only in one sex . . ." (*a*) It is of course quite inaccurate to state that crossing-over always occurs only in one sex, but this is Prof. Paton's error, not Morgan's. (*b*) The exchange not only is *said* to occur in only one sex of Drosophila but actually *does* do so, as Prof. Paton could verify for himself if he would take the trouble. Finally, suppositions as to crossing-over may be "quite improbable," but crossing-over itself is again merely a convenient name for a set of *facts*, namely, the existence of linkages that are not complete.

On p. 34 Prof. Paton italicises part of a statement by Morgan, namely: "the percentage of cross-overs is definite *for a given stock of a given age and under given environmental conditions*," and proceeds to treat this as a damaging admission. To this, and to his whole view that if neo-Mendelism is correct, then sex and every other factor-dependent character must be fixed and unalterable, I would like to oppose myself most vigorously. It is a denial of the ordinary canons of experiment, and, indeed, of common sense. Because the same dose of thyroid produces tadpoles' metamorphosis at high temperature but not at low temperature, is thyroxin therefore not a definite chemical individual? Or again, does Prof. Paton expect the same physiological preparation always to give the same result, even if the salt composition or the *p*H of the perfusion fluid be altered? Chromosomes being living constituents of the cell, how is constancy of crossing-over to be expected if the environment alters?

When we come to details, matters are not much better. On p. 34 we are told that in the cross between normal and bar-eyed Drosophila, "The F2 shows all gradations from bar-eye to normal eye." This surprised me so much that I have looked up the original papers (Tice, *Biol. Bull.* 26, 1914; Morgan and Bridges, *Carneg. Inst. Publ.* 237, 1916). The statement is simply incorrect. In fact, *bar* segregates so well that it is used as a fixed locus in linkage determinations. The assertion should at once be withdrawn. P. 30, and elsewhere, Prof. Paton adduces against Mendelian ideas the fact that dominance is not always complete. As was early recognised, however, dominance is a sporadic phenomenon, apparently existing only when the difference between allelomorphs is of a certain kind, and its presence or absence has no bearing whatever upon the fundamental Mendelian idea, namely, that of unit-factors which are constant (save for mutation), and are capable of segregation and of some degree of independent recombination. His statement that segregation is not always complete appears to be based mainly on the bar-eye case mentioned above. Other examples which he cites depend upon multiple and modifying factors, the very existence of which he apparently refuses to accept.

Finally, Prof. Paton quotes with approval, as in favour of his views and against those of Morgan's, Johannsen's words: that when we find "one single genotypical point of difference between them [*sc.* two organisms], this difference may probably consist in an alteration of the 'chemism' at a special point of the chromosome. . . . . ." However, this view of Johannsen's is precisely what not only I for one, but Morgan himself, finds most probable (see the close of Morgan's latest book, "The Theory of the Gene").

I have dealt with these points at length because they involve grave misconceptions; and it seems to me a serious matter that such misunderstandings, appearing under a name so deservedly distinguished as Prof. Paton's, should be allowed to interfere with the progress of biology.

There is no doubt in my mind that the next great step in biology will be the linking up of genetics and physiology via the analytic study of development. But this step will be sadly delayed if physiologists persist in misunderstanding genetics and in substituting for its clear-cut achievements such nebulous phrases as Prof. Paton's 'hereditary inertia' in place of the definite hereditary gene-complex, or fluctuating 'lines of metabolism' in place of the constant chemical units or genes, that segregate at reduction.

As final illustration of the inadequacy of the one view and the adequacy of the other, I will cite one further example. Prof. Paton prefers the view (against all the cytological evidence for chromosome continuity, especially of McClung, Miss Carothers, and L. V. Morgan) that chromosomes are "developed as the result of the metabolism of the cells." An acquaintance with the literature, however, would show that this is entirely negatived by the Drosophila results with haplo- and triplo-IV chromosomes, and by all the numerous results on supernumerary chromosomes in plants, notably Gates's on Oenothera and Blakeslee's on Datura. Further, in respect of the sex-chromosome, it is put out of count by the Drosophila results on gynandromorphism; and especially by the results of breeding from animals whose sex has been reversed, these *retaining* the original chromosomic constitution (as shown by the sex-ratio of the offspring: Crew and Witschi in frogs, Goldschmidt in moths, and Crew in fowls) in spite of the metabolic and functional change.

With reference to the inheritance of acquired characters, Prof. Paton is equally uncritical. He accepts Pavlov's preliminary communication on mice, for which no full paper with protocols has ever been published, but omits to mention the fully documented contrary results of Vicari and of McDowall. Alytes of course is adduced; on this point I would refer him to Dr. Noble's article in NATURE of August 7. Finally, he quotes Tornier's work on goldfish. Now, if he had looked up Tornier's original paper (he does not quote the reference—it is *Sitzb. Ges. Naturf. Freunde*, Berlin, 1908), he would have seen that Tornier has never conducted any genetic experiments at all. Tornier has shown (what we all knew before) that fish and amphibia raised under unfavourable conditions produce monstrosities; but he has never raised even an F1 generation from these animals, nor has this been done by his pupil Milewski, the only other worker who has essayed to extend Tornier's results. It should surely by this time be universally agreed that we cannot possibly distinguish what changes and characters are somatic and what are germinal until we have tried the test of breeding. As they stand, Tornier's results have no bearing one way or the other, either on genetics or on evolution.

Any stick will do to beat a dog with, so this *petitio principii* of Tornier (and, following him, of MacBride) is used in support of Lamarckian views. When it comes to the other side of the picture, however, we find Prof. Paton solemnly adducing Yule's analysis of Darbishire's pea figures as a proof that the law of segregation is not valid. I have referred to the original paper in the *Journal of Genetics*. In the crucial results, four classes are expected, in the percentage proportions 56·25, 18·75, 18·75, 6·25. In the material as a whole the actual proportions are 56·6, 18·9, 18·7, 5·9. They are 56·8, 21·2, 18·2, 4·8 in the 'worst' sample. Would any physiologist regard these figures as a bad fit? Yule has shown, it is true, that the divergences are statistically significant, but a slight acquaintance with genetic literature would show that numerous divergences of much greater magnitude may exist, but have been shown to depend on physiological differences between the zygotes (as when one type is less viable) or between the gametes or gametophytes (as when one type of pollen-tube grows faster than another, *e.g.* Renner's beautiful work on Oenothera). To deny segregation on the basis of such facts is on a par with denying any validity to the principle of the reflex arc, because in Nature the isolated or unmodified reflex arc does not exist.

Passing now to the rest of the book, we find some interesting chapters on reproduction, and especially on the relations of the endocrines to the gonads and to growth. The chief criticism I would urge of these chapters is that the student will be left with a somewhat chaotic impression. It is doubtless impossible to lay down such clear-cut principles as regards endocrine interaction as are possible in genetics. None the less, it would have been illuminating to have put forward frankly provisional views along the lines indicated by so many endocrinologists, showing the probable reinforcements and antagonisms of the various ductless glands.

Further, we miss any discussion of the question whether the reproductive and other hormones are chemically similar in all vertebrates; of the specificity of tissue responses to hormone action; of Keith's principle; and of the relation of hormonally-induced differentiation to that brought about within the cells by chromosomes (as in the sex-characters of insects). None the less, this part is a useful compendium of facts, and, if somewhat expanded, would be of considerable value.

There is an undue proportion of misspelt proper names, and an irritating irresponsibility in the matter of giving references, some being given, others of equal importance being omitted. A number of minor errors should be corrected. The frog has no organ of Bidder (p. 66). Drosophila is the *pomace*—not the 'pumice'—fly (p. 46). Pp. 71, 173, Inachus is not an example of alternating sex. It reverts in the non-breeding season to an 'infantile' or, better, neutral condition, exactly as do many small mammals in winter.

On p. 82 Prof. Paton repeatedly refers to "the passage from parthenogenic to sexual reproduction," apparently as if this had been the actual course of evolutionary events. Most biologists would certainly uphold the contrary view, that parthenogenesis is secondary. P. 157: if the author is so particular about *thyreoid* as the etymologically correct spelling, why does he use the hybrid and unfamiliar word *somal* for *somatic* throughout the book? P. 85: the term *sex-limited* for *sex-linked* should be dropped, since it is a misnomer. P. 92: the number of chromosomes and type of the sex-chromosomes of man is no longer in serious doubt, as Prof. Paton avers, since the publication of Painter's papers. I saw Painter's beautiful preparations in the University of Texas in 1924; there are 48 chromosomes, with a highly dissimilar XY pair in the male. P. 23: in quoting the experiments of Sumner (misspelt Summer throughout), who obtained an alteration of bodily proportions in young mice by exposing their parents to low temperature, Prof. Paton states that this must be an effect of the soma upon the germ cells. He does not seem to be aware of the elaborate and conclusive experiments of H. Przibram, who showed that the internal temperature of rats is altered by about 0·2° C. for every alteration of 5° C. in external temperature, and proved that changes of proportions in the offspring such as those observed by Sumner were in point of fact direct effects of change of maternal body-temperature upon the developing embryo.

Such examples only go to show the difficulty nowadays of an investigator who has specialised in one field seeking to master and to criticise results in another field—the difficulty, in other words, of effecting the synthesis that is so desirable.

Prof. Paton's book is, it appears to me, a failure chiefly because he has tried to be destructive without full comprehension of the principles or knowledge of the facts in the branch of science which he has attacked. If he would but collaborate with a geneticist to help us towards an understanding of the interrelations between genetic factors and endocrine (and other) modifiers of development, it would be a more fruitful task, in which he would be eminently qualified to achieve valuable results.

J. S. HUXLEY.

Fuel Utilisation.

(1) *Fuels and their Combustion.* By Prof. Robert T. Haslam and Prof. Robert P. Russell. Pp. xiv+809. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 37*s.* 6*d.* net.

(2) *Industrial Stoichiometry: Chemical Calculations of Manufacturing Processes.* By Warren K. Lewis and Prof. Arthur H. Radasch. (Chemical Engineering Series.) Pp. xi+174. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 12*s.* 6*d.* net.

(1) THE question of the economical use of fuel is becoming steadily more insistent, but the problems involved are far from simple. Most text-books on the subject deal only with some aspects, and there is a distinct need for a text-book giving a general

view of the whole subject, descriptions of the various natural fuels, the principles underlying their use for different purposes, together with examples of how these principles are applied in practice. The book by Profs. Haslam and Russell is intended to fill this gap, and does so with success. It deals with many points on which information is not readily available, and the fact that it is written for use in America, though it detracts to some extent from its usefulness in Great Britain, enhances its interest in other respects. It makes very clear the complexity of the problems involved in the economic use of fuel and the necessity both for further research and the better dissemination of the knowledge already existing.

One of the most noticeable facts brought out by a study of the book is the confusion that is liable to result from the multiplicity of units in use. The chemist thinks in the metric system of units and degrees Centigrade; the industrialist and engineer generally think in pounds, feet, and degrees Fahrenheit. As an example of the lack of system prevailing, the following energy units, which are all in use, may be cited: British thermal units, pound-centigrade units, calories, foot-pounds, kilogram-metres, horsepower-hours, kilowatt-hours, and Joules. To make matters worse, 'Standard Temperature and Pressure,' when considering measurements of gases, are 0° C. and 760 mm. of mercury, but the normal conditions under which gas is sold, and the legal conditions in Great Britain, are 60° F. and 30 inches of mercury. The authors steer ably through the resulting maze, but the unnecessary confusion of units undoubtedly retards progress in fuel economy. The English reader of an American book must further remember that the American 'ton' is 2000 lb. and the American gallon only 8·33 lb. of water, while the Imperial gallon is 10 lb.

The book deals first with the occurrence and nature of the natural fuels, solid, liquid, and gaseous. Analyses are given of many typical American coals, and various proposed coal classifications are considered; the Seyler classification, however, found so useful in England, is not mentioned. There is still much to be learned on the spontaneous combustion of coal and the changes that take place during storage; this is well brought out in Chap. iv., which gives a good account of present knowledge and practice.

The chemistry of the reactions occurring during combustion is dealt with more fully than usual, and the equilibrium conditions, velocity of reactions, flame temperatures, and the factors affecting them are clearly dealt with. Useful tables are included of the heats of reactions, specific heats, sensible heat in gases at various temperatures, and many of them are plotted as graphs—in some cases the data are given only in the form of graphs. It is a pity that these graphs, some of them of great practical use, are reproduced on so small a scale. The numerical examples given to illustrate their use quote data, as obtained from the graphs, to an accuracy quite unobtainable from the reproductions. Many numerical examples are given of combustion calculations, but these would frequently have been easier to follow had the authors been less afraid of using algebraic symbols. After dealing with theory, examples are given of practical applications to boilers and furnaces, and sufficient details of typical plants, both of American and European type, are given to illustrate current practice, and to emphasise the widely varying importance of the different factors involved according to the requirements of the various industrial processes.

The properties and methods of manufacture of producer gas, water gas, oil gas, coal gas, and coke are all considered. The chapter on carbonisation of coal is excellent, but it is somewhat surprising that the work of the Fuel Research Board on steaming in vertical gas retorts, and on carbonisation at 'low' temperatures, is neither mentioned nor referred to in the bibliography. It is clearly brought out that chemical analyses give little indication of the coking properties of a coal, and though results of various British workers are quoted, and several laboratory tests for coking properties are mentioned, no reference is made to the Gray-King assay apparatus developed for the Fuel Research Board, and found so useful by them and other workers in England.

It is frequently forgotten in text-books and academic discussions that commercial efficiency and thermal efficiency are two distinct things; an increase of thermal efficiency may indeed sometimes only be obtainable by actually increasing the cost of the service required. This is well brought out in many places in the book, and examples are given of how to determine the most economical design and method of working under given conditions and with a given fuel. These are valuable in driving home the fact that the most economical method to adopt depends on a host of factors which vary greatly with local conditions. At the same time, there is sometimes a tendency to generalise from insufficient data, probably because really adequate data are not available.

The authors have apparently felt it desirable to assume that the reader has no knowledge of mathematics beyond simple arithmetic, until they come to the discussion of the flow of liquids and gases, the flow of heat, and the rate of heating, which are well dealt with, but relegated to appendices. One feels that, at any rate for the English student, and one hopes for the industrialist, a knowledge of algebra could have been safely assumed with advantage to the explanations.

Apart from the small size of some of the graphs, and a few misprints, the book is well produced, and the difficult problem of apportioning the available space to the different subjects dealt with has been well solved. A bibliography at the end of each chapter gives references to the authorities quoted, and indicates where further information can be obtained.

(2) This book is in quite a different category from the preceding; it is a classroom text-book which deals with chemical calculations in industrial processes. So far as combustion is concerned, it covers some of the ground dealt with in (1), but extends also into other chemical processes. Copious numerical examples are given, together with problems to be worked out by the student. In a table of constants at the end appears the statement that "one gallon of water" is "8·33 lb. per cubic foot," a rather alarming misprint to occur in a text-book of this nature.

A Popular Work on Tides.

The Tide. By H. A. Marmer. Pp. xi+282+4 plates. (New York and London: D. Appleton and Co., 1926.) 10*s.* 6*d.* net.

THIS excellent book is written by the assistant chief of the Division of Tides and Currents of the U.S. Coast and Geodetic Survey. It gives an account of the subject of tides intended for the general reader and without the use of mathematics. Its chapters cover the development of tidal knowledge, the tide-producing forces, the characteristics of observed tides in rivers, bays, and the open sea, the effects of wind and weather, the analysis of observations, the making of tide-tables, the utilisation of tidal energy, and the evolutional effects of tidal friction. Special chapters are devoted to the tides of the Bay of Fundy and of New York Harbour.

The book is written with remarkable accuracy, lucidity, and force, and should find few readers who cannot master its contents. In kinematical and dynamical explanations the aims of the author are very modest, many relationships being referred to the authority of the mathematicians. Nevertheless, numerous simple calculations are given regarding the mechanics of actual tides, and these throw much light on the subject.

To explain the making of the tides in 'the seven seas,' a sketch is given of some of the principles underlying the theories of R. A. Harris, and one is bound to admire the way in which on this subject the author has kept within the justifiable. The cotidal charts of Harris have been wisely omitted, but an explanation of the meaning of a cotidal chart would have fallen easily within the scope of the book. As is natural, the illustrations are taken chiefly from the tides of the New World, but an exception might well have been made for one of the well-attested cotidal charts, which happen to belong to the Old World, especially as these always prove so interesting to those unfamiliar with the subject. No mention, however, is made of the results of the sort of work in this connexion on which R. Sterneck and A. Defant have been continuously engaged since about 1910, though the introduction asserts that the book refers more especially to the results of recent investigations.

It is curious that in describing the action of the tide-predicting machines the amplitude of the curve for a single harmonic constituent is stated (p. 197) to be equal to the length of the crank-arm instead of double this length. The printing and general appearance of the book are very good, but two lines have got interchanged on p. 168. Also, in the reviewer's copy, pp. 275-280 are unfortunately omitted; they include the end of the text and much of the index.

Perhaps it may be of interest to compare the book with the well-known non-mathematical work of Sir G. H. Darwin. The two are very different; that of Darwin reflects the dynamical researches of a great cosmogonist, while the present volume reflects the work of a member of a national survey. Much of Darwin's book is not immediately concerned with ocean tides, but with kindred phenomena of the solar system, and lies outside the scope of Marmer's book. J. P.

The History of Fishing.

Fishing from the Earliest Times. By William Radcliffe. Second edition. Pp. xxi+494+22 plates. (London: John Murray, 1926.) 21*s.* net.

MR. WILLIAM RADCLIFFE'S interesting volume upon the history of the fisherman's craft received a well-deserved welcome when it was first published in 1921, and was accepted at once as an attractive and instructive contribution, filling an important gap in the literature of the subject, voluminous though this literature already was. We may rejoice with the author over the success of the first edition, as evidenced by the advent of a second. Actually, little needs to be said in regard to this new edition, since it differs but slightly from the earlier. The new volume is in fact a reprint with sundry minor alterations and emendations. The pagination remains the same, and the alterations have been governed by the necessity of making the new passages conform exactly to the spaces occupied by the discarded ones. This, no doubt, has been considered imperative, but one cannot but realise that the emendations would have proved more satisfying had these limitations not been imposed.

The author, in his preface to the new issue, deals briefly and disarmingly with some of the criticisms applied to the first edition, but one feels that those criticisms would have been more ably and fully met had the author been given a free hand to re-write some of the passages, instead of trimming them with carefully equated verbal modifications, which do not completely succeed in spiking the critics' guns. Thus, the passages relating to Aristotle as the earliest 'scale reader' might have been so rendered as to differentiate more satisfactorily between the shell laminæ of the mollusc and the scales of a fish, which belong to such different structural categories. Also, in regard to his including dolphins among the fishes, one would feel more appeased by the added footnote on p. 90 had he applied inverted commas to the word *fish* whenever it functions for the cetacean. Aristotle himself was at pains to differentiate dolphins from fishes, and thus early set a good example.

The '*pattern* of Torpedo fish' identified by the author upon the Campanian plate (p. 180) has in the new edition been reduced to *one* Torpedo fish; but he still does not enlighten us as to which individual in the group *is* the fish in question. The prominent figures represent clearly three teleostean fishes and one squid (decapod mollusc). There remains, on the right-hand margin of the plate, a small indefinite figure; but, if *this* is the Torpedo-ray, it is a very unconvincing portrayal, scarcely justifying the inclusion of the whole-page illustration.

Mr. Radcliffe refers in his new preface to the lengthy correspondence and controversy which was stimulated by his disquisition upon the κέρας βοὸς ἀγραύλοιο of the "Iliad." He adds yet another suggestion, based upon an epigram by Quintus Maccius, though it is very hard to see how this may help in the solution of this interesting and elusive problem. One would have welcomed from him a judicial summing up of the case, in the light of all the suggestions hitherto offered, but this clearly was not possible without playing havoc with the existing pagination. But one or more appendices might have been added and the interest and authority of the new edition might thus have been further augmented. The feasibility of such added appendices is, indeed, exemplified by the useful and welcome bibliography which appears as a new feature in the second edition. This bibliography does not profess to be exhaustive, but gives a complete list of authorities referred to by the author in his text. The index could still be expanded and revised with advantage, and in the text of the volume sundry misprints and slips seem to have been inherited by the second from the first edition.

Many readers may still cavil at Mr. Radcliffe's chosen definition of 'Angling' as "the action, or art, of fishing with a Rod" (p. 47), and, in spite of his interesting statement of the case, will prefer to retain 'fishing with a Hook' as more nearly in keeping with such etymological evidence as is available. But a subject which includes no debatable items risks being a dull one, and Mr. Radcliffe is the last person to allow any subject of which he treats to be dull; so, while casting a few friendly 'lures' over him, to induce a 'rise,' we offer to him a second edition of our thanks in welcoming a second edition of his important, suggestive, and entertaining book.

H. B.

Our Bookshelf.

Physico-Chemical Methods. By Prof. J. Reilly, Prof. W. N. Rae, and Dr. T. S. Wheeler. Pp. xi+735. (London: Methuen and Co., Ltd., 1926.) 30*s.* net.

THE task of providing an English substitute for the well-known "Handbuch und Hilfsbuch" of Ostwald is a formidable one, if only because the latter volume has had thirty years' start, with the further advantage of revision and expansion in successive editions during that period. The present volume must therefore be regarded as the beginning rather than as the completion of a new enterprise.

Nevertheless, a first reading of the book gives an impression of unexpected completeness, and suggests that the authors have perhaps checked their own table of contents against those of other works of a similar character, in order to avoid the type of omission which may be revealed more clearly by practice than it can be foreseen by theory. Thus a careful search through several sections has been required to discover the possibility of supplementing the text by including descriptions (1) of the home-made glass Bourdon gauges which are now used for measuring the pressure, *e.g.* of corrosive gases; (2) of the method of measuring low pressures by observing the rate of cooling of a hot wire and (3) of Rast's method of determining molecular weights with an ordinary thermometer by observing the large depressions of the freezing-point of camphor. The apparatus used by Adam for measuring the lowering of the surface tension of water by the addition of films of oil is also sufficiently practical to be included in a volume of this kind. On the other hand, the methods of X-ray-analysis of crystals are so difficult to master that one may reasonably question whether a chapter of 23 pages can be of any real value to a beginner who wishes to undertake work of this kind. The inclusion of a chapter in colloid chemistry is much easier to justify, although it is scarcely possible for such a chapter to compete successfully with books which are devoted entirely to this subject.

The book is well illustrated, but a mistake has been made in reproducing some of the figures on a far larger scale than is necessary; in particular the diagram of a burette tap on p. 168 is singularly out of proportion to its importance. Better results could probably have been obtained if the number of writers had been increased to such an extent that each chapter could be entrusted to an author specially selected for his experience in the particular type of measurement to be described; but, leaving this possibility out of account, the three authors of the present volume may be congratulated on the measure of success which they have already attained in covering, by their joint efforts, the wide field of physico-chemical measurements.

Food, its Composition and Preparation: a Textbook for Classes in Household Science. By Mary T. Dowd and Jean D. Jameson. Second edition, revised. Pp. x + 177. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1925.) 7*s.* 6*d.* net.

THIS book is intended to supplement notes of students attending domestic science classes, and deals with the theory of food as applied to the kitchen and the household. A general outline of food and its physiological functions comprises the first chapter, which is followed by a discussion of water and its use as a cooking medium. The chapters on carbohydrate deal with the subject from the viewpoint of sugars and starches in such a way as to obscure their connexion in diet unnecessarily. Thus while it is admitted that sugar is mainly a source of energy to the body, "starch plays a most important part in the construction of body tissue," on account of its "nucleo-protein." Such is, unfortunately, typical of some of the chemistry of the book, which should be corrected in the event of another edition being forthcoming.

Tables are given of the time required for cooking various foods, although actual recipes are withheld, as the authors feel that each teacher will prefer to introduce her own. Bread-making is, however, explained in detail, and throughout the book little points are clearly defined, the omission of which frequently spoils what is otherwise excellent food. The use and preparation of the protein foods occupy five chapters, under the headings of milk, eggs, meats, poultry and game, fish. The directions for planning menus, and the combination of foods in meals, are well presented, although based upon American usage, which has little differences from those generally adopted in England. Thus, after a meatless breakfast and luncheon, dinner is left to complete the total daily allowance of 2500 calories, about one-tenth of which are to be derived from the mayonnaise dressing on our salad to be served with our ration of "two thin slices" of roast beef.

The book has the merit that it never allows the student to lose sight of the cost of the different foods. This is achieved by a list of suggested experiments and examples for laboratory and kitchen practice at the end of each chapter. The book is well illustrated and contains a glossary of the principal terms used.

British Snails: a Guide to the Non-Marine Gastropoda of Great Britain and Ireland, Pliocene to Recent. By A. E. Ellis. Pp. 275 + 14 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 10*s.* net.

"THE want of a handy work of reference, giving in a convenient form descriptions and figures of all the British non-marine Gastropods," inspired the author to attempt the present publication. He has, wisely we think, included in his scope some forms, such as *Littorina neritoides*, *Otina otis*, and *Onchidiella celtica*, that dwell just above high-water mark and are apt to be omitted by writers on the marine forms on one hand and on non-marine on the other. For an obviously first endeavour this book is a remarkably successful and well-written piece of work, and it will prove of very great use to those for whom it is intended. No pains have been spared to make it complete and the net of research has been thrown wide. Still one cannot but regret that the author did not stay his pen until he had acquired more extensive first-hand knowledge of his subject. There are minor errors and slips on every page from the first, where rhinophores are treated as if synonymous for tentacles, down to the last, where the bracketing of the geological formations has gone all wrong. By the time, however, that a second edition is called for, the author will probably have realised this and rectified matters.

The introductory portion treats briefly and wisely, in an elementary manner, the structure of the snail, the classification of the mollusca, the origin of the non-marine mollusca, and further includes a "Synopsis of the Genera" which takes up space that might have been far more profitably employed. There are fourteen plates, which, save the two illustrating the slugs, are half-tone reproductions of photographs taken by the author's father. As photographs they are remarkably good, and far surpass Rimmer's first essay in this mode of illustration in 1880, while the originals must have been even finer. As illustrations from which to name species, however, they cannot be deemed a success, while some are for that purpose useless. This, though, is the fault of the sitters and not of the photographer. The text illustrations are unexceptionable, while the get-up of the whole book is only what one expects from its publishers, and no higher praise than that is possible.

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Band 1: *Mess-Methoden und Mess-Technik*, von Dr. Ludwig Holborn; *Technik des Experiments*, von Dr. Ernest von Angerer. Pp. xx + 484. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 42 gold marks.

THIS handsome book with its large pages, clear type, and numerous illustrations, has a very attractive appearance. It forms the first volume of the important 'Handbook' of experimental physics now in course of publication in Leipzig. The editors state that it appeared desirable to place in the forefront of their work a summary account of physical measurements and the technique of experimentation. It would be unfair to criticise the scope of the work in the absence of the later volumes, as it forms only the first part of a complete whole.

Dr. Holborn, the author of the first section (on methods of measurement), has had no easy task to perform in having to avoid, on one hand, the mere reproduction of an instrument-maker's catalogue and, on the other, the supply of information to be found in any text-book of practical physics. He has been limited to a description of the more fundamental methods, since it is obviously impossible, for example, to give an exhaustive account of the measurement of electrical resistance in some ten or twelve pages. We could, however, have wished for a more critical discussion as to the relative merits of different methods.

The experimental physicist has to carry out or superintend the construction of many kinds of apparatus, and it is necessary for him to be familiar with many mechanical processes and the properties of various materials. In the second section of this book he will find much useful information as to the characteristics of metals, solders, and cements, the working of glass and the deposition upon it of thin metallic layers. Hints are given on such widely different topics as the preparation of vacuum tubes and the choice and treatment of photographic plates. It is only by actual trial that such instructions can be tested, but so far as can be judged, they are just those which the experimenter is likely to require. The information seems well up-to-date, and where necessary, references are given to books in which further details of methods and processes are to be found.

Crop and Stock Improvement. By A. B. Bruce and Dr. H. Hunter. (*The Farmer and Stock-Breeder* Manuals.) Pp. 119. (London: Ernest Benn, Ltd., 1926.) 5*s.* net.

THE authors have succeeded in presenting, in the form of a readable story, an account of the methods used in the improvement of plants and animals, and the results achieved thereby. So far as possible the story is told in simple, non-technical language, but does not suffer in accuracy on this account. The historical method is followed, and throughout the book the attitude of the authors is refreshingly critical.

In the plant section Dr. Hunter deals first with improvement by selection, then with the work of the hybridisers, pre- and post-Mendelian. A long chapter is devoted to a description of the results which have been achieved, and there is an excellent final chapter on the distribution of improved strains of crops.

Mr. Bruce's treatment of the improvement of animals, on account of the much greater complexity of the subject, is necessarily more general. The first chapter describes the main principles of Mendelian segregation. In the second and third chapters are discussed the methods by which the present-day improved breeds of farm animals have been produced. The last chapter is devoted to an examination of the methods and use of inbreeding.

The book is commended to all those who are interested in agriculture, whether students or farmers or both. It will give them a measure of the results which have been achieved in the past, and a basis on which they may estimate what further improvements may be hoped for in the future.

Chemistry of the Proteins and its Economic Applications. By Dr. Dorothy Jordan Lloyd. Pp. xii+279. (London: J. and A. Churchill, 1926.) 10*s.* 6*d.* net.

THIS volume, bearing, as it does, an introduction by Sir Frederick Gowland Hopkins, is developed from a series of lectures by the author. The subject naturally falls into two main parts, the chemical constitution and the physical chemistry. The first part, after dealing in a general way with the composition of the protein molecule, proceeds to outline one or two of the more usual methods of analysis. A full discussion of the use of the amino acids from the physiological point of view is followed by a chapter on the problems of food preservation. It cannot be claimed that this part of the work offers more than a compilation of material already available to the student or general reader. The second part is devoted to a systematic discussion of the physical behaviour of the proteins so far as research has been carried. The results of Loeb, Cohn, and others are dealt with side by side and compared in such a way that their study will be repaid by a grasp of the different aspects of the subject by any student already possessing fundamental knowledge of physical chemistry. The value and importance of the physical chemistry of the proteins are well illustrated by the chapter on the "Industrial Uses of the Proteins," which could with advantage have been extended. Each chapter bears a bibliography, which, while not quite complete, gives reference to most of the fundamental research on the subject.

Adventures of Exploration. Book 5: *Australia and New Zealand.* By Sir John Scott Keltie and Samuel Carter Gilmour. Pp. iv+204. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., n.d.) 2*s.* 3*d.*

THE fifth volume in this series is even better than the earlier ones. The material has been chosen with so much care and the stories told with such admirable lucidity that no one reading the volume can fail to get a well-balanced general view of the stages by which Australia, New Guinea, New Zealand, and South Victoria Land became known and were explored. After some account of early voyages of discovery, there are chapters on the work of Cook, Bass, and Flinders, the overland journeys of Oxley, Stuart, Eyre, Grey, Burke, and others in Australia, followed by chapters on New Zealand and Papua. The book closes with two chapters on the Antarctic, giving accounts of the work of Scott, Amundsen, and Shackleton in the Ross Sea and Mawson in Wilkes Land. There are a number of well-chosen illustrations and portraits, and every chapter has its own map. The series should be a valuable aid in teaching school geography.

Immunochemical Studies. Edited by Prof. Carl H. Browning. Pp. xiii+239. (London: Constable and Co., Ltd., 1925.) 12*s.* 6*d.* net.

IN this small volume the editor has gathered together a series of papers published by himself and his collaborators over more than a decade. The matter has been rearranged to make it suitable for book form. The work is entirely on the humoral aspects of immunity. The first chapter gives an excellent short account of antibody action in general: among the subjects dealt with in the succeeding chapters are the antigenic power of globin, the alterations which occur in hæmolytic immune bodies during the process of immunisation, heterophile antigen and antibody, and complement. The section on the latter contains a certain amount of matter which has not hitherto been published. The work will appeal to those interested as giving in handy form information which is scattered in a number of different volumes.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Fayum Lakes.

THE first of six reasons given by Sir Flinders Petrie (NATURE, Oct. 9, p. 514) for maintaining his view that the level of the Fayum lake gradually rose with the rise of the Nile, is that there must have been an open channel which it is unlikely would have become blocked when a large mass of water flowed to and fro each year The flood waters of the Nile are heavily silt laden, and when they entered and filled the Fayum the surplus would have re-established its ordinary course northwards along the valley. The lake, connected by a channel at least 10 kilometres long, would never have filled quite to the highest flood level of the river. As soon as the crest of the flood passed and the water levels began to fall, the current in the connecting channel would die away, silt would be deposited, and it would have become choked and blocked up. The river carries most silt at the highest levels of the flood, and the rapidity with which deposits are formed must be seen to be realised The inlet, once closed with a bank of silt, would not have been readily reopened.

Such conditions are illustrated by many depressions bordering the Blue Nile between Singa and Roseires. They are minute in comparison with the Fayum, but the same principle doubtless applies

Under organised government, the connecting channel could have been kept open and the annual influx and efflux referred to by Sir Flinders may have been maintained, the lake being subject to a range of levels depending principally on the height of the Nile flood, the efflux, and evaporation Under natural conditions, on the other hand, when the connecting channel had been closed by silt, communication would not have been re-established until either erosion cut away the bank or an exceptionally high flood occurred. In our own times there have been the very high floods of 1874 and 1878, had such floods silted an inlet channel, several decades might also have passed before communication could have been re-established Sir Flinders Petrie remarks that complete drying up would occupy only about twenty-five years. It is for such reasons that it is difficult to understand how lakes with fairly stable water-levels could have been maintained in the Fayum under the conditions we know in the Nile Valley to-day, which have certainly prevailed over a large part, if not the whole, of historic times.

Another factor which might influence the relations of the Nile to the Fayum is the position of the sea-shore and consequently the slope of the river in the intervening distance. We know that the Delta has been subject to earth movements, and in fact Sir Flinders was understood to say in his contribution to the discussion that it had fallen about 30 ft. before Ptolemaic times, when it rose about 15 ft. It may be readily supposed that a fall of 30 feet at the Delta shore might have led to considerably increased slopes and a consequent incising of the river bed affecting conditions at least so far as the neighbourhood of the Fayum, which is about 110 kilometres upstream of the apex of the Delta. This is a second reason for doubting the view that the Fayum lake-levels belong to a simple progressive series.

The levels under consideration are as follows :

	Feet above Birket Qarun	Metres, referred to mean sea-level, Alexandria	W F.P dating, submerged since
Present Nile flood .	243½	+29	
Present valley floor .	237	+27	
High-level lake . .	222	+22·5	
Neolithic lake . .	205	+17·4	
Implements on gravel	185	+11·3	8,000 B C
Flints	176	+ 8·5	9,000 B C.
Lake	160	+ 3·6	
Prehistoric pottery .	156	+ 2·4	14,000 B C
Pigmy flints and cores	138	− 3·0	17,000 B C
Present Birket Qarun.	zero	−45·1	

If the Nile now had unrestricted access to the depression, the resulting lake, depending on the connecting channel cut through the Nile flood plain, might be expected to stand at about 25 or 26 metres above sea-level. The dates have been culled from *Ancient Egypt*, March 1926, where they were added by Sir Flinders Petrie In reducing the levels given there, he adopted − 144 ft. as that of Birket Qarun, while in the papers presented at Oxford − 148 ft has been used.

Sir Flinders evidently considers that the lake-levels have been gradually rising for a very long period of time. Have we any justification for supposing that the same steady rise has extended so far back into prehistoric times ? The definite lake margins recorded by Sir Flinders' assistants appear to oppose his theory of a gradually rising lake.

It seemed generally agreed by those who had studied the subject in the field that the lake which stood at 22·5 m. above sea-level was of very much older date than the 17·4 m lake associated with the neolithic remains. Sir Flinders in his reply did not refer to the date of this higher lake He has doubtless given the evidence very careful consideration, and it would be of interest to know how he fits it into his scheme of dates. It appears that the fauna of the 22·5 m lake, while distinctly Nilotic in character, shows certain differences when compared with the 17·4 m. lake, and also that the deposits associated with the higher lake were consolidated and eroded before the 17·4 m. lake came into existence.

Among the six reasons given by Sir Flinders for maintaining the view that the levels of the Fayum lake gradually rose, the fourth, stating that there is no trace of human work anywhere below the Nile level of its own age, makes the strongest appeal. May this not be due to the fact that the dried-up floor of the depression attracted no inhabitants in the intervals between the lakes, and also because any remains are hidden from us by deposits of silt ? Even if Herodotus did see the water flowing to and from the lake of his time, and the quays of late origin were made for a lake that stood at 215 ft, it does not necessarily follow that the early lakes belong to the same progressive sequence. We can accept, too, what Sir Flinders gives as his third reason, namely, the discovery of a cooking pot, fire, and flints *in situ* at 170 ft. level, and that these were submerged by a lake in Greek times, again without need to suppose that the levels rose progressively from one to the other. The two lakes may have been quite independent The remaining point as regards the water that filled the lake being from the Nile has no direct bearing on the sequence of levels.

The band of brilliant workers who have been studying the ancient history of the Fayum and the Nile valley, stimulated by Sir Flinders' leadership, have established a number of facts, among them the existence of definite lake margins. The researches are admittedly incomplete and further developments, besides elucidating the sequence of the lakes, may show during what lengths of time they existed and what were the conditions that allowed the water to remain steady for those periods. While some of the facts do not seem to fit the older ideas, it might be better to hold those theories in suspense

Turning to another aspect of Sir Flinders' letter, the epithet of unfortunate irrelevance seems severe to apply to the remarks contributed about the character of the implements. Has not Sir Flinders figured implements from the Fayum as Solutrean (*Ancient Egypt*, 1915), and remarked on their close equivalence to the Solutrean of Europe, basing his comparisons largely on a group which he tells us were selected at a dealer's from among the contents of a barrel?

G. W. GRABHAM.

Khartoum, November 3

Laue-Photograph taken with a Long Slit.

ORDINARY metals are composed of aggregates of small crystals. These small crystals may be made to grow, by suitable processes, to very much larger ones, so that we can obtain a test piece of proper size composed entirely of a single crystal of a metal. Such test pieces of single crystals of metals do not, as a rule, possess plane faces, that is, the external forms of crystals, but X-rays afford us a means of determining the orientations of the axes of such crystals. A. Muller (*Proc. Roy. Soc.*, London, 1924) photographed the Laue-spots at various orientations of the specimen, and from the position of the characteristic *K*-radiations of the anticathode on the photograph, he determined the orientations of the axes of the crystal. Next, T. Fujiwara (*Mazda Kenkyu Jiho*, Tokyo Electric Co., 1926) achieved the same purpose by finding the characteristic *K*-radiation in some of the ordinary Laue-spots; while H. Mark, M. Polanyi, and E. Schmid (*Zeit. fur Phys.*, 1923), and K. Weissenberg (*Zeit. fur Phys.*, 1924) applied the method of rotating the crystals. All these authors employed a narrow and nearly parallel beam of X-rays, so that only a small portion of the specimen could be tested at one time.

In order to examine the whole of the specimen at once, we have utilised divergent X-rays starting from the focus on the molybdenum target of a Coolidge tube. These divergent rays were made to pass through a long narrow slit, and then to illuminate a long thin specimen composed entirely of a single crystal of aluminium. The Laue-spots thus became an assemblage of many lines on the photograph, as seen in the accompanying illustration (Fig. 1). Each one of these 'diffraction-lines' is a spectrum of the X-rays caused by reflection from a certain atomic plane of the crystal; any one point on one of these lines being registered by the X-ray of a certain wave-length, which is reflected from a part of the atomic plane of the crystal situated at a certain point of the specimen. Thus each point on any one of the diffraction-lines in the photograph corresponds to a certain part of the specimen. This correspondence is important, and we have made it recognisable on the photograph by the shadows cast by some thin wires of lead, which were stretched across the slit situated very near to the specimen.

When this correspondence and the data of relative positions of various parts of the apparatus are known, the orientation of the atomic plane of the crystal which caused a diffraction-line on the photograph, and the glancing angle of the beam of X-rays to this atomic plane, can be calculated readily at each corresponding point on the specimen. Moreover, for a diffraction-line on the photograph, on which the characteristic *K*-radiations of the target appeared, the indices of the atomic plane of the crystal which is responsible for that diffraction-line can be found easily. By knowing the values of the glancing angles at two points on the specimen which correspond to two shadow-points on the diffraction-line, the glancing angle for the *K*-radiation on the same diffraction-line can be obtained by interpolation. With this value of the glancing angle for the *K*-radiation, and wave-lengths of that radiation, the value of the grating constant, and consequently the indices of the atomic plane under consideration, can also be found immediately.

For the present purpose an X-ray tube with a sharp focus is preferable. The focus of the tube we used was not quite sharp, being about 5 mm. in diameter. We could, however, use it as a sharp focus—one of about 1 mm.—by setting it in such a position that the surface of the target is nearly, but not exactly at right angles to the slit.

With this apparatus we could determine the orientations of the axes of single crystals of some thin aluminium wires and of a fairly thick block of lead which had a nearly cylindrical surface. Single crystals of aluminium wires were made by H. C. H. Carpenter and C. F. Elam's method (*Proc. Roy. Soc.*, London, 1921). Their diameters were about 2 mm., and their lengths were not the same for all the specimens, varying from 4 cm. to 12 cm. With these specimens many diffraction lines were usually obtained in a single photograph, which contained the impressions of the *K*-radiations of molybdenum, as seen in the accompanying illustration. We have calculated the orientations of the axes of the crystal with reference to the co-ordinate axes fixed to the specimen by these several diffraction-lines. In the following table the angles between the axis of the wire and the three edges of the elementary cubic lattice of the aluminium crystal are given for six different crystals examined.

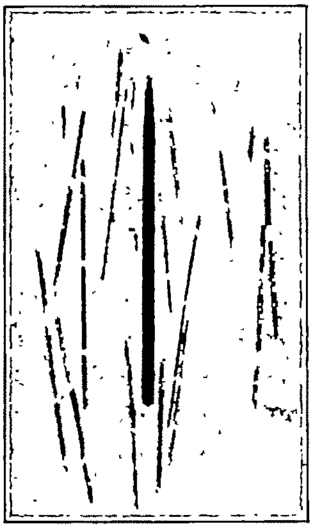


FIG. 1.

No. 1.	No. 2.	No. 3.	No. 4	No. 5.	No. 6.
87°	87°	85°	88°	89°	89°
62	57	65	63	61	61
29	34	26	27	28	30

Though it may be premature to state general conclusions here, it seems not out of place to note that these angles are nearly the same, and that one of the (100) planes of the crystal is situated nearly parallel to the axis of the wire, at any rate for all the six specimens tabulated above.

The present method of determining the orientation of the axes of crystals is very simple, and at the same time it shows very clearly on the photograph whether the specimen is composed of a perfect single crystal or not. So far we have applied this method to thin wires only, but it may equally be applied to thin plates or to any specimen which has a plane or cylindrical surface.

USABURO YOSHIDA.
KENZO TANAKA.

Physical Laboratory,
Kioto Imperial University, Kioto,
Japan, September 21.

The Crystalline Nature of the Chief Constituent of Ordinary Coal.

AN examination of a microscope section of Indian coal from the Raniganj coal-field showed that the main substance of the coal was a madder-red coloured, translucent material, which in a section cut vertical to the bedding planes of the coal, gave faint pleochroic effects when examined in plane polarised light. The same substance, when viewed between crossed Nicols, had distinct extinction parallel to the lines of the laminæ and behaved like a uniaxial mineral. The peculiarity is that the whole of the red-madder substance, seen in the field of the microscope, behaved as though in optical continuity and as if part of a single crystal.

Eight slides, two each, one cut parallel to the planes of bedding and the other vertical to this direction, of so-called clarain, vitrain, durain, and fusain made by Mr. James Lomax of Bolton, were procured, and in the vertically cut sections the same phenomena are to be observed. In the sections cut parallel to the bedding the substance behaves as an isotropic mineral. The first six slides are of the thick coal of Exhall in Warwickshire, while the sections of fusain are of the Trencherbone coal of Lancashire.

These slides show that there is only one chief constituent in the coals examined, which for lack of a better name, one may speak of as vitro-clarain (after Stopes) or anthraxylon (after Thiessen). Scattered through the coal, usually along the planes of bedding, are sections of bright gold or red resinous matter suggestive of the sheaths or walls of sporangia, and smaller gold specks and lenticles which may be spores. In addition, there are red translucent patches of a rough, pitted nature, which might be the outer skin of sporangia, as some of these, cut obliquely, show a distinct cellular structure.

In the sections of durain the laminæ are rather closer together than in the slides of clarain, and the laminæ are well marked, as though with thin sheets of opaque inorganic material. The fusain is obviously associated with 'dirt' bands in which pyrite, siderite, and calcite can be distinguished along with the powdery carbon. In some cases a beautiful reticulated structure is evident in the fusain, as though the inorganic matter was an infilling in some organic structure.

Thus it appears, from a petrographic examination of the usual kind, that these coals consist of four components, but rather different from those identified by Dr. Marie Stopes. My components are as follows: (*A*) One main constituent which simulates a crystalline structure, and (*B*) three minor or relatively minor constituents—(1) resinous bodies, such as sporangia and spores which may be present in large or small quantities and may markedly affect the quality of the coal; (2) powdery, soft carbon with the macrostructure of charred wood, which is well known as mineral charcoal or fusain; and (3) inorganic matter—clay along the laminæ or scattered through the coal, as well as other such recognisable minerals as pyrite, calcite, siderite, etc., usually associated with the fusain. With this inorganic matter could be grouped the inorganic impurities, for example, ankerite, etc., which occur in cracks and joints in the coal.

The most important and certainly most uniform substance of these coals is the material, designated *vitro-clarain* in courtesy to Dr. Stopes, which constitutes the main bulk of good coal and probably represents the mineralised form of woody tissue. Its crystalline behaviour is strange, but will probably be fully accounted for by organic chemists as some kind of strain phenomenon.

CYRIL S. FOX.

Geological Survey of India,
Calcutta, September 23.

THE application of the petrological microscope to the study of coal sections may lead to interesting observations on the details of coal structure, and I am glad Mr. Fox is taking it up. It is a little unfortunate, however, that he should add to the complexities of coal nomenclature on so slender a basis as his observations on his first few sections.

In his third paragraph he writes as though "vitro-clarain (after Stopes)" were identical with "anthraxylon (after Thiessen)," a confusion which has already been exposed concisely by Seyler; see "The Nomenclature of the Banded Constituents of Coal" (NATURE, April 3, 1926).

In his fourth paragraph Mr. Fox describes "a beautiful reticulated structure" as being evident, "as though the inorganic matter was an infilling in some organic structure." This is a truism to students of coal, the "reticulated structure" being tracheids of woody tissue, generally the secondary wood of Lepidodendron, or Cordaitean trees, which constantly have crystalline matter filling the laminæ of the tracheids.

Mr. Fox's main point, however, that there is *one* main constituent which simulates crystalline structure in coal, is a suggestion which, if true, would have a very material bearing on the details of research into coal structure, and should certainly be checked by observations on much larger numbers and varieties of coal sections.

It must be borne in mind that, in general, the large bulk of bituminous coal contains ulmic compounds which are colloidal in their nature.

I must dissent from the phrase in the concluding paragraph that this ". . . constitutes the main bulk of good coal and probably represents the mineralised form of woody tissue" The major part of coal substances is not mineralised but mummified; and woody tissue is *one* of its constituents, but only one of many.

MARIE C. STOPES.

Givons Grove, Leatherhead, Surrey,
October 25.

Adsorption of Dyes to Silver Halides.

THE quantitative determination of the amounts of dyes taken up by crystalline solids has both a general and special interest. The adsorption of dyes to silver halides, and particularly of sensitising dyes, has considerable photographic importance in relation to the theory of optical sensitising. Work has been in progress for some time in this laboratory on this problem by methods devised by the writer and Mr. H. Crouch. The dyes investigated are of the iso-cyanine and carbo-cyanine class, and the bulk of the work so far has been carried out with orthochrome T-bromide (*p*-toluquinaldin-*p*-toluquinoline-ethylcyanine bromide).

These dyes are decolorised at sufficient acidity, the colour being restored by alkali, and the colour change being sharp enough for the dye to be used as an indicator. The partition coefficient of the dye between a weakly buffered aqueous solution of about 1/100th normal buffer content and chloroform was determined at different pH values; at about $p\mathrm{H} = 8$ the dye is practically completely removed from the water by the chloroform.

The concentration of dye was determined by extraction with chloroform and measurement of the spectro-photometric extinction at the wavelength of maximum visible absorption, about 570 mμ. The dye solution of given pH was shaken with a silver bromide precipitate, the integral surface of which could be computed from the size-frequency curve of the particles. On plotting amount of dye carried down by the silver bromide against residual concentration of the dye in the solution, curves were obtained which first rose rapidly, then reached a period of practically equal adsorption, which was again followed by a period of almost vertical ascent. The interpretation of these results is as follows: The dye is at first adsorbed to the surface to the point of surface saturation of the silver halide with *dye* molecules. The dye disperses in water to *colloidal* as well as to true solution and the last ascending portion of the curve corresponds to the precipitation of the dye on the silver bromide, that is, to the *colloidal* or *mechanical* adsorption. The point at which the final ascending portion of the curve when produced cuts the concentration axis of the dye, represents the *true solubility* of the dye in the aqueous solution.

Of various adsorption formulæ, the so-called Freundlich formula failed entirely to represent the data, but a modification of Langmuir's formula for the monomolecular adsorption of gas molecules to a plane surface was found to fit the data very well.

From the known total area of the silver bromide, and the lattice interval, the number of ions in the surface layer can be calculated. Assuming octahedral surfaces, which all the evidence indicates, the adsorption density of the dye on the surface diminishes as the pH of the solution is decreased, but at a pH of 5·5 it was calculated that one molecule of dye was adsorbed for 20 ions of the lattice surface.

Several reasons might be advanced in explanation of the low adsorption density of the dye. From optical sensitising experiments it has been known for a long time that the effective amount of dye adsorbed was of a very low order. Mr. T. Thorne Baker has recently contended (*Phot. J.*, 50, 299, 1926) that the dye is only adsorbed to what have been termed the 'sensitivity specks' in the silver halide, which have been shown by the writer to be, in all probability, silver sulphide. This interpretation does not at present seem probable, in view of the existence of a similar order of adsorption of the dye when the silver halides are prepared in the absence of sulphiding material. It seems equally probable that the dye is actually held to the silver halide, that the dye molecule has a very large area, and very possibly tends to orient itself parallel to the lattice surface. The most obvious condition would be for the dye cation to be held to a bromide ion of the silver halide lattice, but residual affinity in other parts of the molecule may also be exerted.

The solubility of the dye in water is enormously diminished in the presence of quite small amounts of soluble halides, and the part which these play in the adsorption process is being investigated. These measurements must be carried out in a yellow light such as is given by Wratten Safelight 00, owing to the photochemical reactivity of the dye.

The work is to be extended, and it is hoped to publish a fuller account shortly.

S. E. SHEPHERD.
(Assistant Director of Research.)

Eastman Kodak Company,
Rochester, N.Y., October 29.

The Genetics of Evening Primroses and Mice.

IN 1905, Dr. G. H. Shull, of Princeton, received from Dr. de Vries ten rosettes of *Oenothera lamarckiana* from the locality at Hilversum, Holland, which had supplied the original material for the classic researches of de Vries many years before. In 1921, among the descendants of these plants appeared a colour-mutation which Shull calls 'old gold' (*vetaurea*). The petals are flushed with apricot-colour, strong toward the base, fading out distally. In a very interesting and detailed paper (*Genetics*, May 1926, p. 201), Shull describes the behaviour of this mutant in a variety of crosses. It is recessive to the ordinary yellow flower. In order to test it further, Shull introduced into his cultures the very pale yellow mutant called 'sulphur' (*sulphurea*), and was surprised to find that old-gold was complementary to sulphur, the two when crossed giving invariably plants with flowers of the normal yellow colour. Accordingly the normal yellow is expressed by the symbol SSVV (double dominant), the homozygous sulphur by ssVV, and the homozygous old-gold by SSvv. By suitable crosses the double recessive ssvv was obtained, and proved to be a pale flower, with the bases of the petals flushed with the apricot tint. Shull called it 'gold-centre' (*aurata*). The amount of the reddish or old-gold colour is much less than in old gold.

From my experience in breeding sunflowers, and to a lesser extent evening primroses, I feel sure that microscopical and chemical investigations would make this case clearer. The normal yellow is due to plastids in the cells, and 'sulphur,' while possibly having paler plastids, more probably has them less numerous or diluted, with more air in the cells—an approach toward the condition of the white-flowered species. The old-gold effect must surely be due to an anthocyanin soluble in the sap. An inhibitor of this anthocyanin suffusion is dominant, and exists in the normal yellow flowers. Thus the allelomorphs are not really yellow and old gold, but no flush, and flush, yellow being present in either case. If the allelomorphs in the case of yellow and sulphur are dense and dilute, this explains why less anthocyanin is visible in the double recessive than in old gold, on the same principle as that of the white evening primroses, which turn pink on fading. It is possible that as much anthocyanin could be extracted from the one as the other.

In experimenting with transplantable neoplasms or tumors in mice (*Genetics*, May 1926, p. 294), Mr. Leonell C. Strong, of the Bussey Institution, found that transplants from a spontaneous cancer rarely grew well in the first generations, but usually the number of successful takes increases until a very high rate is attained. He directs attention to certain cases in which abrupt changes have taken place in the behaviour of the tumours, so that from one original type he now has four, with different reactions appropriate to each. He shows that these differences cannot possibly be ascribed to anything in the host mice, and so is driven to the conclusion that somatic mutations have occurred in certain of the tumour cells. The general improbability of the occurrence of such mutations in so short a time apparently cannot count against the observed facts. Possibly there may be a slightly different explanation. The complicated mitotic phenomena are of course controlled by genetic factors. If we assumed (and the idea is not new) that the original tumour cells arose as the result of a breakdown in or disturbance of the mitosis-controlling factor or factors, this one change would seem to account for all the rest. The partially inadequate control would result in sundry mitotic errors, and those which led to the most prolific and 'non-specific' tumours would be perpetuated in preference to others. T. D. A. COCKERELL.

University of Colorado,
Boulder, October 23.

Mathematical Proof *versus* Observation.

THE history of the physical sciences offers many examples of theories which have been 'proved' mathematically and been set as foundation-stones in the edifice of science, only long after and when a superstructure has been reared upon them to be abandoned as untenable. The operation of taking out a 'foundation stone of science' presents all the difficulties which are encountered in extracting its physical parallel.

Mathematical formulæ to be applied practically require the use of numerical factors which are often wanting or are subject to such wide range that a large element of guessing enters into the computation. In actual practice a far greater source of error is one which might well be eliminated—the neglect to compare and check carefully the results of the mathematical treatment with the facts of observation.

A noteworthy example of the abiding faith in mathematical formulæ when not in harmony with observation, is afforded by a formula in common use where the disparity between the calculated and the observed numerical values is that between 26,000 and 200. A neglected factor has just been discovered which brings the theoretical and the actual values in this case into harmony. Obviously this example might be cited to show the value of mathematical treatment; but even more clearly it sounds the warning against putting our faith in any mathematical treatment of physical phenomena where a careful comparison has not been made to see that the results of the computation check with the observations.

Even when the mathematician has himself been careful to state the limitations to which his conclusions are subject because of the assumptions made, those who cite him are not so easily controlled. As a striking example it is stated in a recent review: "Dr. Jeffreys has recently demonstrated (*Quart Jour. Roy. Met. Soc.*, vol. 52, p. 85, January 1926) that whatever superficial increase of pressure there may be over either pole or over Greenland, in consequence of the cold, this is a shallow surface effect, and that both poles are seats of low pressure"; as though such a fact could be proved by mathematical discussion alone. When we consult the original, we find that this eminent mathematician has stated that his discussion has not been developed for the actual earth on which we live; but for a hypothetical earth on which the atmospheric circulation is assumed to be symmetrically disposed with reference to the geographical poles, operates without friction, and is without interference from the irregular distribution of land areas. No one of the assumptions holds true of our earth.

It should be stated that Dr. Jeffreys has faithfully tried to compare his conclusions with observation, though without very happy results; for neither Greenland nor the north and south polar areas are regions of low atmospheric pressure. The north polar area is one of nearly normal atmospheric pressure, whereas the south polar region and Greenland are both notably areas of high atmospheric pressure. Observations are consistent in support of these statements. WM. H. HOBBS.

Ann Arbor, Michigan, October 28.

The Oscillations of Superposed Fluids.

THE explanation of Franklin's experiment quoted in NATURE of December 4, p. 823, is purely dynamical. When a stratum of oil rests on water the restoring forces of gravity called into play by any disturbance of the interface are comparatively small, owing to the slight difference of density. Free oscillations are consequently slow, and so in Franklin's case apparently came within the range of the imposed periods due to the motion of the ship.

The formula for the periods ($2\pi/\sigma$) of waves of given length ($2\pi/k$) in the case of two superposed liquids of depths h, h' and densities ρ, ρ' was given long ago by Stokes. The equation has two roots, which reduce to

$$\sigma^2 = gk \tanh k(h+h'), \quad \sigma^2 = gk\frac{\rho-\rho'}{\rho}\,\frac{\sinh kh \sinh kh'}{\sinh k(h+h')},$$

approximately, when the ratio $(\rho-\rho')/\rho$ is small. The former root corresponds to the motion of the fluid mass as a whole, as if it were of uniform density throughout. The second root is relevant to the observed phenomenon, the disturbance being confined to the neighbourhood of the interface. The ratio of the amplitudes at the upper and lower surfaces is in fact

$$-\frac{\rho-\rho'}{\rho}\cdot\frac{\sinh kh}{\sinh k(h+h')},$$

approximately. If the fluids are contained in a cylindrical vessel of radius a the admissible values of k are given by the roots of $J_n'(ka)=0$. The slowest oscillation of all corresponds to the smallest root of this in the case of $n=1$, namely, $ka=1{\cdot}841$. The interface then oscillates about a nodal diameter.

For a numerical example, probably not very different from the circumstances of Franklin's case, we may assume $h=h'=4$ cm., $a=4$ cm., $(\rho-\rho')/\rho=0{\cdot}9$. With the above value of ka this gives a period of 1·36 sec. The corresponding ratio of the amplitude at the upper surface to that of the interface is only 0·0155, or less than one-sixtieth. If the oil were removed the period would be 0·302 sec. H. LAMB.

6 Selwyn Gardens, Cambridge.

Rainfall Interception by Plants.

THE major part of the 'interception gain' found by Mr. Phillips in his experiments at Deepwalls, described in NATURE of Dec. 11, p. 837, is no doubt due to the screen catching rain which would otherwise have fallen on the lee side of the gauge. This would become negligible if a large area were covered by a comparatively close network of screens, except for a narrow strip at the edge of the area, where the gain would still be appreciable. This particular experiment does not appear likely to give information about the amount of water deposited on plants when there is no rain (or practically no rain) falling to the ground.

The percentage excess in Mr. Phillips' experiment should be greatest when the ratio of the velocity of the wind to the rate of fall of the raindrops is greatest.

E. GOLD.

Allotropy.

By Prof. A. Smits, University of Amsterdam.

THE liquid state of aggregation or phase of an element under its own vapour pressure is always stable over a certain temperature range, that is to say, from the critical point to the solidifying or melting-point. Below this point the liquid is not stable, for in this case it has gone beyond its range and should have crystallised, but seems to be too indolent or has forgotten to do it.

All liquids can be cooled more or less below the solidifying point without freezing, or, in other words, can be supercooled. This supercooled state is metastable, since although it is not stable it can be realised. But what about the crystallised aggregation? If only *one* solid state exists the case is very simple, for then we can say, from the solidifying point to lower temperatures the solid state is stable. It is generally found, however, that the same element can exist in two or more crystalline states, or modifications, differing in physical and chemical properties. This phenomenon is called *allotropy*, or better *phase-allotropy*, as the intention is to indicate the appearance of two or more similar *phases*. If at any time two liquid states of an element are found, one may also speak of phase-allotropy. It should be observed that though we have referred here to elements, the same holds for compounds, if the different phases have the same composition.

Two cases must now be distinguished. It is possible that what is said above holds only for one of the solid states, whilst the other modifications are always metastable. This phenomenon is called *monotropy*. The peculiarity of such metastable states is, that contact with the stable state or with a solution, etc., can effect the transformation into the stable state. When such a metastable state can be heated to the melting-point, then it appears that the melting temperature is lower than that of the stable state. Sometimes these melting-points are very close and sometimes they are a great way apart. For example, the stable violet phosphorus melts at 589·5° C., whilst the metastable black modification melts at 588°, and the metastable white modification at 44·1°. It appears also that the stability is transferred from one modification to the other. For example, over a certain temperature range *A* is stable and *B* metastable, and above a given temperature the position is reversed; *B* becomes stable and *A* metastable, and at this given temperature both of the two modifications can exist stable, side by side, and be in equilibrium. This temperature is called the transition temperature and is completely comparable with the melting temperature, at which the solid and the liquid aggregation are in equilibrium. This phenomenon is called *enantiotropy*. A good example is mercury iodide: below 127° the red tetragonal modification is stable and above this temperature the yellow rhombic modification is the stable one. At 127°, the transition temperature, both forms are stable. It must be remembered here that we have considered liquid and solid phases, being under vapour pressure. It is necessary to mention here that it happens frequently, that whilst under vapour pressure only one crystalline phase is stable; under higher pressures the transition phenomenon occurs.

Though, consequently, two modifications only can be stable, side by side, at the transition temperature, it happens frequently, owing to retardation, that a stable and a metastable modification exist side by side over a large range of temperature. In this case, consequently, the substance is a *conglomerate* of two modifications, one only of which is stable. This behaviour, as it is only a consequence of retardation phenomena, might have been expected, and has no connexion at all with those to be described below.

Until fifteen years ago it was considered that the so-called single substances were completely understood, and that no new aspects remained for investigation. The connexion between the different aggregations of a single substance was indicated simply by a diagram on which the vapour pressure curves and melting-point curves were drawn, or in other words, by indicating how the vapour pressure changes with temperature and how the melting-point changes with pressure. Such a diagram shows that the vapour pressure of the liquid or of the solid state, at a certain temperature, has a constant value, and the same holds for the melting-point at a definite pressure. As, however, in some cases it was found that the vapour pressure could be changed without altering the temperature, and that the melting-point could be altered without changing the pressure, and that in certain cases the transition temperature could be shifted, it was clear that something was lacking in our knowledge of the states of aggregation.

Some of these phenomena to which I refer are described below. It was found that by partial distillation of most carefully purified crystalline violet phosphorus at 360°, a residue was obtained showing a much lower vapour pressure than the original substance. The original violet phosphorus at 460° had a vapour pressure of 3 atmospheres, whilst the vapour pressure of the residue at the same temperature was 1 atmosphere (*Zeitsch. f. phys. chem.*, 91, 249, 1916; "The Theory of Allotropy," p. 214). Further, it was found that the melting-point of violet phosphorus was considerably lower when the substance was slowly heated, than that observed when the heating was carried out quickly. The maximum difference observed was about 20°, and the melting did not take place at a constant temperature, but over a range of temperature (*Zeitsch. f. phys. chem.*, 91, 249, 1916; "The Theory of Allotropy," p. 195).

In the same way, according to the previous history of the substance, the fat trilaurine could be caused to melt, arbitrarily, at any temperature between 18° and 46°. Rhombic sulphur showed similar results, but on a small scale. As regards the transition phenomenon mentioned above, it was found that according to the rate of cooling the transition temperature of mercury iodide could be raised some degrees ("The Theory of Allotropy," pp. 188, 193, 201, 206), and the same holds for the transformation of β-crystobalite into α-crystobalite, where the effect is more marked. Two crystalline modifications of silica prepared at 1600° showed that the transformation $\beta \rightarrow \alpha$ had already taken place about 18° above the temperature at which the change in material prepared at 1000° occurs.

It is evident that a change of the vapour-pressure of the liquid state causes a change in the boiling-point; consequently a change of the boiling-point indicates that the vapour-pressure of the liquid is altered. A change of the vapour-pressure of the liquid causes also a change of the melting-point, unless the new vapour tension of the solid state has accidentally such a value that the new vapour tension lines of liquid and solid meet at the ordinary melting temperature.

As regards changes of the boiling-point, most interesting results were obtained by H. B. Baker and Mrs. Baker (*Trans. Chem. Soc.*, 51, 2339, 1912). They found that while pure, not intensively dried nitrogen trioxide boils under atmospheric pressure at $-2°$, the intensely dried liquid, freed from the last traces of water by phosphorus pentoxide, boiled at $+43°$, that is, 45° higher. With nitrogen tetroxide they obtained a similar result, the boiling-point of the intensely dried liquid having risen more than 47°.

These investigations were the beginning of a series of still more important experiments, carried out by Baker (*Trans. Chem. Soc.*, 121, 568, 1922) on the intensive drying of ten liquids and some solid substances of very different character. The examination of these substances, being postponed by the War much longer than was intended, was delayed eight or nine years. The result was that all the liquids showed a great rise of boiling-point. For example, the boiling-point of benzene had risen from 80° to 109°, that of ethyl alcohol from 78·5° to 138°, that of ethyl ether from 35° to 83°, that of hexane from 68·4° to 82°, that of bromine from 63° to 118°, and that of mercury from 358° to 420°.

Further, it was found that if these intensively dried liquids were allowed to take up a trace of water-vapour, for which purpose contact with ordinary dried air (air which had been passed first through concentrated sulphuric acid and then over phosphorus pentoxide) was sufficient, the liquids regained their original state with the normal boiling-points. In some cases, as with alcohol, the normal state was reached in twenty-four hours, but with benzene it required a month.

At first sight it might be thought that this phenomenon is a simple superheating of the liquid. Indeed it is well known that if a liquid and the wall of the vessel containing the liquid are freed from gases, it is possible to heat the liquid some degrees above the normal boiling-point before boiling occurs. Now if intensive drying facilitates this phenomenon, Baker's results might be described to superheating. For those who are not familiar with the phenomenon of superheating, it may be mentioned that should anyone succeed in heating water in an open vessel, for example, up to 130°, it would be most necessary for the experimenter to place it under cover, since that at any moment an intense and explosive boiling might take place (explosion of boilers). Taking now into consideration the fact that boiling-points up to 60° above the normal boiling-points were observed by Baker and that the boiling took place very quietly, then it is clear that considerable superheating was altogether out of the question. Corresponding to this, Baker found that at the same temperature intensively dried ether showed a lower vapour-pressure than the moist liquid. The vapour-pressure is a quantity which can be accurately measured, and since a decrease of vapour-pressure corresponds to a rise of the boiling-point, it was proved that the phenomenon observed by Baker was the result of a change of the state of the substance involving a change of the vapour-pressure. That the state of the substance is really changed by intensive drying followed from the results obtained by determining the mean size of the molecules in the intensively dried liquids, for which values were found 2 to 2·5 times as large as in the moist liquids. Consequently, association or polymerisation had taken place.

These results, being completely unsuspected and lying far beyond the horizon of current conceptions, were at the time not generally accepted. It was not possible to say how Baker could have erred, but one could simply not believe that the properties of a substance could change so much.

Though chemists and physicists in general were sceptical, in the chemical laboratory of the University of Amsterdam the results obtained by Baker were received with great enthusiasm, since there in 1911 a theory had been put forward by means of which such results could be easily explained. Baker's results were, indeed, a valuable confirmation of the new theory ("The Theory of Allotropy," 1922).

This theory assumes that every state of aggregation, even of the most simple substance, in reality is complex, that is to say, it is built up of molecules of different kinds. Taking, for example, benzene, it is assumed that in each state of aggregation, namely, gaseous, liquid, and solid, it consists of different kinds of molecules. For simplicity only two different kinds of molecules are assumed, indicated by the indices α and β, thus $C_6H_6\alpha$ and $C_6H_6\beta$. In general, we cannot say beforehand in what way these kinds of molecules will differ. First, it is possible that these molecules are equal in size but different in structure, and these differences may be very small. Secondly, the molecules may be of different size. With benzene it is probable that the different kinds of molecules differ in size, and for simplicity we shall assume here that one kind is a simple molecule, C_6H_6, and the other kind is an associated molecule $(C_6H_6)n$, formed by combination of n simple molecules to form a new large molecule. Let us consider now pure benzene. This liquid boils at 80°. Supposing we had a liquid consisting only of simple molecules C_6H_6, then this liquid would be more volatile, would have a higher vapour-pressure and a lower boiling-point than ordinary benzene, let us say 70°. If we had, on the other hand, a liquid containing only the larger molecules $(C_6H_6)n$, this liquid would be much less volatile, and would have a much higher boiling temperature, let us say 150°. Ordinary benzene boils at 80°, since in this liquid, molecules of the liquid boiling at 70° and molecules of the liquid boiling at 150° are present side by side.

It is natural then to ask: Is benzene a mixture? Certainly it is, for that is exactly what these considerations indicate. Benzene vapour and benzene liquid are gaseous and liquid mixtures, and crystallised benzene, that is to say, every crystal of the solid state, is also a mixture, namely, a mixed crystal, but, as we shall see, they are not ordinary mixtures.

By adding water to alcohol we obtain an ordinary mixture, and the properties of that mixture depend on the proportion in which the substances are mixed. A certain mixture begins to boil at a definite temperature, begins to solidify at a definite temperature, and shows a definite vapour-pressure at a certain temperature. The property by which a liquid is known as a mixture is this, that by distilling off a portion, or by solidifying a part, we obtain a liquid of different composition and therefore different boiling-point, different vapour-pressure, and different solidifying point. The easiest manipulation is partial distillation. Applying this method, for example, to a mixture of equal quantities of water and alcohol, then a vapour escapes which is richer in alcohol than the liquid, and the remaining liquid has become poorer in alcohol, effecting a decrease of the vapour tension and an increase of the boiling-point.

This decrease of the vapour-pressure and increase of the boiling-point by partial distillation is a characteristic property of a mixture. If a solidifying mixture gives mixed crystals—*i.e.* crystals in which all the substances we have mixed are present, just as every drop of a liquid mixture contains each part present (a mixture of chlorine and bromine is a very good example)—then for these mixed crystals this rule holds just as for liquid mixtures, namely, by partial distillation the vapour tension is decreased.

It is mentioned above, however, that pure benzene is a mixture. Yet if benzene is submitted to partial distillation the properties of the liquid are not changed at all. Vapour-pressure, boiling-point, melting-point are exactly the same as before. What is, then, the explanation of this behaviour, which is characteristic of a true simple substance, whilst benzene is not simple? It seems indeed a contradiction, but it is not so. Although benzene is composed of different kinds of molecules, it behaves as a single substance, on account of the great velocity with which these kinds of molecules are transformed in each other. These mutual transformations are indicated in the following way:

$$nC_6H_6 \rightleftarrows (C_6H_6)n.$$

These two very rapid opposite reactions lead to a so-called equilibrium, in which the proportion between the single and the associated molecules, or the composition, has a definite value at constant temperature and pressure. If we have to do with ordinary dried benzene, we have no means of changing this composition, temperature and pressure remaining constant. Let us assume we had an instrument which enabled us, just as a stork catching fish from the water, to catch up and carry off the large molecules in liquid benzene. Still we should not succeed in making the remaining liquid poorer in big molecules, for so soon as the number of large molecules is decreased the small molecules will be associated to form large molecules, until that proportion between small and large molecules is reached which corresponds with the inner equilibrium.

By distilling benzene as rapidly as possible a similar process occurs; the smaller molecules are more rapid than the large ones, and in consequence of this the smaller molecules will leave the liquid surface in greater numbers per second than the large molecules. Notwithstanding this the liquid does not get poorer in small molecules, since the larger molecules dissociate until the proportion of the different kinds of molecules, corresponding with the inner equilibrium, is reached.

According to these considerations, a so-called simple substance is in reality a mixture, not an ordinary one, but a mixture with an inner equilibrium. Now it is evident that if we were able, for example, in the case of benzene to withdraw the big molecules with a velocity greater than the velocity with which they are formed again, the properties of benzene would change. But in most substances these inner transformations are so rapid that an artificial change of the composition is impossible.

We can say, consequently, that it is the rapid establishment of the equilibrium between the different kinds of molecules of the same substance (inner equilibrium) which makes a substance such as ordinary pure benzene, behave as a true single substance.

Considering the results of Baker's experiments from this point of view, it is not difficult to give an explanation of them. Only one very probable supposition is to be made, namely, that the process of intensive drying effects a decrease of the velocity of the transformation between the different kinds of molecules, and that finally the transformation is stopped completely.

In benzene, not intensively dried, the two opposite rapid transformations,

$$nC_6H_6 \rightleftarrows (C_6H_6)n$$

are taking place, but in intensely dried benzene these transformations take place no longer, and the arrows have no longer any signification; the two kinds of molecules have become strangers to each other; *i.e.* intensively dried benzene has become an ordinary mixture.

What can we say now of this mixture? We have already mentioned above that a liquid consisting exclusively of the small simple molecules, C_6H_6, would be more volatile and would boil perhaps at 70°, whilst a liquid containing only the big, associated, molecules $(C_6H_6)n$ would be much less volatile and would boil perhaps at 150°. From this it follows that when, by intensive drying, benzene has become an ordinary mixture, it is a mixture of two substances differing greatly in volatility. Heating this mixture in an open vessel, then, as in most cases, principally the more volatile part will escape, by which the remaining liquid becomes richer in the less volatile part, and when the boiling-point is reached the liquid, considerably enriched in the less volatile and higher boiling part, will begin to boil at a temperature higher than the boiling-point of moist benzene.

This explanation has been tested and confirmed (*Jour. Chem. Soc.*, 125, 1068, 1924), but in addition another supposition has been confirmed, namely, that the process of intensive drying effects more or less a change in the proportion between the different kinds of molecules at the drying temperature; *i.e.* it effects a change of the inner equilibrium (*Jour. Chem. Soc.*, 128, 2655 and 2657, 1926). It seems that with the progress of the drying process the molecular proportion mentioned above changes gradually more or less; this is accom-

GRIFFIN
AND
BAIRD & TATLOCK

At the Science Masters' Association Exhibition in Oxford, instruments for the School Laboratory will be shown, including many of the new models developed recently in our Experimental Departments and described in Catalogue (No. 50) recently published.

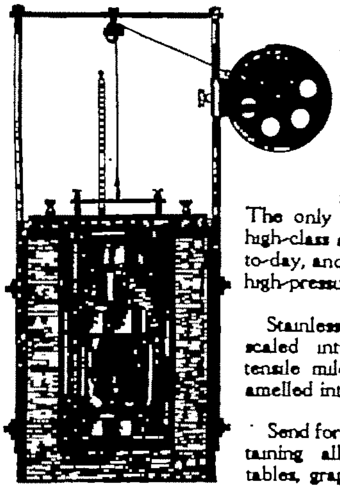
PHYSICAL SOCIETY EXHIBITION

SCIENCE MASTERS' ASSOCIATION EXHIBITION

At the Physical Society Exhibition in London, Griffin and Baird & Tatlock will exhibit new experimental apparatus, which will include the Boys Recording Gas Calorimeter, Microid Pyrometers, and new models of Penetrometer, CO_2 Indicator and Oil Testing Machines.

JOHN J. GRIFFIN & SONS LTD
LONDON W.C.2
BAIRD & TATLOCK LTD.
GLASGOW MANCHESTER
EDINBURGH LIVERPOOL

THE
MAHLER-COOK BOMB CALORIMETER



For determining the calorific value of Fuels (Coal, Coke, Oils, etc.)

The original Bomb Calorimeter, used all over the World and first introduced by the present makers in 1900. The only reliable, accurate, and high-class apparatus on the market to-day, and made by Engineers and high-pressure experts.

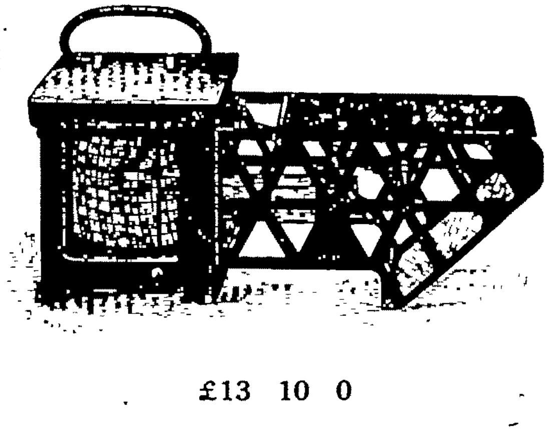
Stainless steel Bombs with descaled internal finish, or high tensile mild steel Bombs with enamelled interior.

Send for Illustrated Booklet containing all working instructions, tables, graphs, etc.

High Pressure Apparatus, Centrifuges, Microtomes, Electroscopes, Steam Meters, Electric Furnaces, etc.

CHAS. W. COOK & SONS,
ROYAL HOTEL WORKS,
ASHBY-DE-LA-ZOUCH, LEICS.
LONDON STOCKISTS · **Messrs. Baird & Tatlock (London) Ltd., Cross Street, Hatton Garden, E.C.1.**

CASELLA'S THERMO-HYGROGRAPH



£13 10 0

C. F. CASELLA & CO. LTD.
49-50 Parliament Street,
London, S.W.1

LEWIS'S CIRCULATING MEDICAL AND SCIENTIFIC LIBRARY.

Covering the widest range of subjects (pure and applied), including **Astronomy, Aviation, Biology, Botany, Chemistry, Electricity, Engineering, Geology, Microscopy, Mining, Philosophy, Physics, Sociology, Technology, Travels, Zoology, &c.**, in addition to **Every Branch of Medical Science.**
Duplicates of NEW BOOKS are added in UNLIMITED SUPPLIES, as long as the demand requires, delay or disappointment thus being prevented.

ANNUAL SUBSCRIPTION (Town or Country) FROM ONE GUINEA,
according to the number of books required at one time. Subscriptions may begin at any date. Books may be retained as long or exchanged as frequently as desired.
The Library READING AND WRITING ROOM (first floor) is open daily.
Prospectus, with monthly list of additions, post free.

H. K. LEWIS & CO. Ltd., 136 GOWER STREET, and 24 Gower Place, **LONDON, W.C.1.**
District Railway Euston Square Station All Tube Railways Warren Street Telephone Museum 1072 Telegrams "Publicavit, Eusroad, London"

BROOKLYN BOTANIC GARDEN MEMOIRS

Volume I : 33 contributions by various authors on Genetics, Pathology, Mycology, Physiology, Ecology, Plant Geography, and Systematic Botany. Price, $3.50 plus postage.
Volume II. : The Vegetation of Long Island. Part I. The Vegetation of Montauk, etc. Pub. 1923. 108 pp. Price, $1.

AMERICAN JOURNAL OF BOTANY

Devoted to All Branches of Botanical Science.

Established 1914. Monthly, except August and September. Official publication of the Botanical Society of America.
Subscription, $7 a year for complete volumes only. Volumes 1-13 complete, $106, post free. Single numbers, $1 each, post free. Prices of odd volumes on request. Foreign postage, 40 cents.

ECOLOGY

Devoted to All Forms of Life in Relation to Environment.

Established 1920. Quarterly.
Official publication of the Ecological Society of America. Subscription, $4 a year for complete volumes only. Back volumes, 1, 2, and 4-7, $5 each, post free. Single numbers, $1.25, post free. Foreign postage, 20 cents.

GENETICS

A Periodical Record of Investigations in Heredity and Variation.

Established 1916. Bi-monthly
Subscription, $6 a year for complete volumes only. Single numbers, $1.25, post free. Back volumes, 2-10, $7 each. Foreign postage, 50 cents.

Orders should be placed with
The Secretary, Brooklyn Botanic Garden,
BROOKLYN, N.Y., U.S.A.

ADLARD & SON
LIMITED
"BARTHOLOMEW PRESS"
SCIENCE PRINTERS.
Home and Export.
New London Offices:
21 Hart Street, Bloomsbury, W.C.1.

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

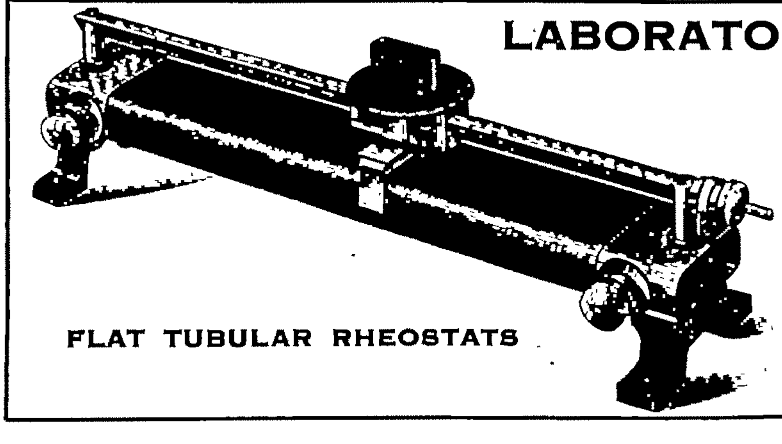
Already published. Part I: Sets of Scientific Periodicals. General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

LABORATORY RHEOSTATS



FLAT TUBULAR RHEOSTATS

These Rheostats embody perfection in detail if made
BY ISENTHAL

LIST ON REQUEST

ISENTHAL & CO. LTD.

Contractors to the Admiralty, War Office, Air Ministry, Postmaster-General, &c.

Ducon Works, Victoria Road,
NORTH ACTON, LONDON, W.3

Recent Scientific and Technical Books.

Volumes marked with an asterisk have been received at "NATURE" *Office.*

Mathematics : Mechanics : Physics

Abderhalden, Emil, Herausgegeben von. Handbuch der biologischen Arbeitsmethoden. Lieferung 209. Abt. 2: Physikalische Methoden, Teil 2, Heft 5 Die radioaktiven Substanzen, von Stefan Meyer; Bestimmung der Verbrennungswärme und ergänzende thermochemische Messungen, von A. W. Roth. Sup. Roy. 8vo. Pp. 1537-1690. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 7.80 gold marks.*

Ainsley, Thomas L. Magnetism and the Deviation of the Compass in Iron Ships. New edition. Roy. 8vo. Pp. 165 (South Shields: Thomas L. Ainsley, 1926) 4*s.* 6*d* net.

Appell, P., et Fériet, J. Kampé de. Fonctions hypergéométriques et hypersphériques, polynomes d'Hermite. 4to. Pp. 434. (Paris: Gauthier-Villars et Cie, 1926) 140 francs.

Becquerel, Jean. L'Art musical dans ses rapports avec la physique. (Extrait du tome 2 du "Cours de Physique.") Roy. 8vo. Pp. 41. (Paris: J. Hermann, 1926.) 6 francs *

Bedford, T. G. Practical Physics. Demy 8vo. Pp. x+425 (London: Longmans, Green and Co., Ltd, 1926) 10*s.* 6*d.* net.*

Berrens, S. Éléments de mécanique industrielle, suivis d'une conférence sur l'organisation dans les ateliers de Jules Lange. (Bibliothèque d'enseignement technique et professionnel.) Cr. 8vo. Pp. 468+4 planches. (Paris. Gaston Doin et Cie, 1926.) 33.60 francs.

Bligh, N. M. The Evolution and Development of the Quantum Theory. Demy 8vo. Pp. 112 (London: Edward Arnold and Co., 1926.) 9*s.* net *

Board of Education. Catalogue of the Collections in the Science Museum, South Kensington, with Descriptive and Historical Notes and Illustrations. Mathematics. 1: Calculating Machines and Instruments. Compiled by D. Baxandall. Roy. 8vo Pp. 85+13 plates. (London: H.M Stationery Office, 1926.) 1*s.* net.*

Clatworthy, J. P. An Introduction to Mechanics. Cr. 8vo Part 1: Statics. Pp ix+225. (London: Methuen and Co., Ltd., 1926.) 5*s.**

Cracknell, A. G., and Perrott, G. F. Similar Figures, Space and Solids: being a New Geometry of the Subject-Matter of Euclid, Books V., VI. and XI. (Text-Books on Geometry.) Cr. 8vo. Pp. viii+262. (London: University Tutorial Press, Ltd., 1926.) 4*s.**

Davidson, J., and Pressland, A. J. A Second Geometry Being a sequel to the "Primer of Geometry" by W. Parkinson and A. J. Pressland. Cr. 8vo. Pp. 128. (Oxford: Clarendon Press: London: Oxford University Press, 1926.) 2*s.* 6*d.* net.

Department of Scientific and Industrial Research: Illumination Research. Technical Paper No. 1: The Terminology of Illumination and Vision. Roy. 8vo. Pp. iv+21. 9*d.* net. Technical Paper No. 2: The Transmission Factor of Commercial Window Glasses By A. K Taylor and C J. W. Grieveson. Roy. 8vo Pp. iv+10. 6*d.* net Technical Paper No. 3: Light Distribution from Industrial Reflector Fitting No 1 (British Engineering Standard). By H Buckley and C. J. W. Grieveson. Roy. 8vo. Pp. v+26. 1*s* net. (London: H.M. Stationery Office, 1926) *

Durell, Clement V. Answers, Hints and Solutions of the Exercises in "Projective Geometry" Cr 8vo. Pp. 48. (London: Macmillan and Co, Ltd, 1926.) 2*s.* 6*d.*

Eckhart, Ludwig. Konstruktive Abbildungsverfahren: eine Einführung in die neueren Methoden der darstellenden Geometrie. Pp. iv+119. (Wien und Berlin: Julius Springer, 1926.) 5.40 gold marks.

Faivre-Dupaigre, J., Lamirand, J., et Brizard, L. Cours de physique: pour les classes de mathématiques spéciales Tome 1: Optique. Neuvième édition. Pp. 420. (Paris: Masson et Cie, 1926) 4*s.* 8*d.*

Fernau, Albert. Physik und Chemie des Radium und Mesothor: für Ärzte und Studierende. Zweite, wesentlich vermehrte Auflage. Pp. 101. (Wien und Berlin: Julius Springer, 1926) 7.50 gold marks.

Filshie, James H. Practice and Progress in Mathematics. Cr. 8vo. Pp. vii+143. (London and Glasgow: The Grant Educational Co., Ltd., 1926.) 2*s.*

Gerlach, Walther. Materie, Elektrizität, Energie: Grundlagen und Ergebnisse der experimentellen Atomforschung. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, Band 7.) Med. 8vo. Pp xi+291 (Dresden und Leipzig: Theodor Steinkopff, 1926) 15 gold marks.*

Juvet, G. Sur une équation aux dérivées fonctionnelles partielles et sur une généralisation du théorème de Jacobi. (Thèse) 4to. Pp. 54. (Paris: Albert Blanchard, 1926.) 22 francs.

Kent, Frederick C., and Kent, Maude E. Compound Interest and Annuity Tables: Values of all Functions to Ten Decimal Places for 1-100, 1-200, 1-300 Years, Rates of Interest ¼ of 1 per cent. to 10½ per cent., Conversion Factors and Logarithms Med. 8vo. Pp. viii+214. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 20*s.* net.*

Macdougall, F. H. Thermodynamics and Chemistry. Second edition 8vo. (London: Chapman and Hall, Ltd, 1926) 27*s.* 6*d.* net.

McKay, Herbert. Preliminary Geometry. Cr. 8vo. Pp. 120. (London: Oxford University Press, 1926.) 2*s.*

Maclean, John. Graphs and Statistics: a Suggestion for a Finishing Course in Mathematics. Demy 8vo. Pp. xiv+200+2 plates. (Bombay Ramchandra Govind and Son, 1926.) 4 rupees *

Metz, A. Les nouvelles théories scientifiques et leurs adversaires: la relativité. Quinzième édition revue et augmentée. 8vo. Pp. 270. (Paris: Étienne Chiron, 1926.) 9 francs

Mines Department: Safety in Mines Research Board. Paper No. 29: The Pressure Wave sent out by an Explosive, Part 2 By W. Payman and W. C. F. Shepherd. Roy. 8vo. Pp. 20+8 plates. (London: H.M. Stationery Office, 1926.) 1*s.* net.*

Moreux, Abbé Th. Pour comprendre la physique moderne. (Bibliothèque d'éducation scientifique.) Cr. 8vo. Pp. 300. (Paris: Gaston Doin et Cie, 1926.) 12 francs.

Paterson, W. E. Test Papers in Geometry: Points essential to Answers. Demy 8vo. Pp. 32 (London: Sir Isaac Pitman and Sons, Ltd., 1926) 1*s.*

Siddons, A. W., and Hughes, R. T. Notes and Answers to Exercises in "Practical Geometry" and "Theoretical Geometry." Cr. 8vo. Pp. 26. (Cambridge: At the University Press, 1926.) 1*s.* 6*d.*

Stead, C. Elementary Physics: for Medical, First Year University Science Students and General Use in Schools Second edition. Demy 8vo. Pp. 469. (London: J. and A. Churchill, 1926.) 10*s.* 6*d.* net.

Vézo, L. Les mathématiques de l'ouvrier moderne: géométrie Troisième édition. Ex. Cr. 8vo. Pp. vi+310. (Paris: Libr. Dunod, 1926) 14 francs

Wagstaff, C. J. N. Properties of Matter. Fourth edition. Cr. 8vo. Pp. viii+279. (London: University Tutorial Press, Ltd., 1926.) 5*s.*

Walmsley, Charles. An Introductory Course of Mathematical Analysis. Demy 8vo. Pp x+293. (Cambridge: At the University Press, 1926) 15*s.* net.*

Ward, William. Engineering Science: a First Year's Course in Mechanics and Heat Engines. Cr. 8vo. Pp. 128. (London: Edward Arnold and Co, 1926) 3*s.**

Wien, W., und Harms, F., Herausgegeben von. Handbuch der experimentalphysik. Band 14: Kathodenstrahlen, von P. Lenard und A. Becker; Kanalstrahlen, von Wilhelm Wien. Sup. Roy. 8vo. Pp. xiv+788. (Leipzig: Akademische Verlagsgesellschaft m b.H., 1926.) 72 gold marks *

Engineering

Aldebert, E., et Aucamus, Eugène. Charpente et couverture. (Bibliothèque de l'ingénieur des travaux publics) Deuxième édition, par Eugène Aucamus et A Lemaire. Gl. 8vo. Pp. viii+472. (Paris: Libr. Dunod, 1926.) 42 francs

Antoine, A. Les routes américaines. Deuxième édition. Med. 8vo. Pp. viii + 100. (Paris: Libr. Dunod, 1926) 16 francs.

Archibald, Robert Douglas. Polyphase Induction Motors. Cr. 8vo. Pp. vii + 88. (London: Chapman and Hall, Ltd., 1926.) 5*s.* net.*

Atkinson, Robert, and **Bagenal, Hope.** Theory and Elements of Architecture. Vol. 1, Part 1. Cr. 4to. Pp. 414. (London: Ernest Benn, Ltd., 1926.) 30*s.* net.

Aucamus, Eugène, et Lemaire, A. Bois et métaux. (Bibliothèque de l'ingénieur des travaux publics.) Deuxième édition. Gl. 8vo. Pp. viii + 592. (Paris: Libr. Dunod, 1926.) 48 francs.

Baker, T. Thorne. Wireless Pictures and Television: a Practical Description of the Telegraphy of Pictures, Photographs and Visual Images. Cr. 8vo. Pp. x + 188. (London: Constable and Co., Ltd., 1926.) 6*s.* 6*d.* net.*

British Engineering Standards Association. British Standard Specification for Portland-Blast Furnace Cement. No. 146, 1926. 8vo. Pp. 17. 1*s.* British Standard Sections of Light Rails and Fishplates for Use in Mines (Flat Bottom and Bridge). No. 248, 1926. 8vo. Pp. 31. 1*s.* (London: British Engineering Standards Association, 1926)

Butler, A. S. G. The Substance of Architecture. Demy 8vo. Pp. xvii + 320 + 8 plates. (London: Constable and Co., Ltd., 1926.) 12*s.* net.

Carton, René, et Dumartin, Pierre. La transformation de l'énergie électrique. (Collection Armand Colin.) Tome 1: Les transformateurs. Cr. 8vo. Pp. 217. (Paris: Armand Colin, 1926.) 9 80 francs.

Chauvierre, Marc. Théorie et pratique du moteur à deux temps. Ex. Cr. 8vo. Pp. xii + 208. (Paris: Libr. Dunod, 1926.) 18 francs.

Coleman, G. S., and **Flood, G. M.** Civil Engineering Specifications and Quantities. Demy 8vo. Pp. xv + 282. (London: Longmans, Green and Co, Ltd., 1926.) 10*s.* 6*d.* net.*

Department of Scientific and Industrial Research: Building Research. Technical Paper No 5: The Consistence of Cement Pastes, Mortars and Concrete. By N. Davey. Roy. 8vo. Pp. vii + 54. (London: H.M. Stationery Office, 1926.) 2*s.* net.*

Dickinson, P. L. An Outline History of Architecture of the British Isles. Ex. Cr. 8vo. Pp. 320 + 62 plates. (London: Jonathan Cape, Ltd., 1926.) 15*s* net.

Dinsdale, Alfred. Television (Seeing by Wire or Wireless). Cr. 8vo. Pp. 62. (London: Sir Isaac Pitman and Sons, Ltd, 1926.) 2*s.* net.*

Edwards, Norman. Broadcasting for Everyone: a Popular Outline for the Listener-in. Cr. 8vo. Pp. 260. (London: Herbert Jenkins, Ltd., 1926.) 2*s* 6*d* net.

Forestier, V. Le portefeuille du béton armé: recueil de projets-types constituant une documentation complète; à l'usage des ingénieurs, constructeurs et entrepreneurs, architectes et industriels, ingénieurs et agents techniques des administrations, chemins de fer, ponts et chaussées, projeteurs, métreurs, conducteurs et agents d'entreprises. Fascicules 1 à 4. Deuxième édition. Pott folio. No. 1: Calcul direct par des formules simples des hourdis, poutres et piliers en béton armé. Pp 12. No 2: Note générale sur la construction des usines, projet de construction industrielle. Pp. 20 + 2 planches. No. 3: Ponts à travées rectilignes Pp. 24 + 2 planches. No. 4: Réservoirs, étude d'un château d'eau, généralités sur les réservoirs Pp. 24 + 2 planches. (Paris: Libr. Dunod, 1926.) 40 francs.

Fournier, Lucien. Les moteurs. Pp. 64. (Paris Hachette et Cie, 1926.) 3.50 francs.

Frick, P. Considérations sur l'établissement des projets d'adduction et de distribution d'eau potable dans les communes. Deuxième édition revisée et mise à jour par Paul Lévy-Salvador. Roy. 8vo. Pp. viii + 140. (Paris: Libr. Dunod, 1926) 18 francs.

Fuller, George W., and **McClintock, James R.** Solving Sewage Problems. Med. 8vo. Pp. x + 548. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 30*s.* net.*

Grassmann, R. Geometrie und Massbestimmung der Kulissensteuerungen: ein Lehrbuch für den Selbstunterricht. Zweite, unveränderte Auflage. 4to. Pp. 148 + 20 Tafeln. (Berlin: Julius Springer, 1926.) 13.50 gold marks.

Grüning, Martin. Die Tragfähigkeit statisch unbestimmter Tragwerke aus Stahl bei beliebig häufig wiederholter Belastung. (Berlin: Julius Springer, 1926.) 3 30 gold marks.

Higgins, George. Centrifugal Pumps: their Design, Operation and Testing. Demy 8vo Pp. viii + 86 + 7 plates. (London: Crosby Lockwood and Son, 1926.) 9*s.* 6*d.* net.*

Hirschauer, L., et Dollfus, Ch. L'année aéronautique, 1925–1926. Cr. 4to. Pp. 362. (Paris: Libr. Dunod, 1926.) 30 francs

Kármán, Th. von, Herausgegeben von. Abhandlungen aus dem Aerodynamischen Institut an der Technischen Hochschule Aachen. Heft 1: Über laminare und turbulente Reibung, von Th. von Kármán; Zur naherungsweisen Integration der Differentialgleichung der laminaren Grenzschicht, von K. Pohlhausen, Der Warmeübergang an einen turbulenten Flussigkeits- oder Gasstrom, von H Latzko; Grundwasserstromung in einem abfallenden Gelände mit Abfanggraben, von L. Hopf und E. Trefftz. Manuldruck 1926. 4to. Pp. 68. 6 gold marks. Heft 2: Ein Beitrag zum Spaltflügelproblem, von W. Klemperer; Flug- und Trudelkurven, von L. Hopf; Mechanische Modelle zum Segelflug, von Th. von Kármán; Der Einfluss des Windes auf die Transportleistung, von W. Klemperer; Theoretische Bemerkungen zur Frage des Schraubenfliegers, von Th. von Kármán. Manuldruck 1926. 4to. Pp. 56. 6 gold marks. Heft 3: Die Messung der hydraulischen Rauhigkeit, von L. Hopf; Strömungswiderstand in rauhen Rohren, von K. Fromm; Zahlenmaterial zur vorigen Abhandlung, von K. Fromm. Manuldruck 1926. 4to. Pp. 44. 6 gold marks. (Berlin: Julius Springer, 1926.)

Latham, Ernest. Marine Works: a Practical Treatise for Maritime Engineers, Landowners and Public Authorities. Second edition, considerably enlarged. Demy 8vo. Pp. xii + 223. (London: Crosby Lockwood and Son, 1926.) 16*s.* net.*

Lefebvre, Georges. Voie publique. (Bibliothèque de l'ingénieur des travaux publics) Deuxième édition par A. Roulleau Gl. 8vo. Pp. viii + 592 + 2 planches (Paris: Libr. Dunod, 1926) 48 francs.

Levy, Leonard A. Gasworks Recorders: their Construction and Uses Roy. 8vo. Pp. 258. (London: Ernest Benn, Ltd., 1926.) 18*s.* net.

Marcotte, Edm. Les moteurs à combustion. (Collection Armand Colin.) Cr. 8vo. Pp. 220. (Paris: Armand Colin, 1926) 9 80 francs.

Mauduit, A. Installations électriques à haute et basse tension. production, transport, distribution et utilisation de l'énergie électrique. 2 vols. Roy. 8vo. Vol. 1. Pp. xxiv + 730. Vol. 2. Pp. xii + 731-1366. (Paris: Libr. Dunod, 1926) 150 francs.

Nicolas, E. Vingt leçons pratiques sur les courants alternatifs. Troisième édition. 8vo. Pp viii + 278. (Paris: Libr Vuibert, 1926) 22 francs.

Plessis, Jean du. Les grands dirigeables dans la paix et dans la guerre. Tome 2: Leur technique. 8vo. Pp. 217 + 2 planches (Paris: Libr. Plon, 1926.) 20 francs

Raymond, William G., Woodwood, Sherman M., and **Prageman, Irving H.** Engineering Problems: a Brief Elementary Course for Engineering Students. Med. 8vo Pp. vii + 47. (New York: McGraw-Hill Book Co, Inc., London. McGraw-Hill Publishing Co., Ltd, 1926.) 5*s* net.*

Roberjot, P. Travaux pratiques d'électricité industrielle. Tome 4: Usines génératrices, transformations, canalisations Deuxième édition Ex. Cr. 8vo Pp. iv + 202 + 7 planches. (Paris: Libr. Dunod, 1926.) 13 francs

Schoklitsch, Armin. Geschiebebewegung in Flussen und an Stauwerken. Pp. 112. (Berlin: Julius Springer, 1926.) 8.70 gold marks.

Warnes, Arthur R. Building Stones. their Properties, Decay and Preservation. Demy 8vo. Pp. 269. (London: Ernest Benn, Ltd., 1926.) 16*s.* net

Weeks, Walter S. Ventilation of Mines Med. 8vo. Pp. x + 228. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15*s.* net *

Chemistry: Chemical Industry

Brinkley, Stuart R. Principles of General Chemistry Demy 8vo. Pp. x + 477 + 11 plates. (New York: The Macmillan Co., 1926.) 15*s.* net *

Brinkley, Stuart R., and **Kelsey, Erwin B.** Laboratory Manual, arranged to accompany "Principles of General Chemistry." Demy 8vo. Pp. xiii + 159 (interleaved). (New York: The Macmillan Co., 1926.) 6*s* 6*d.* net.*

Christy, Miller, Compiled, with an Introduction and Notes, by. The Bryant and May Museum of Fire-making Appliances: Catalogue of the Exhibits. Demy 8vo. Pp. viii + 192 + 33 plates. (London: Bryant and May, Ltd.; Simpkin, Marshall and Co., Ltd., 1926.) 5*s.* net *

Clarke, Hans Thacher. A Handbook of Organic Analysis: Qualitative and Quantitative. Fourth edition. Cr. 8vo. Pp. xii + 363. (London: Edward Arnold and Co, 1926.) 8*s.* 6*d.* net.*

Crabb, W. H. Chemistry Questions for Rapid Revision. (First Series.) Demy 8vo. Pp. 32. (Oxford: The Holywell Press, 1926) 6*d.*

Davidsohn, J. Untersuchungsmethoden der Öle, Fette und Seifen. Pp xx + 442. (Berlin: Gebruder Borntraeger, 1926.) 25.80 gold marks.

Department of Scientific and Industrial Research: Building Research. Technical Paper No. 4: The Determination of Free Lime in Hydraulic Cement. By F. L. Brady and F. J. McConnell. Roy. 8vo. Pp. iv + 13. (London: H M. Stationery Office, 1926.) 6*d.* net.*

Eckelt, J. L. C., und **Gassner, O.** Projektierungen und Apparaturen fur die chemische Industrie Band 1: Gruppe; Nitrocellulose, synthetischer Campher, Pulver. Pp. 156. (Leipzig: Otto Spamer, 1926) 15 gold marks.

Eggert, Johann. Die Herstellung und Verarbeitung der Viscose: unter besonderer Berücksichtigung der Kunstseidenfabrikation. Pp. vi + 92 (Berlin: Julius Springer, 1926) 6.60 gold marks.

Elliott, Cyril, and **FitzGerald, Marion**, Edited by. Home Fires without Smoke: a Handbook on the Prevention of Domestic Smoke. (Published in London on Behalf of the Smoke Abatement League of Great Britain.) Demy 8vo Pp. xvi + 59. (London: Ernest Benn, Ltd., 1926.) 3*s.* 6*d* net *

Evans, Ulick R. The Corrosion of Metals. Second edition. Demy 8vo. Pp. xvi + 259. (London: Edward Arnold and Co., 1926.) 15*s.* net.*

Evans, Ulick R. Die Korrosion der Metalle. Deutsche bearbeitung von E. Honegger. Pp. 269. (Zurich, Leipzig und Berlin: Orell Füssli, 1926.) 14.40 gold marks.

Faraday Society. Explosive Reactions in Gaseous Media: a General Discussion held by the Faraday Society, June 1926. Roy. 8vo Pp. 247-375. (London: The Faraday Society, 1926) 10*s.* net *

Finnemore, Horace. The Essential Oils. Roy. 8vo. Pp. xv + 880 + 11 plates. (London: Ernest Benn, Ltd, 1926.) 70*s.* net.*

Finter, F. B. An Introduction to Physical Chemistry. Cr. 8vo. Pp. xv + 276 + 4 plates. (London: Longmans, Green and Co., Ltd., 1926.) 6*s.**

Fox, J. J., and **Bowles, T. H.** The Analysis of Pigments, Paints and Varnishes. (Oil and Colour Chemistry Monographs.) Roy. 8vo. Pp. 179. (London: Ernest Benn, Ltd., 1927.) 16*s.* net.*

Freundlich, Herbert. New Conceptions in Colloidal Chemistry. Cr. 8vo. Pp. vii + 147. (London: Methuen and Co., Ltd., 1926.) 6*s.* net.*

Frey, A., und **Ostwald, Wo.** Ambronn-Festschrift der kolloidchemischen Beihefte. Pp 376. (Dresden und Leipzig: Theodor Steinkopff, 1926.) 18 gold marks.

Friend, J. Newton, Edited by. A Text-Book of Inorganic Chemistry. (Griffin's Scientific Text-Books.) Vol. 3, Part 2: Beryllium and its Congeners. By Joshua C. Gregory and May Sybil Burr (née Leslie). Med. 8vo. Pp. xxvi + 342. (London: Charles Griffin and Co, Ltd., 1926.) 18*s.* net.*

Gmelin-Krauts Handbuch der anorganischen Chemie. Siebente ganzlich umgearbeitete Auflage. Herausgegeben von C. Friedheim und Franz Peters. Lfg. 216-217. (Band 6, Abt. 1.) Inhalt: Seltene Erdelemente im allgemeinen. Bearbeitet von Franz Peters (Heidelberg: Carl Winters Universitäts-Buchhandlung, 1926.) 8 gold marks.

Gurwitsch, Leo. The Scientific Principles of Petroleum Technology. Translated and revised by Harold Moore. Demy 8vo. Pp. xvi + 470 + 8 plates. (London: Chapman and Hall, Ltd., 1926.) 25*s* net.*

Haas, Arthur. Die Welt der Atome. Zehn gemeinverständliche Vortrage. Pp. 130 + 3 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1926) 4.80 gold marks.

Hahne, Friedrich. Leitfaden der Filmphotographie: Anleitung zur Ausübung der Photographie mit Roll-, Flach- und Packfilmen. (Photogr. Bücherschatz, Band 17.) Zweite vollständig umgearbeitete Auflage. Pp. 87. (Leipzig: Ed. Liesegangs Verlag, 1926.) 3 gold marks.

Hawley, L. F. Holz-Destillation. Deutsch von Albert A. Schreiber. Pp. vi + 135. (Berlin: Julius Springer, 1926.) 12 gold marks.

Keach, DeWitt T. The Electron in Oxidation-Reduction Cr. 8vo. Pp. vi + 58. (Boston, New York and London: Ginn and Co., 1926) 2*s.* 6*d.* net.*

Kolthoff, I. M. Indicators: their Use in Quantitative Analysis and in the Colorimetric Determination of Hydrogen-Ion Concentration. An authorized translation based upon the second German edition, revised and enlarged, by N. Howell Furman. Med. 8vo. Pp. xii + 269 (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 17*s.* 6*d* net.*

Kopaczewski, W. Les ions d'hydrogène: signification, mésure, applications, données numériques Roy. 8vo. Pp. ix + 322. (Paris: Gauthier-Villars et Cie, 1926.) 70 francs.*

Koster, M. Compulsory Teaching of Chemistry in Schools. Cr. 8vo. Pp. 48. (London: John Bale, Sons and Danielsson, Ltd., 1926.) 1*s.* net.

Lebbin, Georg. Getränkegesetze und Getränkesteuergesetze (Wein, Bier, Branntwein, Mineralwasser) (Guttentagsche Sammlung deutscher Reichsgesetze, Nr. 54b.) Pp. 401. (Berlin und Leipzig: Walter de Gruyter und Co., 1926.) 10 gold marks.

Michaelis, Leonor. Hydrogen Ion Concentration: its Significance in the Biological Sciences and Methods for its Determinations. Vol. 1: Principles of the Theory. Authorized translation from the second revised and enlarged German edition, by William A. Perlzweig. Med. 8vo. Pp. xiv + 299. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 22*s*, 6*d.* net.*

Morris, J. Outlines of Inorganic Chemistry: for Schools and Colleges. Cr. 8vo. Pp. 484. (London: Methuen and Co., Ltd., 1926.) 7*s.* 6*d.*

Neumann, Bernhard. Ergänzungswerk zu Muspratts Encyklopädisches Handbuch der technischen Chemie Herausgegeben von B. Neumann, A. Binz und F. Hayduck. Band 2: Chemische Technologie der anorganischen Industriezweige. Halbband 1. Teil 1. 28 gold marks. Teil 2. 19 gold marks. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1926.)

Pfau, Ernst. Anleitung zum chemischen Praktikum für Mediziner: theoretisches und praktisches. 8vo. Pp. 96. (Leipzig: Johann Ambrosius Barth, 1926.) 4.50 gold marks.

Price, Edward E. Atomic Form: with Special Reference to the Configuration of the Carbon Atom. Second edition, revised and enlarged. Cr. 8vo. Pp. 256. (London: Longmans, Green and Co., Ltd, 1926.) 7*s.* 6*d.* net

Schorger, A. W. The Chemistry of Cellulose and Wood. (International Chemical Series.) Demy 8vo. Pp. xiv + 596. (New York: McGraw-Hill Book Co, Inc.; London: McGraw-Hill Publishing Co., Ltd, 1926.) 30*s.* net.*

Skrabal, Anton. Das Atom: eine gemeinverständliche Darstellung. (Mitteilungen des Naturwissenschaftlichen Vereins fur Steiermark, C. Wissenschaftliche Abhandlung, Band 61.) (Graz: Ulrich Mosers (J. Meyerhoff) Buchhandlung, 1926.)

Sneed, M. Cannon. General Inorganic Chemistry. Demy 8vo. Pp. vi + 674. (Boston, New York and London: Ginn and Co, 1926.) 12*s.* 6*d.* net.*

Spear, R. H. A Junior Inorganic Chemistry. Second edition. Cr. 8vo. Pp. viii + 392. (London: J. and A. Churchill, 1926.) 6*s.* 6*d.* net.*

Spoehr, H. A. Photosynthesis. (American Chemical Society Monograph Series, No. 29.) Med. 8vo. Pp 393. (New York: The Chemical Catalog Co., Inc., 1926.) 6 50 dollars.*

Starke, Rich. F. Erzeugung und Verwendung des Gases zur offentlichen Gasversorgung. Pp. 95. (Munchen: R. Oldenbourg, 1926.)

Vigneron, H. Précis de chimie physique. Deuxième édition, revue et augmentée. Pp. 448. (Paris: Masson et Cie, 1926.) 6*s.*

Waldschmidt-Leitz, Ernst. Die Enzyme, Wirkungen und Eigenschaften. (Die Wissenschaft, Band 76.) Pp. 233. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1926.) 14 gold marks.

Weiser, Harry Boyer. The Hydrous Oxides. (International Chemical Series.) Demy 8vo. Pp. x+452. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 25*s.* net.*

Windheuser, Carl, und **Jessen, Wilhelm.** Repetitorium der Agrikulturchemie. (Pflanzen- und Tierernahrung.) Pp. 266. (Stuttgart: Eugen Ulmer, 1926.) 7 gold marks.

Astronomy

Clark, David. Field Astronomy: for Engineers and Surveyors. Cr. 8vo. Pp. viii+164. (London: Constable and Co., Ltd., 1926.) 10*s.* 6*d.* net.*

Eddington, A. S. The Internal Constitution of the Stars. Imp. 8vo. Pp. viii+407. (Cambridge: At the University Press, 1926.) 25*s.* net.*

Gyllenberg, W. Katalog von 11800 Sternen der Zone +35° bis +40° ag 'Lund. Mit dem Repsold'schen Meridiankreise der Universitätssternwarte in Lund in den Jahren 1920–1926 beobachtet und auf das Äquinoktium 1925.0 reduziert. Die Bearbeitung des Katalogs ist ausgefuhrt worden unter Mitwirkung von J. B. Ohlsson und N. P. Ambolt. Roy. 4to. Pp. xv+237. (Lund: Verlag Scientia, 1926.) *

Häfker, Hermann. Das Sternbilder-Buch: ein Buch von Himmel und Weltanschauung. 4to. Pp. 190. (München: Verlag Callwey, 1926.) 12 gold marks.

Hale, George Ellery. Beyond the Milky Way. Cr. 8vo. Pp. xv+105. (New York and London: Charles Scribner's Sons, 1926.) 7*s.* 6*d.* net.*

Meteorology: Geophysics

Bliss, E. W. The Nile Flood and World Weather. (Memoirs of the Royal Meteorological Society, Vol. 1, No. 5.) Roy. 8vo. Pp. 79-85. (London: Edward Stanford, Ltd., 1926.) 2*s.* 6*d.*.*

Meteorological Office: Air Ministry. British Rainfall, 1925: the Sixty-fifth Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1925, as recorded by about 5000 Observers in Great Britain and Ireland. Issued by the Authority of the Meteorological Committee. (M.O. 285.) Pott 4to. Pp. xviii+279. (London: H.M. Stationery Office, 1926.) 15*s* net.*

Meteorological Office: Air Ministry. Geophysical Memoirs, No. 31: Classification of Monthly Charts of Pressure Anomaly over the Northern Hemisphere. By C. E. P. Brooks and Winifred A. Quennell. Published by Authority of the Meteorological Committee. (M.O. 286a.) Roy. 4to. Pp. 12+6 plates. (London: H.M. Stationery Office, 1926.) 1*s* 6*d.* net.*

Nölke, Fr. Entwicklung im Weltall, kosmogonische Probleme und Hypothesen. Pp. 134+4 Tafeln. (Hamburg: Henri Grand, 1926.) 7.50 gold marks.

Richardson, Lewis F., Proctor, Denis, and **Smith, Robert Clifford.** The Variance of Upper Wind and the Accumulation of Mass. (Memoirs of the Royal Meteorological Society, Vol. 1, No. 4.) Roy. 8vo. Pp. 59-78. (London: Edward Stanford, Ltd., 1926.) 2*s.* 6*d.* *

Geology: Mineralogy

Bernewitz, M. W. von. Handbook for Prospectors. Cr. 8vo. Pp. ix+319. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15*s.* net.*

Berz, Karl C. Über die Natur und Bildungsweise der marinen Eisensilikate insbesondere der chamositischen Substanzen: ein Beitrag zur chemischen und mechanischen Sedimentation. (Fortschritte der Geologie und Palaontologie, Heft 11.) Sup. Roy. 8vo. Pp. viii+365-522+6 Tafeln. (Berlin: Gebrüder Borntraeger, 1926.) 12 gold marks.*

British Museum (Natural History). Catalogue of Cainozoic Plants in the Department of Geology. Vol. 1: The Bembridge Flora. By Eleanor Mary Reid and Marjorie Elizabeth Jane Chandler. With a Section on the Charophyta, by James Groves. Demy 8vo. Pp. viii+206+12 plates. (London: British Museum (Natural History), 1926.) 15*s.**

Field, Richard M. Geology Manual: an Instruction and Laboratory Manual for Beginners. Roy. 8vo. Pp. vi+132+blanks. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1926.) 18*s.* net.*

Friedel, Georges. Leçons de cristallographie, professées à la Faculté des Sciences de Strasbourg. Roy. 8vo. Pp. xx+602. (Paris: Libr. Berger-Levrault, 1926.)

Geological Society. List of Geological Literature added to the Geological Society's Library during the Year ended December 31st, 1925. Compiled by the Staff of the Library. Demy 8vo. Pp. iv+220. (London: Geological Society, 1926.) 10*s.**

Niggli, P. Lehrbuch der Mineralogie. 2: Spezielle Mineralogie. Unter besonderer Mithilfe von L. Weber. Zweite Auflage. Sup. Roy. 8vo. Pp. xvi+697. (Berlin: Gebrüder Borntraeger, 1926.) 30 gold marks.*

North, F. J. Coal: and the Coalfields in Wales. Demy 8vo. Pp. viii+175+13 plates. (Cardiff: National Museum of Wales; London: Oxford University Press, 1926.) 1*s.**

Salomon, W. Grundzüge der Geologie. Band 2: Erdgeschichte. Teil 1: Archaikum, Proterozoikum, Palaozoikum. Pp. viii+308. Teil 2: Mesozoikum und Neozoikum. Pp. viii+312. (Stuttgart: E. Schweizerbartsche Verlagsbuchhandlung, 1925–1926.) 32 gold marks.

Tyrrell, G. W. The Principles of Petrology: an Introduction to the Science of Rocks. (Methuen's Geological Series.) Cr. 8vo. Pp. xii+349. (London: Methuen and Co., Ltd., 1926.) 10*s.* net.*

General Biology: Natural History Zoology: Botany

Abel, Othenio. Amerikafahrt: Eindrucke, Beobachtungen und Studien eines Naturforschers auf einer Reise nach Nordamerika und Westindien. Sup. Roy. 8vo. Pp. ix+462. (Jena: Gustav Fischer, 1926.) 24 gold marks.*

Allen, Grant. The Story of the Plants. (Hodder and Stoughton's People's Library.) New edition, fully revised and annotated, and with a Biography of the Author, by Marcus Woodward. With illustrations specially drawn for this edition by C. Dillon McGurk. Gl. 8vo. Pp. 200. (London: Hodder and Stoughton, Ltd., 1926.) 2*s.* 6*d.* net.*

Batten, H. Mortimer. Nature Jottings of a Motorist. Cr. 8vo. Pp. 312. (London: Herbert Jenkins, Ltd., 1926.) 7*s.* 6*d.* net.

Blyton, Enid. The Bird Book. Cr. 4to. Pp. 124. (London: George Newnes, Ltd., 1926.) 3*s.* 6*d.* net.

Coward, T. A. The Birds of the British Isles. (The Wayside and Woodland Series.) Third Series: Comprising their Migration and Habits and Observations on our Rarer Visitants. Roy. 16mo. Pp. xi+308+127 plates. (London and New York: Frederick Warne and Co., Ltd., 1926.) 10*s.* 6*d.* net.*

Craib, W. G. Florae Siamensis Enumeratio: a List of the Plants known from Siam, with Records of their Occurrence. (Published under the Auspices of the Siam Society.) Vol. 1, Part 2: Linaceae to Anacardiaceae. Gl. 4to. Pp. 197-358. (Bangkok: Bangkok Times Press, Ltd.; London: Luzac and Co., 1926.) 7 Tcs.; 12*s.* 10*d.**

Crookes, Marguerite W. Plant Life in Maoriland: a Botanist's Notebook. Cr. 8vo. Pp. xiii+190. (Auckland, Melbourne and London: Whitcombe and Tombs, Ltd., 1926.) 7*s.* 6*d.* net.

Daudin, Henri. De Linné à Jussieu : Méthodes de la classification et idée de série en botanique et en zoologie (1740–1790). (Études d'histoire des sciences naturelles, 1.) Demy 8vo. Pp. v+264. (Paris : Félix Alcan, 1926.) 20 francs.*

Daudin, Henri. Cuvier et Lamarck : Les classes zoologiques et l'idée de série animale (1790–1830). (Études d'histoire des sciences naturelles, 2.) 2 vols. Vol. 1. Pp. xvii+460. Vol 2. Pp. 338. (Paris : Félix Alcan, 1926.) 60 francs.*

Department of Scientific and Industrial Research : Forest Products Research. Technical Paper No. 2 : Moisture Movement through Wood ; the Steady State. By J. F. Martley. Cr. 4to. Pp. iv+22. (London : H.M. Stationery Office, 1926.) 1*s.* 3*d.* net.*

Dunn, J. Allan. Gone Wild : the Epic of a Wolf-Hound. Pott 4to. Pp. 192+16 plates. (London : Gerald Duckworth and Co., Ltd., 1926.) 8*s.* 6*d.* net.*

Fishery Board for Scotland. Salmon Fisheries, 1926. No. 5, Salmon Investigations in Scotland, 1923. 2 : Salmon of the River Spey. By W. J. M. Menzies and P. R. C. Macfarlane. Roy. 8vo. Pp. 36+2 plates. (Edinburgh and London : H.M. Stationery Office, 1926.) 3*s.* 6*d.* net.*

Fritel, P.-H., et **Charpiat, R.** A marée basse : animaux et plantes du littoral. Cr. 8vo. Pp. 95. (Paris : Ch. Delagrave, 1926.) 7 francs.

Gask, Lilian. With Nature's Children. (The Little Story Books.) Revised and abridged edition. Roy. 16mo. Pp. 109+4 plates. (London, Calcutta and Sydney : George G. Harrap and Co., Ltd., 1926.) 1*s.* 3*d.**

Gask, Lilian. Brave Dogs. (The Little Story Books.) Roy. 16mo. Pp. 128. (London, Calcutta and Sydney : George G. Harrap and Co., Ltd., 1926.) 1*s.* 3*d.**

Harvey-Gibson, R. J. A Short History of Botany. Cr. 8vo. Pp. vii+96+2 plates. (London and Toronto : J. M. Dent and Sons, Ltd. ; New York : E. P. Dutton and Co., 1926.) 2*s.* 6*d.* net.*

Haviland, Maud D. (Mrs. H. H. Brindley). Forest, Steppe and Tundra : Studies in Animal Environment. Demy 8vo. Pp. viii+218+8 plates. (Cambridge : At the University Press, 1926.) 12*s.* 6*d.* net.*

Henderson, Daniel. Children of the Tide : a Book of Beach and Ocean Wonders. Cr. 8vo. Pp. xv+176. (London and New York : D. Appleton and Co., 1926.) 5*s.* net.*

Hudson, W. H. Green Mansions : a Romance of the Tropical Forest. Illustrated edition. Demy 8vo. Pp. 325+12 plates. (London : Gerald Duckworth and Co., Ltd., 1926.) 15*s.* net.*

James, Will. Smoky, the Cow Horse. Pott 4to. Pp. xi+310. (New York and London : Charles Scribner's Sons, 1926.) 10*s.* 6*d.* net.

Joubin, L. Les métamorphoses des animaux marins. (Bibliothèque de Philosophie scientifique.) Cr. 8vo. Pp. 272. (Paris : Ernest Flammarion, 1926.) 14 francs.

Le Souef, A. S., and **Burrell, Harry.** The Wild Animals of Australasia : embracing the Mammals of New Guinea and the nearer Pacific Islands. With a Chapter on the Bats of Australia and New Guinea, by Ellis Le G. Troughton. Med. 8vo. Pp. 388+61 plates. (London, Calcutta and Sydney : George G. Harrap and Co., Ltd., 1926.) 25*s.* net.*

Linsbauer, K., Herausgegeben von. Handbuch der Pflanzenanatomie. Abteilung 1, Teil 2 : Histologie. Band 5 : Die Bewegungsgewerbe. Von Hermann von Guttenberg. Sup. Roy. 8vo. Pp. v+289. (Berlin : Gebruder Borntraeger, 1926.) 25.50 gold marks.*

Litzelmann, Erwin. Unsere heimische Tierwelt in Alltag, bei Spiel und Tod. (Der Weg zur Natur : Gemeinverständliche Darstellungen aus dem Reich der Natur.) Cr. 8vo. Pp. xi+168. (Freiburg im Breisgau : Herder und Co., G.m.b.H., 1926.) 3.40 gold marks.*

Lydekker, Richard. The Game Animals of Africa. Second edition, revised by J. C. Dollman. Sup. Roy. 8vo. Pp. xiv+483. (London : Rowland Ward, Ltd., 1926.) 30*s.* net.

Margold, Charles W. Sex Freedom and Social Control. Cr. 8vo. (Cambridge : At the University Press, 1926.) 10*s.* net.

Newman, Isidora. Fairy Flowers : Nature Legends of Fact and Fantasy. Demy 4to. Pp. ix+160. (London : Oxford University Press, 1926.) 10*s.* 6*d.* net.

Plaskitt, F. J. W. Microscopic Fresh Water Life. Demy 8vo. Pp. xi+278+14 plates. (London : Chapman and Hall, Ltd., 1926.) 13*s.* 6*d.* net.*

Réaumur, René Antoine Ferchault de. The Natural History of Ants. From an Unpublished Manuscript in the Archives of the Academy of Sciences of Paris. Translated and annotated by William Morton Wheeler. Roy. 8vo. Pp. xvii+280+4 plates. (New York and London : Alfred A. Knopf, 1926.) 25*s.* net.*

Retterer, Éd. De la durée des êtres vivants. 8vo. Pp. 188. (Paris : Gaston Doin et Cie, 1926.) 10 francs.

Rouhier, Alexandre. La plante qui fait les yeux émerveillés : le Peyotl (*Echinocactus* Williamsii). Roy. 8vo. Pp. 384. (Paris : Gaston Doin et Cie, 1926.) 35 francs.

Salt, George, and **Myers, J. G.** 1 : Report on Sugar-Cane Borers at Soledad, Cuba, by George Salt ; and 2 : Dry-Season Studies of Cane Homoptera at Soledad, Cuba, with a List of the Coccids of the District, by J. G. Myers. (Contributions from the Harvard Institute for Tropical Biology and Medicine, 3.) Imp. 8vo. Pp. 110+4 plates. (Cambridge, Mass. : Harvard University Press ; London : Oxford University Press, 1926.) 11*s.* net.*

Schiffner, Victor. Der Neo-Darwinismus : metaphysisch begrundet durch das Allgemeine Zweckmassigkeitsgesetz. Roy. 8vo. Pp. ii+50. (Jena : Gustav Fischer, 1926.) 2 gold marks.*

Timms, Betty. The Little Grey Men of the Moor. (The Little Story Books.) Roy. 16mo. Pp. 96. (London, Calcutta and Sydney : George G. Harrap and Co., Ltd., 1926.) 1*s.**

Vahey, John Haslette. The New Zoo. Fcap. 4to. Pp. 63. (London : Faber and Gwyer, Ltd., 1926.) 5*s.* net.

Verne, J. Les pigments dans l'organisme animal : chimie, morphologie, physiologie, éthologie. (Encyclopédie scientifique : Bibliothèque de biologie générale.) Gl. 8vo. Pp. xv+608. (Paris : Gaston Doin et Cie, 1926.) 28 francs.*

Watson, W. Elementary Botany : an Introduction to the Study of Plant Life. Cr. 8vo. Pp. viii+368. (London : Edward Arnold and Co., 1926.) 6*s.* 6*d.**

Wheeler, William Morton. Les sociétés d'insectes : leur origine, leur évolution. (Encyclopédie scientifique : Bibliothèque de biologie générale.) Gl. 8vo. Pp. xii+468. (Paris : Gaston Doin et Cie, 1926.) 25.20 francs.*

Horticulture : Forestry : Agriculture

Boone. Le bananier. Pp. 346. (Paris : Société d'éditions géographiques, maritimes et coloniales, 1926.) 50 francs.

Bruce, A. B., and **Hunter, H.** Crop and Stock Improvement. (*The Farmer and Stock-Breeder* Manuals.) Cr. 8vo. Pp. 119. (London : Ernest Benn, Ltd., 1926.) 5*s.* net.*

Caillas, Alin. L'Engraissement des volailles. (Toute la basse-cour, Fascicule 12.) 8vo. Pp. 14. (Paris : Librairie spéciale agricole, 1926.) 1.50 francs.

Cane, Percy S., Text by. Modern Gardens : British and Foreign. Edited by C. Geoffrey Holme and Shirley B. Wainwright. Demy 4to. Pp. 24+142 plates. (London : *The Studio*, Ltd., 1926.) 10*s.* 6*d.* net.

Deumié. Constitution et organisation modernes des vergers de pêchers. 8vo. Pp. 48. (Paris : Librairie spéciale agricole, 1926.) 5.40 francs.

Engledow, F. L., and **Yule, G. Udny.** The Principles and Practice of Yield Trials. Roy. 8vo. Pp. 78. (London : The Empire Cotton Growing Corporation, 1926.) 2*s.**

Faure, Gabriel. The Gardens of Rome. Translated by Frank Kemp. Water-colours by Pierre Vignal. Roy. 4to. Pp. 100. (London : The Medici Society, 1926.) 30*s.* net.

Gibson, J. L. Carnations for Amateurs. Demy 8vo. Pp. 127. (London : W. H. and L. Collingridge, 1926.) 5*s.* net.

Hamer, A. Handel. Wild Flowers of The Cape : a Floral Year. Cr. 4to. Pp. viii+104+12 plates. (Cape Town : Maskew Miller, Ltd. ; Oxford : Basil Blackwell, Ltd., 1926.) 21*s.* net.*

Liversage, V. Economics of Production of Grade A (Tuberculin Tested) Milk. (Publications of the Agricultural Economics Research Institute at Oxford.) Demy 8vo. Pp. 58. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 2*s* net.

Mawson, Thomas H., assisted by **Mawson, E. Prentice.** The Art and Craft of Garden Making. Fifth edition. Sup Roy. 4to. Pp. xii+440. (London: B. T. Batsford, Ltd., 1926.) 75*s* net.

Neuville, H. Technologie du thé. Deuxième édition. Pp. 304. (Paris: Société d'éditions géographiques, maritimes et coloniales, 1926.) 50 francs.

Robinson, William. The English Flower Garden and Home Grounds of Hardy Trees and Flowers Only. Fourteenth edition, revised. Roy. 8vo. Pp. xii+710. (London: John Murray, 1926.) 24*s*. net.

Scott, J. W. Robertson. The Dying Peasant: and the Future of his Sons. Demy 8vo Pp xvi+282. (London: Williams and Norgate, Ltd., 1926) 10*s* 6*d*. net.

Sessions, William H. The Selling Side of Agriculture. Demy 8vo. Pp. 70. (London: Simpkin, Marshall and Co., Ltd., 1926.) 2*s*. net.

Thomson, G. Sutherland. Testing Milk and its Products. Cr. 8vo. Pp. viii+83 (London: Crosby Lockwood and Son, 1926.) 4*s*. net.

Watson, James A. Scott, and others The Cattle-Breeder's Handbook. (*The Farmer and Stock-Breeder* Manuals.) Cr. 8vo. Pp. 144 (London: Ernest Benn, Ltd., 1926.) 6*s*. net.

Woodward, Marcus. The New Book of Trees. Illustrated with Wood Engravings by C. Dillon McGurk. Demy 8vo. Pp. 310. (London: A M. Philpot, Ltd., 1926) 12*s*. 6*d*. net.*

Anatomy: Physiology

Bayliss, William Maddock. Grundriss der allgemeinen Physiologie. Nach der dritten, englischen Auflage ins Deutsche übertragen von L. Maass und E. J. Lesser. Pp xvi+951. (Berlin: Julius Springer, 1926.) 39 gold marks.

Grimmer, W. Lehrbuch der Chemie und Physiologie der Milch: für Human- und Veterinärmediziner, Nahrungsmittelchemiker, Land- und Milchwirte sowie Studierende. Zweite neubearbeitete Auflage. Nebst einer Einleitung: Bau und Funktion der Milchdrüse, von Dr. Zietzschmann. Pp. 326. (Berlin: Paul Parey, 1926.) 25 gold marks.

Jordan, Harvey E., and **Kindred, James E.** A Textbook of Embryology. Roy 8vo. (New York and London: D Appleton and Co., 1926.) 25*s*. net.

Kingsley, J. S. Comparative Anatomy of Vertebrates. Third edition. Pp. 470. (Philadelphia and London: P. Blakiston's Sons and Co., 1926.)

Macleod, J. J. R., assisted by Roy G Pearce, A. C. Redfield, N. B. Taylor, and J. M. D. Olmsted, and by others. Physiology and Biochemistry in Modern Medicine. Fifth edition. Roy. 8vo. Pp. xxxii+1054+9 plates. (London: Henry Kimpton, 1926.) 42*s* net.*

Miller, E. Morris. Brain Capacity and Intelligence: including a Comparison of Brain Measurements of Tasmanian and Victorian School Boys, together with a Comparison of the Variations of Cubic Capacity of Brain at Normal and Sub-Normal Levels of Mental Development (Australasian Association of Psychology and Philosophy, Monograph Series, No. 4.) Demy 8vo. Pp. 79. (Sydney, N.S.W.: Australasian Association of Psychology and Philosophy; Hobart, Tasmania: John Vail; London: Macmillan and Co., Ltd., 1926.) 2*s*. 6*d*. net.

Rout, Ettie A. (Mrs F. A. Hornibrook). Native Diet: with numerous Practical Recipes. Demy 8vo. Pp. ix+140+10 plates. (London: William Heinemann (Medical Books), Ltd, 1926.) 6*s*. net.*

Toldt, Carl, assisted by **Rosa, Alois Dalla.** An Atlas of Human Anatomy: for Students and Physicians. Adapted to English and American and International Terminology by M. Eden Paul. Revised edition. In 2 vols. Demy 4to. Vol 1. First Section, A: The Regions of the Human Body; B: Osteology. Second Section, C: Arthrology. Third Section, D: Myology. Pp. iv+400. Vol 2. Fourth Section, E: Splanchnology. Fifth Section, F: Angeiology Sixth Section, G: Neurology; H: The Organs of the Senses. Pp. ii+401-985 (New York: The Macmillan Co., 1926) 42*s*. net.*

Anthropology: Archæology

An Ignorant Student. Origins in Place Names. 50: Laws. Demy 8vo Pp. 7+2 plates. (London: Privately printed at the Chiswick Press, 1926.) 1*s*. 6*d*.*

Bertholet, Alfred. A History of Hebrew Civilization. Translated by the Rev. A. K. Dallas. Med. 8vo. Pp. 400. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1926) 12*s* 6*d*. net.

Bradley, R. N. Racial Origins of English Character. With an Appendix on Language. Cr. 8vo. Pp. 192. (London: George Allen and Unwin, Ltd, 1926) 6*s*. net*

Breasted, James Henry. The Conquest of Civilization. Med. 8vo Pp. xxv+717+50 plates+17 maps (New York and London: Harper and Bros., 1926.) 16*s*. net.*

Browne, Edward Granville. A Year among the Persians: Impressions as to the Life, Character and Thought of the People of Persia, received during Twelve Months' Residence in that Country in the Years 1887–1888. With a Memoir by Sir E. Denison Ross. New edition. Roy. 8vo. Pp xxiii+650. (Cambridge: At the University Press, 1926.) 25*s*. net.*

Burkitt, M. C. Our Early Ancestors: an Introductory Study of Mesolithic, Neolithic and Copper Age Cultures in Europe and Adjacent Regions. Cr. 8vo. Pp. xii+243. (Cambridge: At the University Press, 1926) 7*s*. 6*d*. net.*

Casson, Stanley. Macedonia, Thrace and Illyria: their Relations to Greece from the Earliest Times down to the Time of Philip, Son of Amyntas. Med. 8vo. Pp. xxi+357+106 plates+19 maps. (London: Oxford University Press, 1926.) 21*s*. net.

Contenau, G. La civilisation phénicienne. 8vo. Pp. 396. (Paris: Payot et Cie, 1926.) 25 francs.

Crane, Leo. Indians of the Enchanted Desert. Roy. 8vo. Pp. x+364. (London: Leonard Parsons, Ltd., 1926.) 21*s*. net.

Crump, C. G., and **Jacob, E. F.** The Legacy of the Middle Ages. Cr. 8vo. Pp xii+549+42 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 10*s*. net.

Hamilton, M. A. Greece Illustrated from the Country, the Monuments and the Authors. Cr. 8vo. Pp. xx+250. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 2*s*. 6*d*.

Hose, Charles. Natural Man: a Record from Borneo. Sup. Roy. 8vo. Pp. xvi+284+60 plates (London: Macmillan and Co., Ltd., 1926.) 30*s*. net.*

Joyce, Thomas Athol. Maya and Mexican Art. Roy. 8vo Pp. 199. (London: *The Studio*, Ltd, 1926.) 10*s*. 6*d*. net.

Karsten, Rafael. The Civilization of the South American Indians: with Special Reference to Magic and Religion. (The History of Civilization Series.) Roy. 8vo. Pp. xxxii+540 (London: Kegan Paul and Co., Ltd.; New York: Alfred A Knopf, 1926.) 25*s*. net.*

Lucas, A. Ancient Egyptian Materials. Cr. 8vo. Pp. viii+242. (London: Edward Arnold and Co., 1926.) 7*s*. 6*d*. net.*

Major, Albany F., and **Burrow, Edward J.** The Mystery of Wansdyke: the Record of Research and Investigation in the Field. Edition limited to 700 copies. Demy 4to Pp. 208. (London and Cheltenham: E J. Burrow and Co., Ltd., 1926.) 25*s*. net.

Marlowe, Christopher. Legends of the Fenland People. Ex. Cr. 8vo. Pp. xiii+240. (London: Cecil Palmer, 1926.) 7*s*. 6*d*. net.

Parsons, Elsie Clews. The Pueblo of Jemez. (Published for the Department of Archæology, Phillips Academy, Andover, Mass.) Ex. Cr. 4to. Pp. xiv+144. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1926) 32*s*. 6*d*. net.

Poland, F., Reisinger, E., and **Wagner, R.** The Culture of Ancient Greece and Rome: a General Sketch. Authorised translation from the second German edition (1924) by John Henry Freese. Roy. 8vo. Pp. 335 (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1926.) 21*s*. net.

Quennell, Marjorie, and **Quennell, C. H. B.,** Written and Illustrated by. Everyday Life in Anglo-Saxon, Viking and Norman Times. (The Everyday Life Series, 4.) Ex. Cr. 8vo. Pp. vi + 115. (London: B. T. Batsford, 1926.) 5*s*. net

Robinson, James Harvey. The Ordeal of Civilization: a Sketch of the Development and World-Wide Diffusion of our Present-Day Institutions and Ideas. Med. 8vo. Pp. xii + 769 + 59 plates + 12 maps. (New York and London: Harper and Bros., 1926.) 16*s* net.*

Spence, Lewis. The History of Atlantis. Med 8vo. Pp. 256. (London: W. Rider and Son, Ltd., 1926.) 10*s* 6*d*. net.

Thebes, the Glory of a Great Past: a Little Book for Everybody. Oblong Med. 4to. Pp. 26 + 22 plates. (London: George Allen and Unwin, Ltd., 1926.) 3*s*. 6*d* net.

Watson, William J. The History of the Celtic Place-names of Scotland: the Rhind Lectures on Archæology (expanded), 1916. Med. 8vo. Pp. 578. (Edinburgh and London: W. Blackwood and Sons, 1926.) 30*s*. net.

Wells, H. G. The Outline of History: a Plain History of Life and Mankind. Revised edition. 2 vols. Demy 4to. Vol. 1. Pp. 384. Vol. 2. Pp. 390. (London: Cassell and Co., Ltd., 1926.) 18*s* net each.

Westermarck, Edward. A Short History of Marriage. Demy 8vo. Pp. xii + 326. (London: Macmillan and Co., Ltd., 1926.) 10*s*. 6*d*. net

Willard, T. A., Set Down and Illustrated from Photographs by. The City of the Sacred Well: being a Narrative of the Discoveries and Excavations of Edward Herbert Thompson in the Ancient City of Chi-Chenitza; with some Discourse on the Culture and Development of the Mayan Civilization as revealed by their Art and Architecture. Pott 4to. Pp. xvi + 293. (London: William Heinemann, Ltd., 1926.) 15*s*. net.

Philosophy: Psychology

Baker, A. E. Psychoanalysis Explained and Criticised. Gl. 8vo. Pp. 183. (London: The Sheldon Press; New York and Toronto: The Macmillan Co., 1926.) Paper, 2*s* 6*d*. net; cloth, 3*s* 6*d* net.*

Barrett, Sir William, and **Besterman, Theodore.** The Divining Rod: an Experimental and Psychological Investigation. Med. 8vo. Pp. xxiii + 336 + 12 plates. (London: Methuen and Co., Ltd., 1926.) 18*s*. net.*

Benrubi, Isaac. Contemporary Thought of France. Translated by Ernest B. Dicker. (Library of Contemporary Thought.) Ex. Cr. 8vo. Pp. 214. (London: Williams and Norgate, Ltd., 1926.) 5*s*. net.

Bentley, Arthur F. Relativity in Man and Society. Demy 8vo. Pp. 383. (New York and London: G. P. Putnam's Sons, Ltd., 1926.) 10*s*. 6*d*. net.

Berkeley, G. Philosophisches Tagebuch. (Philosophischen Bibliothek, 196.) Übersetzt, eingeleitet und mit Anmerkungen und Registern versehen von A. Hecht. 8vo. Pp. xvii + 173. (Leipzig: Felix Meiner, 1926.) 7 gold marks.

Boutroux, É. La nature et l'esprit. (Bibliothèque d'histoire de la philosophie.) 8vo. Pp. 274. (Paris: J. Vrin, 1926.) 20 francs.

Broad, C. D. The Philosophy of Francis Bacon: an Address delivered at Cambridge on the Occasion of the Bacon Tercentenary, 5 October 1926. Cr. 8vo. Pp. vi + 68. (Cambridge: At the University Press, 1926.) 2*s*. 6*d*. net.*

Brown, William. Mind and Personality: an Essay in Psychology and Philosophy. Med. 8vo. Pp. x + 344. (London: University of London Press, Ltd., 1926.) 12*s*. 6*d*. net.*

Buckle, Gerard Fort. The Mind and the Film: a Treatise on the Psychological Factors in the Film. Cr. 8vo. Pp. xiv + 119. (London: George Routledge and Sons, Ltd., 1926.) 5*s* net.*

Campbell, Charles Macfie. Delusion and Belief. Cr. 8vo. Pp. v + 79. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1926.) 6*s* 6*d*. net.*

Carncross, Horace. The Escape from the Primitive. Demy 8vo. Pp. xiii + 348. (New York and London: Charles Scribner's Sons, 1926.) 10*s*. 6*d*. net.

Catlin, G. E. G. The Science and Method of Politics. Med. 8vo. Pp. xii + 360. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1927.) 12*s*. 6*d* net.*

Collins, Mary, and **Drever, James.** A First Laboratory Guide in Psychology. Cr. 8vo. Pp. viii + 108. (London: Methuen and Co., Ltd., 1926.) 5*s* net.

Crumley, Thomas. Logic: Deductive and Inductive. Ex. Cr. 8vo. Pp. 442. (New York: The Macmillan Co., 1926.) 10*s* net.

Eeman, L. E. The Sub-conscious made Conscious: How to Master your Mind, Direct your Energy, Develop your Body. Gl. 8vo. Pp. 38. (London: Simpkin, Marshall and Co., Ltd., 1926.) 1*s*. net.

Fite, Warner. An Adventure in Moral Philosophy. Demy 8vo. Pp. x + 273. (London: Methuen and Co., Ltd., 1926.) 10*s*. 6*d*. net.

Goodenough, Florence L. Measurement of Intelligence by Drawings. Pp. xi + 177. (Yonkers, N.Y.: World Book Co., 1926.)

Grasset, H. La science de l'homme. Gl. 8vo. Pp. 148. (Paris: Amédée Legrand, 1926.) 8 francs.

Gulat-Wellenburg, W. v., Klinckowstroem, Carl v., und **Rosenbusch, Hans.** Der physikalische Mediumismus. (Der Okkultismus in Urkunden.) Imp. 8vo. Pp. xiv + 494 + 15 Tafeln. (Berlin: Verlag Ullstein, 1925.)*

Haldane, Viscount. The Path to Reality: being the Gifford Lectures delivered in the University of St. Andrews, 1902–1904. New edition in one volume. Demy 8vo. Pp. xxx + 600. (London: John Murray, 1926.) 16*s*. net.*

Hincks, Elizabeth M. Disability in Reading and its Relation to Personality. (Harvard Monographs in Education, Series 1: Studies in Educational Psychology and Educational Measurement, Vol. 2, No. 2.) Sup. Roy. 8vo. Pp. iv + 92. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1926.) 6*s*. net.

Hollingworth, Leta S. Gifted Children: their Nature and Nurture. (Experimental Education Series.) Ex. Cr. 8vo. Pp. xxiv + 374. (New York: The Macmillan Co., 1926.) 8*s*. 6*d*.

Joad, C. E. M., and **Strachey, John.** After-Dinner Philosophy. With an Introductory Talk on the Need for Philosophy, by C. E. M. Joad. Cr. 8vo. Pp. x + 137. (London: George Routledge and Sons, Ltd., 1926.) 3*s*. 6*d* net.*

Luc, Albert. Elysia: a New Philosophy of Happiness. Cr. 8vo. Pp. 88. (London: Watts and Co., 1926.) 3*s* 6*d* net.

Mac-Auliffe, Léon. Les tempéraments: essai de synthèse. (La Pensée contemporaine.) Cr. 8vo. Pp. 290. (Paris: Nouvelle Revue française, 1926.) 13.50 francs.

Mager, Henri. Les sourciers et leurs procédés. Troisième édition complètement refondue. Ex. Cr. 8vo. Pp. xx + 352. (Paris: Libr. Dunod, 1926.) 30 francs.

Medical Research Council and **Department of Scientific and Industrial Research.** The Relation between Illumination and Efficiency in Fine Work (Typesetting by Hand). By H. C. Weston and A. K. Taylor. Joint Report of the Industrial Fatigue Research Board and the Illumination Research Committee. Roy. 8vo. Pp. v + 12. (London: H.M. Stationery Office, 1926.) 6*d*. net.*

Meischke-Smith, W. The Sloping Line. Cr. 8vo. Pp. 127. (London: Thornton Butterworth, Ltd., 1926.) 5*s*. net.

Miller, E. Types of Mind and Body. (Psyche Miniatures: Medical Series, No. 4.) Pott 8vo. Pp. 132 + 5 plates. (London: Kegan Paul and Co., Ltd., 1926.) 2*s* 6*d*. net.*

Namer, É. Les aspects de Dieu dans la philosophie de Giordano Bruno. (Collection Historique des Grands Philosophes.) 8vo. Pp. 160. (Paris: Félix Alcan, 1926.) 15 francs.

Plaut, Felix. Paralysestudien bei Negern und Indianern: ein Beitrag zur vergleichenden Psychiatrie. Pp. viii + 98. (Berlin: Julius Springer, 1926.) 9.60 gold marks.

Pressey, Sidney L., and Pressey, Luella Cole. Mental Abnormality and Deficiency: an Introduction to the Study of Problems of Mental Health. Demy 8vo. Pp. xii+356. (London: George Allen and Unwin, Ltd., 1926.) 10s. 6d. net.

Rignano, Eugenio. Man not a Machine: a Study of the Finalistic Aspects of Life. (Psyche Miniatures: General Series, No. 3.) Pott 8vo. Pp. 77. (London: Kegan Paul and Co., Ltd., 1926.) 2s. 6d. net.*

Rivers, W. H. R. Psychology and Ethnology. (International Library of Psychology, Philosophy and Scientific Method.) Roy. 8vo. Pp. xxviii+324. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1926.) 15s. net.*

Robinson, Edward Stevens. Practical Psychology: Human Nature in Everyday Life. Ex. Cr. 8vo. Pp. xii+479. (New York: The Macmillan Co., 1926.) 7s. 6d.*

Rodier, G. Études de philosophie grecque. (Bibliothèque d'histoire de la philosophie.) 8vo. Pp. viii+356. (Paris: J. Vrin, 1926.) 30 francs.

Ryan, W. P. Eden and Evolution: a Record of Evenings in Avalon. Cr. 8vo. Pp. 158. (London: Noel Douglas, 1926.) 5s. net.

Santayana, George. Winds of Doctrine: Studies in Contemporary Opinion. Second edition. 8vo. Pp. vii+215. (London: J. M. Dent and Sons, Ltd., 1926.) 6s. net.

Snow, A. J. Matter and Gravity in Newton's Physical Philosophy: a Study in the Natural Philosophy of Newton's Time. Cr. 8vo. Pp. 256. (London: Oxford University Press, 1926.) 7s. 6d. net.*

Streeter, Rev. Canon Burnett Hillman. Reality: a New Correlation of Science and Religion. Demy 8vo. Pp. xiii+350. (London: Macmillan and Co., Ltd., 1926.) 8s. 6d. net.*

Taylor, A. E. Plato: the Man and his Work. Demy 8vo. Pp. xi+522. (London: Methuen and Co., Ltd., 1926.) 21s. net.

Vaissière, De la. Elements of Experimental Psychology. Authorised translation from the fifth French edition, by the Rev. S. A. Raemers. Demy 8vo. Pp. lvi+438. (St. Louis, Mo., and London: Herder Book Co., 1926.) 12s. net.

Ward, James, the late. Psychology applied to Education: a Series of Lectures on the Theory and Practice of Education. Edited by G. Dawes Hicks. (The Cambridge Psychological Library.) Roy. 8vo. Pp. xiii+188. (Cambridge: At the University Press, 1926.) 10s. 6d. net.*

Waters, R. C. A Practice of Psychology. Cr. 8vo. Pp. 74. (London: The Author, 12 Collingham Place, S.W. 5, 1926.) 2s. net.

Wentworth, Mary M. Individual Differences in the Intelligence of School Children. (Harvard Studies in Education, Vol. 7.) Med. 8vo. Pp. x+162. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1926.) 8s. 6d. net.

Whitehead, Alfred North. Religion in the Making: Lowell Lectures, 1926. Cr. 8vo. Pp. 160. (Cambridge: At the University Press, 1926.) 6s. net.*

Whittaker, Thomas. The Metaphysics of Evolution: with other Essays (New and Republished). Demy 8vo. Pp. viii+480. (London: Williams and Norgate, Ltd., 1926.) 16s. net.*

Wieman, Henry Nelson. Religious Experience and Scientific Method. Cr. 8vo. Pp. 387. (New York: The Macmillan Co., 1926.) 10s. net.

Wildermuth, Hans. Seele und Seelenkrankheit: eine Einführung in die Grundbegriffe. Pp. iv+56. (Berlin: Julius Springer, 1926.) 2.70 gold marks.

Wilson, John Cook. Statement and Inference: with other Philosophical Papers. Edited from the MSS., etc., by A. S. L. Farquharson. With a portrait, memoir and selected correspondence. In two volumes. Med. 8vo. Vol. 1. Pp. clxiv+409. Vol. 2. Pp. vi+410-901. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 31s. 6d. net.

Wolf, A. Essentials of Logic. Cr. 8vo. Pp. 146. (London: George Allen and Unwin, Ltd., 1926.) 5s. 6d. net.*

Woolley, Helen Thompson. An Experimental Study of Children: at Work and in School between the Ages of Fourteen and Eighteen Years. Sup. Roy. 8vo. Pp. xv+762. (New York: The Macmillan Co., 1926.) 17s. net.

Miscellany

Barnett, H. T. Gramophone Tips: those Things every Gramophone User ought to know. 1927 edition. Cr. 8vo. Pp. 46. (Old Portsmouth: H. T. Barnett, 123 High Street, 1926.) 1s.*

Blum, André S. A Short History of Art: from Prehistoric Times to the Present Day; for the Use of Students and General Readers. Translated from the French. Edited and enlarged by R. R. Tatlock. Med. 8vo. Pp. xiv+291+128 plates. (London: B. T. Batsford, Ltd., 1926.) 21s. net.

Bragg, Sir William. Old Trades and New Knowledge: Six Lectures delivered before a 'Juvenile Auditory' at the Royal Institution, Christmas 1925. Cr. 8vo. Pp. xii+266+42 plates. (London: G. Bell and Sons, Ltd., 1926.) 8s. net.*

Briggs, Thomas H. Curriculum Problems. (Modern Teachers' Series.) Cr. 8vo. Pp. xiv+138. (New York: The Macmillan Co., 1926.) 4s. 6d. net.

Duncanson, David B. Experimental Science for Schools. Parts 4-5. Cr. 8vo. Pp. viii+259-596. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1926.) 4s.*

Haldane, Charlotte. Man's World. Cr. 8vo. Pp. xi+299. (London: Chatto and Windus, 1926.) 7s. 6d. net.*

Hartley, Olga, and Leyel, Mrs. C. F. Lucullus: the Food of the Future. (To-day and To-morrow Series.) Pott 8vo. Pp. 77. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1926.) 2s. 6d. net.*

Huntington, Ellsworth. The Pulse of Progress: including a Sketch of Jewish History. With a Chapter on Climatic Changes by G. C. Simpson. Med. 8vo. Pp. x+341. (New York and London: Charles Scribner's Sons, 1926.) 21s. net.*

Huxley, Julian. Essays in Popular Science. Demy 8vo. Pp. xii+307+6 plates. (London: Chatto and Windus, 1926.) 16s. net.*

Jones, B. Dennis. A Varsity Career. Cr. 8vo. Pp. x+89. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1926.) 3s. 6d. net.*

Lewis, Gilbert N. The Anatomy of Science. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Ex. Cr. 8vo. Pp. x+221. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1926.) 14s. net.*

Lindsay, Kenneth. Social Progress and Educational Work: being a Study of the 'Free-Place' and Scholarship System. (Studies in Economics and Political Science, No. 88.) Demy 8vo. Pp. vii+215. (London: George Routledge and Sons, Ltd., 1926.) 7s. 6d. net.*

Phonetic Transcription and Transliteration. Proposals of the Copenhagen Conference, April 1925. Demy 8vo. Pp. 32. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 1s. 6d. net.*

Sayers, W. C. Berwick. A Manual of Classification: for Librarians and Bibliographers. Demy 8vo. Pp. 345. (London: Grafton and Co., 1926.) 30s. net.

Sélincourt, Basil de. Pomona: or, The Future of English. (To-day and To-morrow Series.) Pott 8vo. Pp. 94. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1926.) 2s. 6d. net.*

Smith, W. Rose. Discoveries, 1917 to 1926, in Philosophical and Scientific Research. Demy 8vo. Pp. 90. (Chesham Bois, Bucks: The Author, Deemount, Long Park, 1926.)

Stokes, Adrian. Sunrise in the West: a Modern Interpretation of Past and Present. Cr. 8vo. Pp. xvi+168. (London: Kegan Paul and Co., Ltd., 1926.) 7s. 6d. net.*

Sullivan, J. W. N. Aspects of Science. Second Series. Med. 8vo. Pp. vii+238. (London and Glasgow: W. Collins, Sons and Co., 1926.) 12s. 6d. net.

POCKET
CALCULATOR

"accuracy is about four times that of the ordinary ten-inch slide rule . . ."

writes a B.Sc., from Canada. This unsolicited letter goes on to state : "My estimate is that I have made about fifty thousand calculations with your product. About twenty-two thousand hydraulic calculations have been made in the last month with a probable error of any one calculation not greater than 5/100 of 1%."

Otis King Model K for multiplication, division, proportion, percentages. Model L gives, in addition, all powers and roots—fractional or otherwise—of all numbers without limit.

Price, packed in leather case, 21/- (special Black Cursor 1/6 extra), post free within U.K.

Write for illustrated and fully descriptive folder.

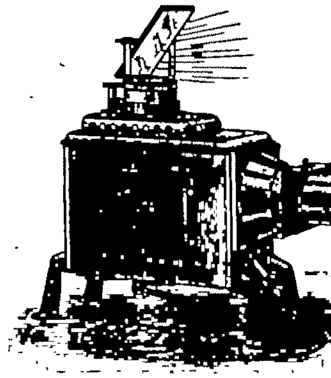
CARBIC LIMITED

(Dept. N), 51 Holborn Viaduct, London, E.C.1.

Agents in most Dominions and Foreign Countries.

JANUS EPIDIASCOPE

(Patented in Germany, England, and in other countries.)



With 500-Watt Incandescent Lamp
for the projection of

LANTERN SLIDES AND PAPER PICTURES
(postcards, book-illustrations, or any other
opaque articles)

VERY EASY TO USE

Gives brilliant pictures up to 8 × 8 feet

The best Lantern
FOR SCHOOLS, UNIVERSITIES, LECTURERS, ETC.

ED. LIESEGANG, DÜSSELDORF (Germany)

Founded 1854. Postbox 124.

FROM CONSTABLE'S LIST

NOMOGENESIS or EVOLUTION DETERMINED BY LAW. L. S. BERG, D.Sc. With an Introduction by D'ARCY WENTWORTH THOMPSON, F.R.S. Demy 8vo. Illustrated. 28s. net.

FROM A REVIEW IN NATURE

"This volume represents the mature thought of an accomplished ichthyologist and traveller who speaks from the point of view of a naturalist and field observer and marshals, in the first nine chapters, all the difficulties that have arisen through field observation in the original concept of Darwinism. . . . A thoughtful and, in large part, original contribution to the newer modern aspect of the evolution theory."—*Oct.* 30, 1926.

WIRELESS PICTURES AND TELEVISION. An Account of the Apparatus used and Experiments carried out for the Transmission of Photographs by Telegraphy and of Television, which will appeal alike to the highly technical and the lay reader. T. THORNE BAKER, F.C.S., F.R.P.S. Crown 8vo. Illustrated. 6s. 6d. net.

FIELD ASTRONOMY. For Engineers and Surveyors. DAVID CLARK, M.A., B.Sc., M.Inst.C.E. Crown 8vo. Illustrated. A manual for University and private students of surveying and geodesy. 10s. 6d. net.

PRINCIPLES OF HUMAN GEOGRAPHY. P. VIDAL DE LA BLACHE. Edited by EMMANUEL DE MARTONNE. Demy 8vo. Illustrated. 18s. net.

PHOTOMETRY. JOHN W. T. WALSH, M.A., M.Sc., A.M.I.E.E., F.Inst.P. Royal 8vo. Illustrated. 40s. net.

SYSTEMATIC ORGANIC CHEMISTRY. A complete laboratory guide to the preparations and estimations of Organic Chemistry. W. M. CUMMING, D.Sc., F.I.C.; I. V. HOPPER, Ph.D., B.Sc., A.R.C.Sc.I., F.I.C.; and T. S. WHEELER, Ph.D., B.Sc., F.R.C.Sc.I., F.I.C. Demy 8vo. Illustrated. 25s. net.

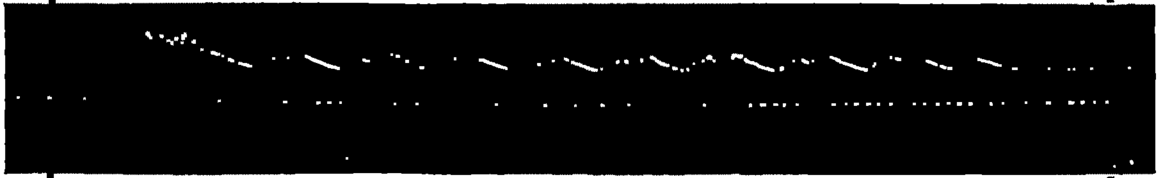
THE STATES OF AGGREGATION: The Changes in the State of Matter in their Dependence upon Pressure and Temperature. GUSTAV TAMMANN, Director of the Institute of Physical Chemistry at the University of Göttingen. Authorised translation from the 2nd German Edition by R. F. MEHL, Ph.D. Demy 8vo. 308 pages. Illustrated. 24s. net.

INTRODUCTION TO THEORETICAL PHYSICS. ARTHUR HAAS, Ph.D. Translated by T. VERSCHOYLE. 2 volumes. Demy 8vo. Illustrated. Vol. I., 21s. net. Vol. II., 21s. net.

10 & 12 ORANGE ST., LONDON, W.C.2

STRESSES IN STRUCTURES

under varying loads



Magnification, approx. 70.

This record, taken with the CAMBRIDGE STRESS RECORDER, shows the stresses in a bridge girder during the pass'ng of a railway train. The diagrams are produced by the action of a moving stylus upon a celluloid film. The records are permanent, and are immediately available for observation and examination.

CAMBRIDGE
INSTRUMENT CO LTD

Works: London & Cambridge
Head Office & Showrooms: 45, GROSVENOR PLACE
LONDON, S.W.1

AMERICAN COMPANY:
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

FULL PARTICULARS ARE GIVEN IN LIST NO. 159-N

GAS SUPPLIES FOR LABORATORIES.

Mansfield Oil-Gas apparatus places in the hands of scientists whose laboratories are not supplied with town's gas, a means of securing a supply of gas which gives a perfect oxidising or reducing flame.

This plant has been supplied during the past 50 years to many of the important laboratories in the British Empire.

Write for particulars to
MANSFIELD & SONS, LTD.,
23 HAMILTON SQUARE, BIRKENHEAD.

OXYGEN
And other Gases.

The British Oxygen Co. have works for the production of Oxygen, Nitrogen, Carbonic Acid, Nitrous Oxide, Hydrogen, and Argon in all chief industrial centres. The Company's Plants are capable of an aggregate output of **about four million cubic feet per day.**

Special Terms quoted to the Trade.

Catalogue and full particulars on application to the Head Offices of the Company—

THE BRITISH OXYGEN CO., Ltd.,
ANGEL ROAD, UPPER EDMONTON,
LONDON, N.18.

SIR HOWARD GRUBB, PARSONS & COMPANY

OPTICAL WORKS
NEWCASTLE-ON-TYNE

STANDARD PRODUCTS

Astronomical Telescopes
Chronographs
Spectrographs
Revolving Domes
Rising Floors

Star Plate Measuring Machines
Transit House Roofs
Submarine Periscopes, etc.
Object Glasses, Prisms, etc.
COMPLETE OBSERVATORY EQUIPMENTS

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH

panied by a decrease of the velocity of the two opposite transformations, until finally *they are stopped completely*. Now it will be clear that the theory is also capable of explaining the phenomenon noted already in the solid state of some substances, for the theory states that every state of aggregation, consequently also the crystalline state of a so-called single substance, is built up of different kinds of molecules. The crystalline state of a single substance is consequently a mixed crystal, not an ordinary one, but a mixed crystal in inner equilibrium.

As I have observed already, the velocity with which the inner equilibrium between the different kinds of molecules is established in the different states of aggregation, seems to be a very characteristic property of substances, so that we can speak of rapid and slow substances. Rapid substances can undergo rapid changes without coming out of inner equilibrium, but slow ones can be disturbed. In the light of these new considerations, the results obtained with violet phosphorus can be explained easily. Violet phosphorus is a slow crystalline substance; it is a slow mixed crystal, and therefore evaporation at relatively low temperatures will cause the remaining mixed crystal to become poorer in the most volatile molecular species, thereby decreasing its vapour tension.

Another phenomenon, mentioned already, showing that the melting-point and transition-point depend on the previous history, can also be predicted by the theory. If the pressure is kept constant and the temperature is changed, it will of course depend on the velocity with which inner equilibrium is established and the rate of change of the temperature, whether for practical purpose inner equilibrium always exists. If the temperature changes so rapidly that the inner equilibrium cannot adjust itself to it, inner equilibrium is not realised, but disturbed conditions are obtained, which are naturally metastable, and the properties of these states, such as specific gravity, solubility, transition-point, melting-point, boiling-point, etc., will deviate from those of the inner equilibrium state. In connexion with this it is clear that it is very difficult or impossible to show complexity with rapid substances. It is easily understood, therefore, that complexity is apparent only in rather slow substances, and as most substances are rapid, the complexity was only proved in a relative small number of cases.

It will be evident now how valuable it is to have a means by which it is possible to change a rapid substance into a slow substance, and finally to bring all inner molecular transformations to rest. A substance to which this has been applied with great success is sulphur trioxide (*Jour. Chem. Soc.*, 125, 2554, 1924; 128, 1108, 1603, 1926). The intensely dried crystalline state has been studied in detail and the phenomenon already found with violet phosphorus was observed here in a marked degree. It was found that sulphur trioxide, dried for one month or longer in a certain way with freshly distilled, purest, very fine phosphorus pentoxide, becomes so exceedingly slow that it behaves distinctly as a mixture. Since the range of temperature and pressure within which that behaviour reveals itself is much more easily approached than in the case of phosphorus, it could be studied more closely. Thus we could obtain by partial distillation substances of nearly every lower vapour-pressure and, within wide limits, of varying melting-points. The vapour-pressure could at ·50° be reduced to 1/15 of its normal value, whilst the melting-point could be raised from 62° to 95°, an increase of no less than 33°. The melting process in such a crystalline state, which has been much changed by partial distillation, is rather dangerous, since in the liquid formed, notwithstanding the intensive drying, in consequence of the higher temperature, inner transformations take place very rapidly. This causes a rapid increase of vapour-pressure, so that the chances are that the apparatus will burst.

The influence of X-rays on such markedly changed crystalline states is also noteworthy. We found that X-rays affect not only the establishment of the inner equilibrium, but also the transformation of the metastable forms into the stable modifications. I have referred here to the phenomena, observed with phosphorus and sulphur trioxide, but recently we have found analogous phenomena with a number of other substances such as phosphorus pentoxide, nitrogen tetroxide, hexane, benzene, etc.

All these phenomena show the complexity of the so-called simple substances, and we may expect that other substances in the intensely dried state will also show complexity, for there is little doubt that complexity is a general phenomenon. Whilst the old ideas of allotropy are completely powerless to explain these phenomena, they give strong confirmation to the principles on which the theory of allotropy is built, while the new phenomena can be explained completely by this theory. The new theory of allotropy shows among other things that in the most simple case the vapour-pressure lines and the melting-point line of a so-called single substance belong to a pressure-temperature-composition model in three dimensions, in which the two different kinds of molecules are the components. These lines take up a particular place in this space model, since they indicate the phases which are in inner equilibrium. But the whole space model refers to the field of the so-called single substance. When the substance is indeed completely dry and inner transformations are stopped, the whole domain of the substance can be studied. So long, however, as the intensive drying is not complete and the inner transformations are only strongly retarded, the same space model shows which phenomena may be expected. As to the different kinds of molecules, I have pointed out that the reason for the existence of these different kinds of molecules must probably often be sought in the existence of different kinds of atoms (*Ber. Sächs. Akad. Leipzig*, 75, 58, 1923), and in connexion with this it is interesting that recently, from the side of physicists, the same assumption has been made on quite different grounds (de Haas, *Kon. Akad. Amsterdam*, 1926).

Finally, to prevent confusion it is necessary to direct attention to the following points. Recently, papers have been published referring to experiments on the influence of 'traces' of water on different properties of substances, as for example solubility, etc. It will be sufficient to state here that these experiments deal with substances containing 'traces' of water *many thousand times* larger than in our cases of intensive drying and are consequently in quite a different field.

From the preceding considerations it follows that whilst for several years the so-called single substances were considered to have been completely investigated, and it was believed that new points of view could only be obtained by the study of more complicated systems, the close study of these single substances has recently become extremely interesting. From the new point of view already reached, the phenomenon of allotropy with all the various phenomena associated with it and the influence of intensive drying can be surveyed.

In conclusion, one among several interesting questions may be put forward here. Consider for a moment a substance such as benzene, which has become an ordinary mixture by intensive dryings. Benzene is one among the large number of substances for which, after drying in the ordinary way, various physical constants, such as critical-point, melting-point, vapour-tension, specific weight, etc., are determined. Now it cannot be said that these constants have no value; on the contrary, they are very valuable, but they are not physical constants of the pure substance but of impure benzene, contaminated by an extremely small trace of water. Before the phenomena to which I have referred above were known, one would have attached little value to this observation, and one would have answered that such an extremely small contamination canno have any perceptible influence and can therefore be neglected. This is quite true, speaking of contamination in general, but now we know that water is a very special contamination, for on removing it completely, benzene becomes an ordinary mixture and our physical constants are no longer suitable. Thus the new theory opens up another field for investigations on which many generations of scientific workers may carry out important research. In future the so-called single substances will be really purified, which means they will also be dried intensively. From the mixtures obtained in this way the components will be separated and studied carefully. Thus the components of a so-called simple substance will be discovered, and no doub will often cause great surprise, since big and noteworthy differences may exist between the different kinds o molecules.

Sea-birds: Their Relation to the Fisheries and Agriculture.

By Dr. Walter E. Collinge.

Under the above title in Nature of April 8, 1920 (pp. 172-173), I gave a brief résumé of an investigation on the economic status of the commoner species of sea-birds of Great Britain then being carried out under the auspices of the Carnegie Trust for the Universities of Scotland. In that investigation, large series of each species from various localities during each month of the year were examined, and the food content of the stomach was estimated by the volumetric method. The investigation has now been completed, and a final résumé of the more important results may not be without interest. In all, nineteen species were examined, embracing 2309 specimens.

One of the most striking facts shown by this work is the very small percentage of fish consumed by the common gull, the herring gull, the black-headed gull, the common tern, the little auk, and the puffin. Hitherto, it has been generally assumed that all sea-birds feed upon fish, and that this item of their diet constituted the bulk, but such is far from the case. Of the total bulk of food consumed in a year, fish constitutes only 5·16 per cent. in the common gull, 18·20 per cent. in the herring gull, 3·73 per cent. in the black-headed gull, 18·01 per cent. in the common tern, 1·17 per cent. in the little auk, and 22·22 per cent. in the puffin. In the first three species, much of this small percentage of fish is obtained from shore refuse.

The case of the black-headed gull is most striking and significant. As a destroyer of injurious insects it is a most valuable bird, 24·70 per cent. of its food being of this nature, which is more than that consumed by either the rook or the blackbird. It also takes 4·38 per cent. of neutral insects and 0·19 per cent. of beneficial ones. The nature of the insect food is of considerable interest, both on account of the enormous amount that is consumed, and the particular species. Of these latter, it must here suffice to state that upwards of sixty different species were identified.

Respecting the bulk of food, accepting Newstead's computation that each bird feeding upon crane-flies will consume some 4000 per day or 28,000 per week the total quantity destroyed must be enormous. On the Fifeshire coast we have estimated in passing from field to field that at least 5000 birds were present on the land ten miles south of St. Andrews. Such flocks would consume 140,000,000 insects in a week. This however, is only on a small area. All along the coast and farther inland the same thing is taking place, so that the amount of insect life consumed must be prodigious. Moreover, it must be borne in mind that the percentage of cereals destroyed by this species is only 0·37 per cent. A similar striking record can be shown for the other five species mentioned.

Of the fish consumed, 27 species were identified The highest percentage consumed of any one species was 9 per cent. in the case of the greater sand eel 8 per cent. of the lesser sand eel, 6·5 per cent. of the gurnard, and 6 per cent. each of cod and herring haddock follows with 5·5 per cent., and then gunne and sprat each 3·5 per cent.; of flat fishes (all species) only 2·5 per cent. was present. Practically the whole of the food of the cormorant, shag, gannet, goosander red-breasted merganser, and great skua consists of fish, whilst 50 per cent. of the same item forms the food of the guillemot and the black-throated and great northern divers.

The bulk of the fish-food consumed by the nineteen species of birds investigated consists of species that are exceedingly common and also plentiful. There is no scarcity of these fishes, and were they still more plentiful they would in all probability only form additional food for predaceous fishes, and thereby add to the increase of a factor over which man has little or no control.

Of the 2309 stomachs examined, 422 were empty or nearly so. It would seem that if there is any scarcity or lack of food, the female bird is the one to suffer for of 97 partly filled stomachs of the herring gull

70 per cent. were of female birds and 30 per cent. males; whilst of 68 empty stomachs 60 per cent. were of females and 40 per cent. males. Of 123 partly filled stomachs of the black-headed gull 73 per cent. were of female birds and 27 per cent. of male birds, and of 82 empty stomachs 65 per cent. were of females and 35 per cent. of males. Only 16 guillemots were obtained with empty stomachs, and here again 75 per cent. were of female birds and 25 per cent. male. Of the remaining empty or partly filled stomachs of eleven species, namely, thirty-six in all, 62 per cent. were of female birds and 38 per cent. of males.

The range of variation of the food according to locality is interesting. Of the 539 herring gulls examined, 351 were obtained on the coast, or nearby, and 188 were obtained from agricultural districts. In the former, food fishes constituted 13 per cent. of the total food consumed, other fishes 4·7 per cent., and injurious insects 14·1 per cent. Those from agricultural districts gave the figures 9·2 per cent. of food fishes, 7·2 per cent. of other fishes, and 12·5 per cent. of injurious insects, showing that the diet of this species gives only a small range of variation. With the black-headed gull the figures are more striking. Those from the coast show 11·5 per cent. of food fishes, 8·3 per cent. of other fishes, and 24 per cent. of injurious insects. From agricultural areas the percentage of food fishes is only 4, other fishes 2, and injurious insects 32·7.

In all the gulls, annelids, crustaceans, molluscans, echinoderms, etc., figure largely, and in nearly all cases a considerable percentage of this is obtained from shore refuse. In the common gull the percentage is 60·69, the herring gull 48·36, the lesser black-backed gull 39·75, and the black-headed gull 44·04.

For the first time we have a volumetric analysis of the food of the common tern, and the results are all in this bird's favour. The whole of the food is of an animal nature, and 53·70 consists of fish. Of this item 18 per cent. is made up of food-fishes and 35·70 per cent. of non food-fishes. Summarising the figures for the total food content, it is shown that 81·99 per cent. of the food is of a neutral nature, and (if we regard the food-fishes eaten as an injury) 18·01 per cent. injurious. It is very significant that no traces of fresh-water or flat fishes were met with.

As a result of this investigation, and the expression of opinion of those who have devoted a lifetime to fisheries investigation, we are of opinion that no action of sea-birds can produce any appreciable effect upon the plenitude of the fishes of the sea. Moreover, many of the species of birds are exceedingly valuable from an agricultural viewpoint, and their wholesale destruction may be fraught with the gravest possibilities.

Obituary.

Prof. C. J. Eberth.

Prof. Carl Josef Eberth, whose death occurred in Berlin at the beginning of December, was born in 1835 and completed his ninety-first year last September. His earlier work was carried out in Zürich, but for many years he held the post of professor of pathological anatomy in the University of Halle. Zoology, anatomy, histology, pathological anatomy, and bacteriology were all enriched by his researches, and his published papers include investigations on nematode worms, fœtal rickets, the structure and development of blood capillaries, thrombosis, the histology of the lung and liver, mitosis, and on inflammation.

Eberth's name is probably best known in connexion with the discovery of the bacillus of typhoid fever. In 1880 and 1881 he published papers in Virchow's *Archiv* describing a bacillus which he found present in the spleen and mesenteric glands of cases of typhoid fever. The bacilli occurred in scattered groups, and were not distributed generally in the tissues, and appeared to be characteristic and distinct from other organisms which were occasionally seen. Of 40 cases of typhoid fever investigated, this bacillus was found in 18 only; it was also absent from 24 cases of tuberculosis and other diseases. Koch, about the same time, also noted the presence of a similar bacillus in typhoid cases and published photo-micrographs of it. Gaffky, in 1884, confirmed Eberth's observations, finding the bacillus in 26 out of 28 cases of typhoid fever investigated, and isolated and cultivated the organism, which since has sometimes been known as the Eberth, or Eberth-Gaffky, bacillus.

Prof. Eberth, who had lived in retirement for many years, was created a "Geheimrath," and a *Festschrift*, with excellent portrait, was dedicated to him on the occasion of his ninetieth birthday last year (*Beiträge zur path. Anat.* Bd. 74, 1925).

R. T. Hewlett.

Mr. Leslie D. Currie, palæontologist on the staff of the Burmah Oil Company, was drowned while bathing in Burmah on November 9. Mr. Currie had only three weeks before arrived in the country, after a brilliant career in the University of Glasgow, during which he had done some promising research work on some undescribed Silurian Crustacea. His death, at the age of twenty-two years, removes a palæontologist of great promise.

We regret to announce the following deaths:

Dr. Walther Bremer, Keeper of the Irish Antiquities in the National Museum, Dublin, whose archæological work included the identification of Asturian flints at Island Magee.

Dr. Franz Exner, emeritus professor of physics in the University of Vienna and a member of the Vienna Academy of Sciences, on November 15, aged seventy-seven years.

Dr. James F Kemp, professor of geology since 1891 in Columbia University, distinguished for his work in economic geology, on November 17, aged sixty-seven years.

Dr. C L. Withycombe, formerly of the Imperial College of Tropical Agriculture, Trinidad, and recently appointed lecturer in advanced and economic entomology in the University of Cambridge, on December 5, aged twenty-eight years.

News and Views.

The congratulatory dinner given at Cambridge on Saturday last to Sir J. J. Thomson, Master of Trinity, will long be cherished in the memory by all who were privileged to take part in it. The occasion was Sir Joseph's seventieth birthday, and the celebration was arranged by the Cavendish Society, which consists of past and present students of the Cavendish Laboratory, together with members of the staff. Sir Ernest Rutherford occupied the chair, and about 130 other members of the Society were present, while numerous messages of affection and esteem were sent by old students who are carrying on the Cavendish tradition of faithful work and productive insight in many parts of the world. To all of these, 'J. J.' is, what man finally became to Wordsworth, "an object of delight, of pure imagination and of love." He is the uncrowned king of physical science, and it is an honour and an inspiration to have come within his sphere of influence. Something of the spirit of devotion which he creates in all who have been associated with him is expressed in the following address, which was presented to Sir Joseph at the dinner, bearing the signatures of 230 of his disciples :—

"We, the past and present workers in the Cavendish Laboratory, wish to congratulate you on the completion of your seventieth year. We remember with pride your contributions to theoretical and experimental physics, and especially your pioneer work on the structure of the atom The additions you have made to knowledge are conspicuous even in this age of remarkable achievement, and have profoundly influenced the history of science. Succeeding to the Chair of Clerk Maxwell and Lord Rayleigh, you have made the Cavendish Laboratory, during your forty-six years' association with it, an unrivalled centre of intellectual activity. We, who have had the privilege of working with you, cannot adequately measure our debt. We can only express our grateful appreciation of the help, encouragement, and friendship given so freely to all your students, and our hope that you may long live to be an inspiration to the Cavendish Laboratory and the whole world of physical science."

In presenting this address, together with two silver caskets to Sir Joseph and Lady Thomson, Sir Ernest Rutherford related some personal reminiscences of the years—"the happiest in my life"—spent with 'J. J.' in the Cavendish Laboratory, of which he is now the director, and so successfully penetrating into the innermost courts of eternal wisdom. Prof. P. Langevin, representing men of science from other lands, who have worked in the laboratory and been admitted to the freedom of its fellowship, paid a charming tribute of affection to the guest of the evening. Sir Joseph expressed his thanks in an eloquent speech in which, in generous words, he referred to the unselfish support he had received from all members of his staff, and to the ever-expanding field of scientific research which can never be a terminus but is always revealing new avenues to be explored. The toast of "The Old Cavendish Students" was proposed by Dr. A. Wood, who, with Mr. H. Thirkill, organised the dinner; and Sir Arthur Schuster, Sir Richard Threlfall, and Prof. F. Horton, in acknowledging it, bore grateful testimony to the stimulating influence of the laboratory and its directors upon successive generations of students. All who have worked within its walls have acquired a quality of spiritual radioactivity which makes for light and leading wherever they go. But though they take away this emanation with them, there is no weakening of the parent source, which, we are sure, will continue to illuminate the road along which science advances to secure increase of knowledge for the benefit and admiration of posterity.

The Council of the Physical Society, at its meeting on December 10, awarded the fourth Duddell medal for meritorious work on scientific instruments and materials to Mr. F. Twyman. The firm of Adam Hilger, Ltd., of which Mr. Twyman has for many years been both managing and technical director, enjoys a reputation for the production of optical instruments employed in physical research which is not approached by that of any other firm in Great Britain or any other country. The fundamental researches which have led to the formation of the current conceptions of the nature of matter have been carried out to a large extent with the aid of instruments of the necessary high degree of precision constructed in the Hilger workshops. The production of these instruments has frequently involved the solution of problems which have only been met successfully through Mr. Twyman's persistence and resourcefulness.

In addition to the services rendered to the cause of pure science, Mr. Twyman has carried out notable work on a number of technical problems. Two may be specially mentioned. His investigations on the annealing of glass (which incidentally led to Twyman's Law on the influence of temperature upon the mobility of the melt) are of fundamental importance, and his instruments for controlling this operation have been of service to all branches of the glass-making industry. These investigations have been an important factor in securing home supplies of reliable glass-ware for scientific purposes. Moreover, during the War, they led to a notable increase in the output of optical glass, by substituting for the traditional routine a novel scheme of annealing, which, without any deterioration in the quality of the product, enabled the time occupied in this operation to be greatly reduced. As another example of technical work, the extensive series of Hilger interferometers may be mentioned. The Michelson type of interferometer has been modified and adapted to a large number of special uses of interest to the optical industry. By the use of these instruments accurate measurements can now be made of the defects of all manner of optical parts and instruments, whether these defects are due to faulty design, imperfect workmanship, or defective material. It is characteristic of Mr. Twyman that these new instruments were immediately used not merely to measure the defects, but also as a means of removing them.

AT the present time, no problem interests electrical engineers more than the question of the best type of main to use for the underground distribution of electrical energy. In many towns, even the suburban districts are so built over that the use of overhead lines is quite out of the question. As the load increases, the necessity of using very high pressures becomes urgent. It is common knowledge that some of the high-tension mains laid in Great Britain have given a great deal of trouble owing to breakdowns. The paper read to the Institution of Electrical Engineers on December 16 by Colonel E. Mercier on the 60,000-volt underground network operated in Paris by the Union d'Électricité was therefore of great value. The system of distribution most favoured at present is the three-phase system. There are three distributing mains which can either be bound together so as to form a single cable called a three-core cable, or three separate cables can be used. The former solution is that generally adopted in Britain, and the latter is the one adopted in Paris When they are bound together they can be handled more expeditiously, but there are a few drawbacks. The carrying capacity of the cables is limited by their temperature rise. The heat generated in three-core cables has greater difficulty in getting conducted away, and so they carry less current in proportion. The predetermination of their carrying capacities and breaking-down voltages presents much greater difficulty. The rotating electrostatic fields produced in these cables also produce dielectric losses. The great steam-driven station at Gennevilliers in Paris in linked with the station at Vitry and will soon be connected with the hydro-electric station at Eguzon on the River Creuse. The total power of these stations is nearly 500,000 kilowatts. The network connects a ring of distributing stations round the city of Paris. The company's engineers have recently examined the best types of three-core cable and have reported adversely on them for their extensions. They consider that single cables involve a smaller initial outlay, are more trustworthy, and are easier to repair.

THE annual Philosophical Lecture of the British Academy under the Henriette Hertz Trust is always an event of much interest. This year's lecture, which was given in the rooms of the Royal Society on Wednesday, December 15, was no exception, as the lecturer, Prof. T. Percy Nunn, Principal of the London Day Training College, is a man of outstanding ability and experience in the realms of education, mathematics, and philosophy. The subject of the lecture was "Anthropomorphism and Physics." By anthropomorphism Prof. Nunn stated that he means, broadly, the 'projection' of any human character into the non-human world, and in this way it is a trait of primitive mentality which still colours man's dealings with his environment. As Prof. Nunn showed, it has played an important part in the history of science, and even some of the technical vocabulary is an indication of the way in which the human point of view can be projected. Prof. Nunn pointed out that to some, the theory of relativity allows for an anthropocentric view of Nature; whereas the truth about the modern theory of relativity is that it is really one more step further away from the old anthropomorphic ideas, emancipation from which was begun by the work of Copernicus. Prof. Max Planck has said that physical science can only reach unity by eliminating all anthropomorphous elements. The main purpose of the lecture was to inquire how far this elimination can proceed. The first step is to seek a tenable theory of physical objects which presumes the objective existence of secondary qualities; such theories have been formulated by the Realists. The next step is to raise the question of the reality of such objects as electrons which physics offers. The tendency of recent attempts to overcome such difficulties is to show that physics has no need of the hypothetical forms of matter which have been claimed as the reality behind the apparent world.

ANCIENT surveying instruments were described by Sir Henry Lyons in a lecture to the Royal Geographical Society on December 13. In Egypt, records of land measurements are found from very early times, although no map of landed property in ancient Egypt has survived. The marking of province boundaries was also recognised as being of great importance, and operations of levelling reached a satisfactory accuracy, as can be gauged from the rock pavement on which the great pyramid was built. In ancient Egypt the instruments employed in land survey were very simple, and included probably only the measuring cord of 100 cubits, the measuring rod, and the *merkhet* for laying out lines in any desired direction. The *merkhet* consisted of a plumb-line hanging from a holder, which was aligned on any object by looking through a sight vane made of a cleft stick. The levelling instrument was probably a right-angled isosceles triangle of wood with a plummet attached to the apex. In use it was placed on a long wooden straight-edge resting on pickets. Probably not until Greco-Roman times was another instrument, the *groma*, introduced. Egypt may have been its place of origin, but the Romans used it widely. The *groma* consists of two pairs of plumb-lines suspended from the ends of two rods at right angles to one another. Some of these instruments of different designs have been recovered.

ON Tuesday, December 14, a new research laboratory for physical and inorganic chemistry was opened at East London College by Mr. E. de Q. Quincey, the chairman of the College council. This laboratory is the gift of Mr. and Mrs. Henry Cohen, of Beckenham, and is a memorial to their son David, a former student of the College, who died in May 1925. The laboratory is equipped for research work in physical and inorganic chemistry and chemical microscopy, and contains a small library, also the gift of Mr. and Mrs. Cohen. Mr. Quincey, in accepting the gift on behalf of the College council, pointed out that it was a valuable appreciation of the necessity of assisting advanced work at the College, and expressed the hope that other old students would follow this excellent example. The

Principal of the College and Prof. J. R. Partington, in whose department the new laboratory is situated, both emphasised the importance of a period of study after graduation to students entering industry or the teaching profession.

In the House of Commons on December 15 Mr. W. Baker asked the President of the Board of Education whether his attention had been directed to the planetarium invented by the firm of Zeiss and erected by the Düsseldorf Corporation. The firm declines to supply these structures to any one proposing to make a profit, and having regard to educational possibilities and the poverty of educational authorities, Mr. Baker asked whether the Board would consider the purchase for educational purposes of at least one planetarium. The Duchess of Atholl, Parliamentary Secretary to the Board of Education, who replied, stated that the Board of Education has no power under the Education Act, 1921, to make a purchase of this kind. Two years ago a planetarium was installed at Munich, and a description of the apparatus appeared in Nature of December 27, 1924, p. 937. According to a letter from Dr. J. Jackson in the *Times* of December 20, the success of this instrument led Messrs. Zeiss to build a larger and improved planetarium for Jena, while similar instruments have been made, or are on order, for Barmen, Berlin, Dresden, Düsseldorf, Hamburg, Hanover, Leipzig, Mannheim, Nürnberg, Stuttgart, and Copenhagen.

At the ordinary scientific meeting of the Chemical Society held on December 16 the president, Prof. H. Brereton Baker, announced that the Council had unanimously resolved to award the Longstaff medal for 1927 to Prof. Robert Robinson of the University of Manchester for his distinguished researches in organic chemistry. It was also announced that, in accordance with the terms of the trust-deed establishing the Edward Frank Harrison Memorial Prize, the selection committee, consisting of the presidents of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry, and the Pharmaceutical Society, had met to consider applications for the Harrison Memorial Prize. This prize, it will be recalled, is awarded to the chemist of either sex, being a natural-born British subject and not more than thirty years of age, who in the opinion of the selection committee has, during the past five years, conducted the most meritorious and promising original investigations in chemistry and published the results of those investigations in a scientific periodical or periodicals. The selection committee has unanimously resolved that the prize for 1926, of the value of 150*l*., should be awarded to Dr. Charles Robert Harington of University College, London. Dr. Harington has within the last five years synthesised the active principle of the thyroid gland (thyroxine); he has determined its constitution and worked out a practical process by which it may be produced on a large scale. This artificial product has been found to have the same physiological efficacy as the active principle in the natural extract. The presentation of the Longstaff medal and of the Harrison Memorial Prize will take place at the annual general meeting of the Chemical Society on March 24, 1927.

The Kamerlingh Onnes Memorial Lecture of the Chemical Society will be delivered by Prof. Ernst Cohen of Utrecht, at the Institution of Mechanical Engineers, Storey's Gate, S.W.1, on Thursday, February 10, 1927, at 8 P.M.

Dr. A. B. Walkom, secretary of the Linnean Society of New South Wales, has been granted twelve months' leave by the council of the Society to enable him to study palæobotany under Prof. A. C. Seward at Cambridge.

Mr. Heron-Allen has presented the Heron-Allen and Earland collection of Foraminifera to the British Museum (Natural History) under conditions which will enable him and his collaborator to keep it up-to-date, with additions and rearrangement. The collection, which numbers between seventeen and eighteen thousand slides, includes the Millett, Siddall, Sidebottom, and other notable collections, and is undoubtedly the largest and most complete in the world.

The annual meeting of the Science Masters' Association will be held at Oxford on January 4-7, under the presidency of Brigadier-General H. Hartley. The meeting includes lectures by distinguished scientific workers at Oxford, and an exhibition of apparatus and books at the Electrical Laboratory, Parks Road. The organising secretary for the meeting is Mr. W. J. Gale, 50 Stanton Road, Wimbledon, London, S.W.20.

The Eastern Siberian section of the Russian Geographical Society announces the celebration of its seventy-fifth anniversary at the end of this month. The occasion is to be marked by various social functions and an exhibition illustrating the results of the Society's work in Siberia. Various publications are also announced, including the fifteenth volume of the *Isvestia*, with a series of historical articles and a volume of general geographical and statistical articles on Eastern Siberia. These publications are apparently to be in Russian.

The Buchan Prize of the Royal Meteorological Society for 1927 has been awarded to Mr. C. K. M. Douglas for the following papers contributed to the *Quarterly Journal* of the Society during the years 1922–25: "Observations of upper cloud drift as an aid to research and to weather forecasting"; "Further researches into the European upper air data, with special reference to the life history of cyclones"; "On the relation between the source of the air and the upper air temperature up to the base of the atmosphere"

An interesting exhibition of some of the results of research recently carried out in adhesives (glues and sticking substances) and their application has been arranged at the Science Museum, South Kensington, by the Adhesives Research Committee of the Department of Scientific and Industrial Research.

This Committee was established by the Department in 1919 to continue the work of the Adhesives Research Committee of the Conjoint Board of Scientific Societies which was set up towards the end of the War to conduct research on adhesives with the aid of a grant from the Ministry of Munitions. The exhibition was opened to the public on Saturday, December 18, and will remain open for some months.

A BROCHURE on electro-medical apparatus by Messrs. Newton and Wright, Ltd., 72 Wigmore Street, London, W.1, gives a fairly complete list of appliances in current use with illustrations and prices. These appliances include portable sets required for administering faradic or galvanic currents. An electro-medical table shown has all the requisite gear for giving both varieties of current from any D.C. supply between 50 and 250 volts. There is also illustrated an "Omnistat" machine in which the motor is an integral part of the apparatus, which is made in two models; the "Standard," providing galvanic and sinusoidal currents; and the "Therapeutic," in which the faradic is substituted for the sinusoidal. Both types are adapted for the inclusion of vibro-massage apparatus.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant master at the Dewsbury Municipal Technical College, with qualifications in physics and electrical engineering—The Secretary for Education, Education Offices, Town Hall, Dewsbury (January 3). An assistant lecturer in physics at the Bradford Technical College—The Principal (January 11). A director of tubercular research in the University of Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (February 1). Assistantships in the departments of zoology, botany, entomology, and mineralogy of the British Museum (Natural History)—The Director, British Museum (Natural History), South Kensington, S.W.7. A teacher of engineering subjects and metalwork at the Doncaster Technical College—The Principal, Technical College, St. George Gate, Doncaster.

Our Astronomical Column.

RECENT SUNSPOTS.—The stream of spots seen near the sun's central meridian on Dec. 15 and 16 is the most important group observed for the last two months. Except for occasional short intervals, there has been no dearth, however, of smaller spots, whilst faculæ have been abundant (see also NATURE, Oct. 23, p. 603). The spots recently under observation appear to have originated about Nov. 21, but cloudy weather prevented their development being followed at that time, and later when the group was due to return at the east limb on Dec. 9. When first seen on Dec. 15, the arrangement of the spots was that usually associated with a bipolar group or stream of normal type. With the exception of the leader, the component spots were much broken up. The length of the stream, which was parallel to the sun's equator, was about 12° of solar longitude. Although the aggregate area of the spots was fully 1000 millionths of the sun's hemisphere, the group could be seen on Dec. 15 and 16 only when the disc was very carefully screened. Particulars of position, etc., are given below. It may be noted that no group so large as this has hitherto appeared during the present cycle so close to the sun's equator.

No.	Date on Disc.	Central Meridian Passage.	Latitude	Area.
11	(Dec. 9–22)	Dec. 15·9	7° N.	1/1000 of sun's hemisphere

THE DOMINION ASTROPHYSICAL OBSERVATORY, VICTORIA, B.C.—Vol. 3, Nos. 9, 10, 11, 12 of the publications of this observatory, deal with the orbits of nine spectroscopic binaries and the radial velocities of 48 stars. 12 Lacertæ is interesting from the rapid change in the amplitude of the radial motion, accompanied, according to Guthnick, by a similar change in the range of variability of light. As in many other cases, the *H* and *K* lines of calcium are stationary, and nearly accord with the solar component of radial motion. The 48 stars were found to include 9 binaries.

Boss 1275 was found to be a binary by Adams at Mt. Wilson in 1916, but the period previously adopted, 27·43 days, is shown to be wrong. The true value is 2·15165 days.

H. D. 191201 is a very massive binary, the minimum values for the components being 13·8 and 12·9 times the sun. The type is B0, and the estimated distance 5000 light years.

U.S. NAVAL OBSERVATORY, WASHINGTON.—Vol. 10 of the publications of this observatory deals, in the first place, with observations made with the Prime Vertical Instrument during the period 1893–1912. Vega was the star most regularly observed, since it is readily visible by day. It was found, however, that the daylight observations differ systematically from the night ones; the difference is ascribed to lateral refraction produced by unequal heating of the layers of air near the instrument.

The parallax of Vega was deduced to be 0·123″, the aberration constant 20·542″, the nutation constant 9·250″, the mass of the moon 1/80·54. The last was deduced from the nutation constant, assuming the luni-solar precession for 1850 to be 50·373″. The variation of latitude was not deduced from the observations but was taken from the values published by the International Geodetic Association.

The volume also gives in detail the results obtained during the total solar eclipses of 1905, 1918, 1923. Two expeditions were sent to Spain and one to Algeria in 1905. Numerous plates contain reproductions of the coronal photographs and also of drawings, both those made direct from the corona and those from combinations of photographs. There are some excellent reproductions of the chromospheric spectrum; in one plate this is placed in juxtaposition with the corresponding region in Rowland's Atlas.

Some striking drawings in colour of the landscape (showing approach of moon's shadow) and of the corona and prominences were obtained in 1918 by Mr. Howard Russell Butler, and are reproduced in colour in the volume. He gives the corona a distinct blue tint, agreeing with several observers, though others describe it as white. The distant hills in the shadow are drawn as purplish violet; the sky just above them in orange, changing to bluish purple higher up. The orange band was also seen in Norway in 1896, when Mr. N. E. Green made a colour drawing of the landscape during totality. The eclipse of 1923 was observed from aeroplanes; interesting descriptions are given, but they are of little scientific value.

Research Items.

HYDROIDS OF THE *VALDIVIA* EXPEDITION.—The account of the hydroids of the German Deep Sea Expedition (*Valdivia*) ("Hydroiden der Tiefsee-Expedition," bearbeitet von Prof. Dr. Eberhard Stechow. Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia*, 1898–1899, Bd 17, Hft. 3. Jena, 1925) is a valuable contribution to coelenterate literature For some years Prof Stechow has published papers in various journals showing that these hydroids are of a peculiarly interesting nature, and now we have a comprehensive survey of them all. In this material twenty-five per cent. of the species are new and there are two new genera. The author is of the opinion that whilst there are many bipolar genera, the species from the Arctic and Antarctic are themselves distinct, and many examples of confusion of species are here cleared up and thoroughly investigated. Only fourteen out of one hundred and twenty-four species described are medusa-bearing forms. The reason for this is attributed to the presence of ice, which is inimicable to medusæ. The same is found to be the case in Arctic seas. In the coldest regions the medusa-bearing hydroids are almost completely absent This subject has already been discussed by the author in 1924 ("Über den Einfluss der Temperatur auf die Erzeugung von freien Medusen, etc," *Verh d. Deutsch Zool. Gesellsch*), and the facts are plainly shown in the present records There are some extremely interesting hydroids amongst this *Valdivia* material. To mention only a few of the most striking, we have the soft parts of *Hydrocorella africana* described, of the family Bougainvilliidæ, having a skeleton of almost pure lime composed of small spines and large horns and bearing sporosacs. This is perhaps the most interesting of the athecate forms. Most of the remaining species belong to the Thecata. Here amongst the Plumulariidæ is the aberrant and very extraordinary *Dinotheca Dofleini*, already briefly described by Prof. Stechow in *Zoologischer Anzeiger*, vol 37, in which there are probable affinities with the Graptolites (Rastrites) Altogether an enormous amount that is new is to be found in this most excellent monograph, and the beautiful series of figures in simple outline adds much to its value

THE STATOCYSTS OF CEPHALOPODS —M. Ishikawa (*Jour Coll. Agr.*, Imp Univ., Tokyo, 7, No 3, 1924, recently received) has studied the statocysts of 59 species of Cephalopoda principally from Japanese localities. The statocyst was removed and cut transversely into two halves; the internal structure and the processes developed on its wall and projecting into the lumen were then examined. In the Octopoda only one process (labelled *c*) is present, and a corresponding one is found in all cephalopods. In Argonauta and Tremoctopus this process is unbranched, while in Ocythoe and Polypus it is provided with two small knobs, and the author suggests that the two former genera are more primitive than the two latter. In the Decapoda the genera can be divided into two series according as a process *b* is present (in four genera) or absent (in nine genera) In the latter group the processes are two only in the genus Pyrgopsis, nine in Cranchia, ten in Watasenia (and four other genera), eleven in Ommastrephes (and five other genera), and twelve in Loligo and Sepioteuthis Of those in which the *b* process is present Idiosepius exhibits five processes, Sepia eleven, Sepiella twelve, and Thysanoteuthis thirteen A phylogenetic tree is shown based on these details, and the author points out that the arrangement is in accordance with other characters, *e g* the fins, the shell, and siphonal joint apparatus. Young specimens of a Sepioteuthis were pricked with a needle so as to injure the statocyst of one or of both sides. When the left statocyst was injured the animal moved in a clockwise direction; when the right one was pricked movement was in the reverse direction, and when both statocysts were destroyed the swimming became quite irregular

NUCLEAR DIVISION IN *Entamœba histolytica* —Two accounts of nuclear division in *Entamœba histolytica* (*dysenteriæ*) have appeared recently One of these, by Prof C. A Kofoid and Dr. O Swezy (*Univ. Cal. Publ Zool*, vol 26, No. 19, 1925), is based chiefly on a study of cysts found in freshly examined human fæces. The karyosome migrates from its previously more or less central position towards the nuclear membrane and divides into two parts which draw out the intradesmose between them as they pass to the poles of the spindle, where they constitute the polar caps. These caps are thus in the position of the centrosomes, but a centriole was seen at the ends of the intradesmose only in two examples, both from the cat. The source or sources of the six chromosomes were not fully traced. By this time the nucleus is spindle-shaped, and the chromosomes divide in a seemingly transverse plane but in reality in the end-phases of a longitudinal separation The two groups of chromosomes migrate towards the poles and the nucleus constricts into two. The second paper, by C Uribe (*Proc. Nat Acad. Sci.*, 12, 1926, pp 305-311), is based on observations of numerous trophozoites in a cat which had been experimentally infected. Division stages were observed both in amœbæ which had invaded the intestinal wall, and in others on the surface of the epithelium The poles of the dividing nucleus are pointed, and each terminates in a clear cone at the apex of which is a small centriole The number of chromosomes is six; after their division the resultant daughter chromosomes move towards the poles. The two daughter nuclei are about this time connected only by an elongate thread which later snaps and then the chromatin becomes distributed on the nuclear membrane The clear cone and the centriole persist in the daughter nuclei after their separation but disappear with the formation of the karyosome Apparently only a part of the 'peripheral chromatin' is incorporated in the chromosomes of the dividing nucleus.

THE PROTOZOA OF THE PITCHER PLANT.—"Primitive conditions of digestion might be expected in insectivorous plants, and this idea is responsible for the investigation"—by Prof. R. W. Hegner (*Biol. Bull*, 50, 1926) of the protozoa of the pitcher plant—in connexion with the general problem of the relationship between intestinal protozoa and their environment. Ten pitchers (*Sarracenia purpurea*) from different localities in Maine were carefully examined, and in all of them protozoa were present—all three classes being represented by several species. The liquid from many other pitchers was examined and similar protozoa found in most of them. The most common organisms in the pitchers were insect larvæ, mites and rotifers; nematodes and Entomostraca were found in a few, and Tardigrada in one pitcher. The protozoa in the pitchers are probably free-living species carried in by flies, though some of them may be restricted to this environment Paramœcia from a culture were placed in the fluid in or obtained from the pitchers, and were found to be able to live therein for an indefinite period, and in some cases to multiply. Colpoda and Chilomonas could also live in the fluid and multiply.

ARACHNIDISM —In two papers recently published (*Jour Amer. Med Assoc.*, 86, 1926, 1894; *Arch. Int. Med*, 38, 1926, 623), Dr. E. Bogen, of Los Angeles, brings forward evidence that poisoning by spider bites, on the reality of which a good deal of doubt has been thrown, is quite a material thing. The effective spider in California is *Latrodectus mactans*, which lives in outhouses and similar places and has an unfortunate liking for closet seats. Symptoms come on at once or within a few hours, and consist mostly of agonising general pains which need large doses of opiates to control them. The patients recover in a few days without any after-effects. Poisoning by allied and other spiders is well-established in southern Europe, Madagascar, Australia, and South America, and though the tale of the tarantula is of course a myth, arachnologists seem to have gone too far in doubting the possibility of human poisoning altogether.

A NOVEL GEAR —In many classes of machinery it is required to vary at will the relative speed of one shaft driven by another. This has usually been done by means of gear-wheels, chains, or belts. With toothed wheels, however, the number of changes are few, while with belts slipping occurs. To increase the number of changes and at the same time to prevent slipping, a novel type of drive has been invented which, in the main, resembles the belt drive between opposed conical discs so commonly used on lathes. In this invention the faces of all the cones have alternate ribs and grooves radiating from the apex, while in each link of the chain are fitted a number of thin steel slats which, while they project sufficiently to engage with the ribs or the cones, have a certain amount of freedom endwise. There cannot thus be any slip, while by closing one pair of cones and opening the other the relative speeds can be altered. The gear is called the " Positive Infinitely Variable " or " P.I.V. Gear," and has been placed upon the market by a syndicate bearing the same name Trials of the gear have been carried out at the National Physical Laboratory, and these show that under favourable conditions an efficiency of 95 per cent can be obtained. One example of the gear was shown at the Textile Exhibition at Leicester in October, where an A.C motor running at 1000 R.P.M. drove another shaft at speeds varying from 250 to 500 R.P.M. The invention is an ingenious one, and provided that the chain does not show abnormal wear with prolonged use, it should have many applications.

LOADING SUBMARINE CABLES.—The competition that has arisen between high frequency radio and submarine telegraphy has accelerated the development of the latter method of communication The greatest recent improvement is the use of cables the cores of which are surrounded by what is practically a cylinder of metal (permalloy) tape which has a very high permeability for very minute magnetising forces The theory of the transmission of signals in this kind of cable was first clearly explained by Oliver Heaviside. His predictions as to the great speeding up that could be effected by a ' uniformly loaded ' cable have been verified in practice. The New York-Azores permalloy loaded cable is perhaps the best-known cable of this type and it works at a very high speed A factor, however, limiting the speed of cables of this type is the mutilation of the received signals by electrical disturbances picked up along the cable and transmitted with the incoming signal to the receiving instrument. In a paper published in the *Bell System Technical Journal* for July 1926, J. J. Gilbert explains how this difficulty has been overcome in the New York-Azores cable At the New York terminal the ocean is comparatively shallow for a distance of about 100 miles. This part of the cable is therefore exposed to atmospheric disturbances and to strong stray fields from the numerous electric railway systems near New York. The Azores end of the cable reaches very deep water after a few miles and is therefore almost completely protected from atmospheric and other disturbances. To prevent the disturbances that experiment showed would otherwise be introduced into the cable at New York, a simple and effective remedy was devised. The earth terminal of the receiving apparatus was connected to the armouring of the cable by means of an insulated cable taken one hundred miles out to sea. This method is entirely successful and the highest speeds can be maintained Mr Gilbert's theory of this new type of sea earthing device is clear and convincing.

WROUGHT MAGNESIUM AND MAGNESIUM ALLOYS. —Report No 1037 of the Engineering Research Board of the Department of Scientific and Industrial Research, by S. L Archbutt and J. W. Jenkin, deals with magnesium and magnesium alloys The use of this metal and its alloys is of considerable importance where the saving of weight is a first consideration, as this metal is much lighter than aluminium. Cast magnesium alloys have already been used in aeroplane engines, and the present work commences a research to fill the gap in the knowledge of the wrought alloys. The materials chosen are the metal itself, its alloys with 3 and 13 per cent of copper, with 6 per cent. of aluminium and the proprietary alloy ' electron,' the composition of which is given as . zinc 4·38 per cent, silicon and aluminium 0·15 per cent each, and copper 0·22 per cent, the remainder being magnesium. The melting and rolling of the alloys are described in detail. Typical values of the mechanical properties of 1 in hot-rolled rod at atmospheric temperatures are :

	Magnesium	6 per cent. Aluminium Alloy.	Electron
Limit of proportionality, tons/sq in . . .	1·60	2·40	4·9
Maximum stress, tons/sq in .	15·7	18·2	17·8
Elongation per cent on 2 in	12·5	20·0	11·6
Reduction of area, per cent	19·0	22·0	18·7
Wohler endurance limit, tons/sq in. .	4·5	6·5	.
Impact, ft lb . .	4·0	4·8	
Brinell hardness (500 kgm load)	39	50	58

The effect of prolonged heating to 350° C. has been determined for the first two of these materials. There is a decrease in both the maximum stress and the elongation. The impact test, however, shows that no embrittling accompanies this loss of elongation, the energy absorbed actually increasing very markedly in the case of the alloy. The Brinell hardness of all the materials has been determined at temperatures up to 350° C. and complicated changes are observed.

HYDRION CONCENTRATION AND PHOTOGRAPHIC EMULSIONS —Under this heading reference was made in NATURE of December 18, p. 893, to a paper by Rawling and Glassett (*Journal of the Royal Photographic Society*, November). It was stated that " the photographic sensitiveness obtained after digestion is greater as the hydrion concentration is increased." This is incorrect; sensitivity increases as the hydrion concentration decreases.

Stress and Rhythm in Speech.

NOTWITHSTANDING the steady advance of knowledge concerning the physics of speech, with regard to certain of the most fundamental speech-phenomena a lush upgrowth of theory has yielded a very small crop of ascertained facts. Especially is this true concerning speech-rhythm. The reasons are several. Too frequently investigators have failed to formulate their problem with precision and have obscured it with terms of undetermined connotation, such as 'stress,' 'accent,' 'quantity,' even the word 'measurement' being very loosely used; most serious, however, has been their failure to appreciate or apply the methods evolved by other sciences for solving kindred problems.

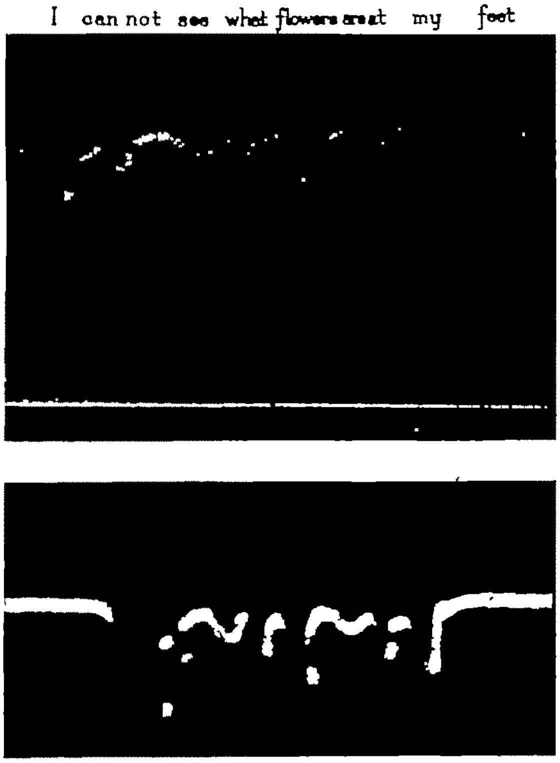


FIG. 1.—Direct photographs of jaw-movement. The lower curve was recorded some months after the upper, but by the same speaker. All the characteristics of the first curve are reproduced in the second, but the latter is more compressed laterally owing to slower movement of film.

Physiological research during the past half-century has shed complete light upon certain rhythms and, in so doing, elaborated characteristic and efficacious methods. A typical case is that of the heart-beat, which presented itself primarily as an *audible* rhythm, but could be subjected to accurate mensuration only when compelled to leave a *graphical* record upon a surface moving with known speed, *i.e.* when time had thus been replaced by its spatial presentment, alone susceptible of measurement. Let the metrician consider the principle involved. Behind the acoustic record of rhythmical sound, the true amplitudes of which were difficult of discovery, the physiologist was interested in the muscular actions, themselves presumably rhythmical, by which it was generated, and he addressed himself to the direct recording and measurement of these, incidentally presenting the metrician with an instructive but neglected example.

Experiments which I have been enabled to carry out during the past few years in the Physiological and Phonetics Laboratories at University College, London, indicate that even a crude adaptation of the physiologist's method yields valuable data as to the nature of 'stress,' and the distribution along the time-line of speech of its moments of maximum incidence. Fig. 1. exhibits the track marked on a photographic film, moving with uniform velocity, by an electric spot-light fixed rigidly between the lower incisor teeth of a speaker who, in profile to the camera and in darkness, recited the line "I cannot see what flowers are at my feet." It represents, therefore, the rise and fall of the jaw during utterance. I can discuss here only one or two of the problems and conclusions suggested by this and very numerous similar experiments. It seems surprising that previous investigators should have neglected to examine this most evident factor in normal speech—the opening and closing of the mouth. The movements involved can scarcely be adjudged *a priori* superfluous and insignificant, since every depression of the jaw, effected by the combined work of numerous muscles and more particularly of those attached to the hyoid, provokes, as anatomists are fully aware, very special pivotings and displacements of the thyroid cartilages supporting the glottis, and consequently special tensions and special modifications of the resonant cavities of mouth and pharynx. These modifications are strictly conditioned by the number of muscles brought into play and the speed and vigour with which they are contracted. Hence the tracing executed by the moving jaw is a valuable index of the whole process of phonation, and this tracing reacts characteristically to every variation of stress, pitch, and vowel quality (timbre). The stressing (emphasising) of any particular vowel involves increased vigour of jaw-movement, and for each timbre characteristic degrees of descent of the jaw and characteristic expenditure of time.

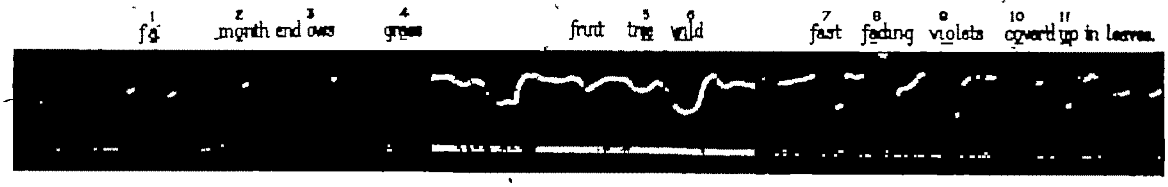


FIG. 2.—Excerpts from a continuous film of jaw-movement: "Wherewith the favourable (*sic*) month endows The grass, the thicket, and the fruit-tree wild," "Fast fading violets covered up in leaves." 1 and 8: characteristic semi-circular trough for a in fading and favourable. 2, 10, and 11: peaked trough for vowel Λ in mouth, covered, up. 4 and 7. characteristic right-hand ascent of trough representing a in grass and fast. 3, 6, and 9 large diphthong troughs in endows, wild, violets. 5: compare trough of i in fruit-tree with that of i in see (Fig. 1).

In Fig. 1 the vowels occupy the wave-troughs, and it will be realised that the lowest point of each trough, *i.e.* the point of maximum stress, corresponds to a unique position of the vocal apparatus, achieved by increasing muscular contractions on the descent and unmade by reversal of these contractions on the ascent. A 'pure' vowel apparently consists of symmetrical phases of approach and recession about

e char-
s of different

d of tracing. Instead

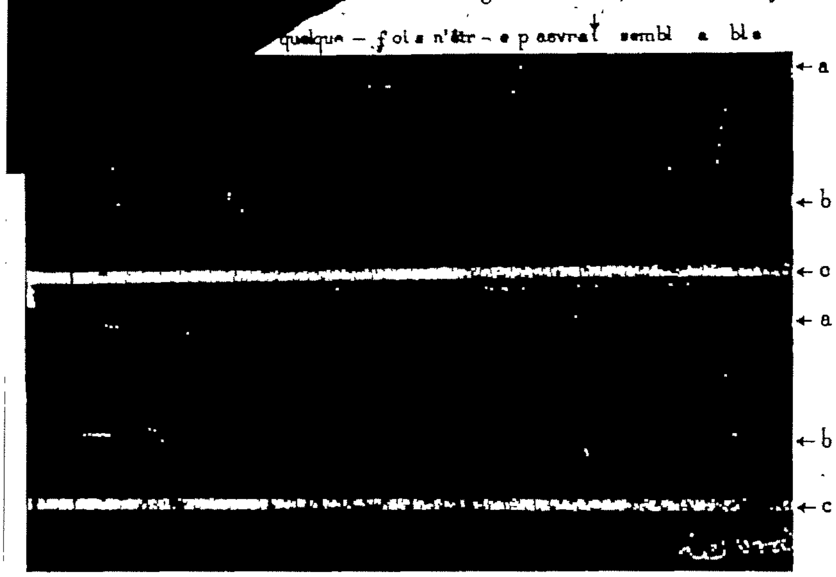


FIG. 3.—Two recitations of "Le vrai peut quelquefois n'être pas vraisemblable" (a) Jaw-movement; (b) sound record; (c) time record (tuning fork, 100 vibrations per sec.).

of the direct photograph of jaw-movement we have here (*a*) an inscription made by the lever of a Marey-tambour fitted with an extremely elastic soft rubber diaphragm and hermetically connected with a bulb carried on a plate under the speaker's chin in such a manner as to eliminate the influence of all head-movements other than those of the jaw, the latter being recorded in terms of air-pressure. The figure contains the inscription of two recitations of the French Alexandrine, "Le vrai peut quelquefois n'être pas vraisemblable." The total time taken by each recitation is 2¼ seconds between the lowest point of the first vowel trough lE and the lowest point of the last, vraisemblAble. It will be observed that the same intricate curve is reproduced with scrupulous fidelity, and, as this reproduction postulates the identical performance of many highly complex and varied acts by a synergy of numerous muscles, it is difficult to believe that this fine accuracy subserves no practical purpose. It is interesting to observe the different depth and shape of trough corresponding to the vowel *ai* (e) in vr*ai* and in vr*ai*semblable, that is, in circumstances of strong and weak stress respectively. The inscription of jaw-movement is accompanied by simultaneous records (*b*) of sound vibrations, registered by the usual phonetic tambour, and (*c*) of the vibrations of a tuning-fork (100 per. sec.). Clearly by synchronising these three tracings we can determine to what phase of jaw-movement each sound corresponds and the time relations between the points of maximum stress. Most of the records thus synchronised have been registered on surfaces moving at a rate of about 10 in. per sec. and permit of accurate time measurements to within a 200th of a second.

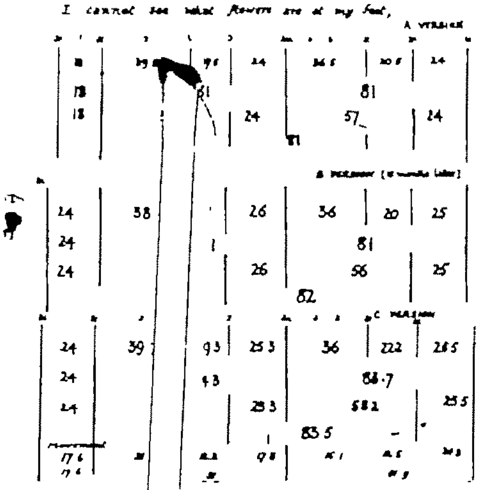
Detailed study of these curves soon reveals a host of unsuspected phonetic data of which the mere summarisation would require more space than is here available. The consonants, according to their nature, can occur only at very definite places on the curve;

and controls and degree and quality of contact. In fine, the observer is able to watch in operation those very factors that have proved so profoundly influential in the historical evolution of speech-sounds.

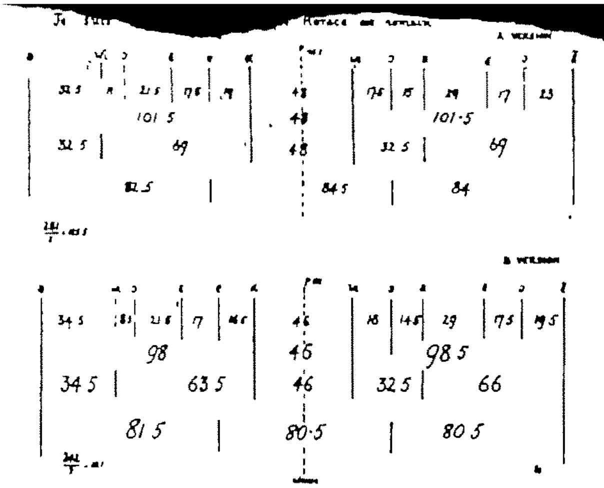
The utility of the curves for the mensuration of poetical rhythm, a subject of greater interest to the general reader, can be more succinctly exemplified. We give below two sets of figures typical of those obtained from the mensuration of many experimental tracings of the kind described. To guard so far as possible against chance numerical coincidences, each experiment has been performed in duplicate or triplicate, *i.e.* the speaker has repeated his lines two or three times. In more than one case, after the corrections necessitated by the slight variations in speed of the best-regulated kymograph had been made, the recitation-curves, complex though they were, were found to be absolutely superposable; in others they had been systematically and proportionately varied and reflected slight alterations in the speaker's *tempo*.

In the following tables each vertical line must be supposed drawn through the lowest point of the trough of the vowel of which the symbol figures at the top of that line; the numbers give the time, in 100ths of a sec., taken by the voice in passing from lowest point to lowest point.

I. Three recitations of the line, "I cannot see what flowers are at my feet."


I cannot see what flowers are at my feet,
24
38
26
36
20
25
24
81
24
26
56
25
82
24
39
36
24
24

It is scarcely
site to insist upon the constant
evidence of ord
ess displayed by these figures.
Excluding the i
interval, the time falls into two
equal groups—e
beyond the metrician's dream—
delimited by tw
ominent stress-maxima; each of
these groups is a
symmetrically subdivisible. The
very weak stres
as may be judged from Fig. 1)
show no measur
maxima.



Here in each recitation the addition of intervals results in a central symmetry of identical design the [illegible] second Div[illegible] chronising this po[illegible] to coincide with the [illegible] same holds true for B v[illegible] say, the '-cæsura,' though n[illegible] situated exactly midway betwe[illegible] stress-maxima. This twin experim[illegible] interesting as revealing (*a*) a stress-[illegible] French verse, (*b*) the manner in which a rec[illegible] ducing his total time expenditure by 9 in 251 h[illegible] of a second, yet accurately apportions the red[illegible] as to maintain the same organic rhythmical structure.

In this preliminary account of a few among a very large number of experiments, I have been compelled to choose only short examples, and to give of these a very summary interpretation. I may, perhaps, add that more extended records, notably those embracing a complete stanza, yield time-forms of beautifully elaborate and accurate symmetrical structure.

J. W. JEAFFRESON.

Dutch Pendulum Observations in the Atlantic and the Pacific.

By Dr. J. J A. MULLER.

THE voyage of Dr. Vening Meinesz announced in NATURE of June 5, 1926, has almost been completed. The latest information by letter was from Honolulu; a cablegram reported the arrival at Amboina on November 25.

H.M. Submarine *K XIII.* left Helder on May 27 on a calm, sunshiny day, but the weather soon changed and after leaving the channel it was impossible to make any observations above the slope to the deep sea. A few days before sailing the ship had taken in much cargo, especially liquid fuel, and the trim was not known, which made it inadvisable to submerge for the first time in a very rough sea. The first observation was made June 2, and nearly every day after this date while at sea the pendulum apparatus was used in the submerged ship, on several days more than one and sometimes so many as four observations were made As on his former voyages, Dr Vening Meinesz also measured the intensity of gravity in every harbour where the submarine called.

The new apparatus has fully answered to expectations; the pitching of the ship causes no troublesome disturbance, and sliding of the pendulums need not be feared. This apparatus can be used in circumstances in which that used during the former voyage would have failed. A rolling of 3°·5 to both sides was no hindrance to the making of observations. This was a great advantage, as in the Atlantic, at a depth of 20 and more metres, the rolling sometimes reached as much as this The strong swell in the Atlantic and the Pacific destroyed the hope that it might be possible to make observations at the surface of the sea

Unfortunately for the deep sea soundings, the senders of the underwater clock signals were placed too high in the shipboard, in the wave zone. The echo was not a definite sound, and consequently the echo method could not be used for soundings at the surface of the sea; in the submerged vessel the place of the senders caused no trouble. The sonic depth-finder, which had been received only a few days before departure from Helder, has been of no use. Before San Francisco was reached, again and again Commander van der Kun and Dr. Vening Meinesz when trying to detect what was wrong, thought at first it was due to the relay; at length it appeared to be a defect in the construction, which only the maker in London can put right. It is a disappointment that owing to these two circumstances the voyage will contribute in only a limited manner to our knowledge of the depth of the sea on the track. For the determination of the interval of time between the production of the sound and the perception of the echo, a stop-watch of the Royal Navy was used indicating a hundredth part of a second.

The time signals used were at first those of Bordeaux, which were audible so far as Mona Passage, and afterwards those of Annapolis, which could be perceived for some days after leaving San Francisco. The use of the signals of Balboa and San Diego could be dropped, and the Naval Observatory at Washington was informed that these stations need not be controlled. In the whole Pacific the time signals of Lembang, given by the powerful radio station of Malabar (Java) can be used; these were clearly audible in Curaçao. The Nardin chronometers were the same as were used on the voyage in 1925; the regularity of the run of both was marvellous. For the comparison of the chronometers with the rhythmic time signals, Dr. Vening Meinesz intercalates the interrupter of the mean time chronometer in the telephone circuit and observes the appearance and the disappearance of the time signals; in this way the personal equation is almost entirely eliminated.

After taking an observation, the film was as a rule immediately developed; often it was directly measured and the preliminary result computed. Only when the temperature was too high was the developing put off until the next harbour was reached. Dr. Vening Meinesz estimates that the difference between the preliminary results will not exceed 0·005 cm./sec.[2], the isostatic reduction, however, will produce much greater differences. In this connexion it will be wise not to arrive at far-reaching conclusions immediately with regard to the prevailing theories of the constitution of the earth's crust, but to wait until the final computations are to hand.

The number of observations on sea at the different passages so far as Manila is as follows ·

Helder—Horta . .	May 27-June 6 :	4,
Horta—Las Palma .	June 9-June 14 :	5,
Las Palmas—Curaçao .	June 21-July 8 ·	17,
Curaçao—Coco Solo .	July 20-July 24 :	4,
Balboa—Mazatlan . .	July 30-Aug. 10 .	12,
Mazatlan—San Francisco	Aug. 17-Aug. 24 .	8,
San Francisco—Honolulu	Sept 7-Sept. 20 :	15,
Honolulu—Guam . .	Oct. 2-Oct 21 :	20,
Guam—Manila . .	Oct. 28-Nov. 8 :	12.

The total number is 97; up to November 8 the number of observations made at sea and in the harbours is 106 altogether.

With the reservation just made, I give the following particulars about the anomalies shown by the preliminary results. The anomalies refer to the Helmert formula of 1901 and are expressed in cm./sec.² or dynes.

The first observation gave a normal gravity :

June 2, 44° 12' N, 15° 33' W., sea-depth 3000 metres, anomaly +0·004.

The three following gave an excess :

June 3, 43° 13' N, 18° 46' W, sea-depth 4350 metres, anomaly +0·055

" 4, 41 33 21 57 " 4000 " " +0·042

" 5, 39 48 24 57 " 3550 " " +0·062

The last was above the mid-Atlantic ridge.

At Horta the anomaly was +0·126.

Eastward from the ridge the anomaly diminished to 0·016; near the north coast of Teneriffe the coast effect was shown by an anomaly of −0·008.

At Las Palmas the anomaly was +0·210. According to a communication from Dr Bowie, it is reduced to +0·089 by applying the isostatic correction.

After leaving Las Palmas the first three observations gave the following anomalies :

June 22, 27° 12' N., 17° 51' W., sea-depth 3610 metres, anomaly +0·040

" 23, 26 33 21 39 " 4630 " " +0·029

" 24, 25 43 25 19 " 4820 (?) " " +0·030

On July 25, the sea being very smooth, an observation was made at the surface, but at intervals a heavy swell occasioned excessive amplitudes of the pendulums and no result could be obtained. The attempt has not been repeated.

On the following days the anomaly amounted to from +0·015 to +0·029 as the sea-depth diminished from 6400 to 3940 metres. The next observation was made on the ridge.

June 30, 23° 21' N., 47° 2' W, sea-depth 3460 metres, anomaly +0·046.

On July 1, sea-depth 4520-5820 metres, the anomaly was +0·030

In the Atlantic between 32° and 54° W. the depth of the sea often showed great changes; the interval between the sound and the echo varied in the moving vessel in a few minutes by several seconds and then again returned to its former value The sea bed seems to be extremely rugged there. The sea-depths also showed great differences from those given on the "Cartes bathymétriques des Océans" of the Prince of Monaco.

Farther west the gravity was normal :

July 2, 22° 45' N., 54° 35' W., sea-depth 5760 metres, anomaly +0·002

" 3, 22 17 58 27 " 5640 " " +0·002.

Getting nearer to the Porto Rico deep, the gravity increased.

July 4, 21° 35' N, 63° 22' W, sea-depth 5480 metres, anomaly +0·023

" 5, 20 42 65 30 " 5290 " " +0·031

This last observation was at the edge of the deep.

July 5, 19° 30' N, 66° 51' W., sea-depth 7660 metres, anomaly −0·321,

above the deep but not at the greatest depth.

July 6, 18° 42' N, 67° 42' W, sea-depth 290 metres, anomaly +0·005,

in Mona Passage.

Before reaching Curaçao an observation was made in the Caribbean Sea.

July 6, 16° 54' N., 67° 42' W, sea-depth 4740 metres, anomaly −0·006

In the harbour of Willemstad (Curaçao) the anomaly amounted to +0·174

Between Curaçao and Colon the Caribbean Sea showed a deficiency of gravity, in the harbour of Coco Solo (Colon) the anomaly was +0·083 and in that of Balboa (Panama) +0·094

On July 31 the first two observations in the Pacific were made, but unfortunately they were both failures, the film being insufficiently extended, so that it was wrinkled and got torn. Before reaching Coco Solo there had been some difficulty in changing the speed of the film, the tension being too great, so it had been slackened. Since this experience the tension of the film has caused no further difficulty.

Along the west coast of America from Balboa to San Francisco the number of successful observations was eighteen at sea and one in the harbour of Mazatlan; so far as this harbour they showed an excess of gravity.

Aug 1, 7° 1' N., 82° 38' W., sea-depth 3020 metres, anomaly +0·061

" 3, 10 22 88 28 " 3490 " " +0·058

" 5, 13 35 95 27 " 3840 " " +0·051.

On Aug. 6 a set of four observations was made in a profile nearly perpendicular to the coast :

14° 58' N., 98° 25' W, sea-depth 3650 metres, anomaly +0·042

15 17 98 21 " 3950 " " +0·020

15 38 98 18 " 4750 " " −0·070

16 1 98 12 " 890 " " +0·037.

Aug. 8 a set of three observations :

17° 30' N., 101° 21' W., sea-depth 4990 metres, anomaly −0·076

18 0 103 26 " 3010 " " −0·070

18 14 103 27 " 670 " " +0·031.]

In the harbour of Mazatlan the anomaly was +0·036.

On July 19 a set of three observations was again made; the results have not yet been received. Along the U.S Pacific coast the gravity was normal. After leaving San Francisco a last set of three observations was made for the study of the coast effect.

In the eastern part of the Pacific the gravity was at first normal; after half the way to the Sandwich Islands had been covered it showed a positive anomaly :

Sept 14, 28° 57' N, 141° 16' W., sea-depth 4920 metres, anomaly +0·090

" 18, 22 57 153 41 " 4540 " " +0·065

It appears that the excesses of gravity in the Atlantic and the Pacific extend over enormous areas, while the excesses or defects on the continents possess a more limited, regional character.

The preliminary results of the observations do not show any trace of a flattening of the equator; it may be expected that this problem will be solved by the final results.

The long voyage from Las Palmas to Curaçao, 17 days, from San Francisco to Honolulu, 13 days, and from Honolulu to Guam, 19 days, was very strenuous, and the relaxation in the harbours was well deserved. In every harbour at which the submarine called, the crew met with the most cordial reception. Scientific workers, especially at San Francisco and at Honolulu, took much interest in Dr. Vening Meinesz and his work. In the latter place he met a number of delegates to the Pan-Pacific Congress on their voyage to Tokyo.

Thus far the voyage, the longest ever made by a submarine, has been very successful. If all goes well Dr. Vening Meinesz should have reached Surabaya about December 10; he will then stay at Java for some time to recover from the fatigues of the voyage before his return home on board a mail steamer. It may be recorded with satisfaction and thanks that the commander, the officers, and the crew of the submarine did all they could to facilitate the fulfilment of his task.

After the receipt of particulars about the rest of the voyage up to the arrival at Surabaya, I propose to give a brief account of the later results and to complete the present information.

Since the above was written, I have received from Washington the isostatic reductions of the observations made between Helder and Curaçao. These have been computed by the U S Coast and Geodetic Survey as a token of appreciation of the work of Dr. Vening Meinesz, which is justly considered to be of international interest. I must express here a word of thanks for this valuable co-operation, especially to Dr. William Bowie, Chief of the Division of Geodesy.

For the present it may suffice to mention that the excess of gravity in the Atlantic is confirmed, after the isostatic reductions have been taken into account.

The Burning of Carbonic Oxide.

IT was a sound movement on the part of the directors of the Gas Light and Coke Company to invite Prof. Bone to lecture before the Company and others on the work which he is carrying out on gaseous combustion, and particularly on the investigations made by Mr. F. R. Weston, the first holder of the Gas Research Fellowship, founded by the Company three years ago, at the Imperial College of Science. Prof. Bone had no difficulty in proving what important scientific results can be secured by means of such endowments of research, and Mr. Milne Watson, governor of the Company, showed that he realised that the development of chemical industries depended on the successful prosecution of strictly scientific investigations in the laboratory.

After comparing and contrasting the flames of hydrogen and carbonic oxide, and the effect of their mixture in water-gas, Prof Bone took up the tale of the burning of carbonic oxide as it began to be studied in Oxford fifty years ago, when H. B. Dixon, in repeating Bunsen's experiments on the distribution of oxygen between hydrogen and carbonic oxide, showed that the latter apparently did not react directly with oxygen but was oxidised by the steam, and that the final division of the oxygen depended on an equilibrium being established between this and the reverse action—the reduction of the carbon dioxide by the hydrogen:

$$CO + H_2O \rightleftarrows CO_2 + H_2.$$

The non-inflammability of dried mixtures of carbonic oxide and oxygen led to many conjectures as to its cause, and as to the mechanism of steam in the reaction. That no chemical reaction can take place without 'conducting' water; that *liquid* water particles are the necessary electrical go-between; that gases can only react molecule with molecule, *i.e.* in equal volumes, that the oxygen molecule is too stable to be broken up, but steam is more yielding—these and other explanations were advanced by men of scientific eminence. For some years Dixon has held the more prosaic view that the direct oxidation of carbonic oxide in explosions is limited by the thermal dissociation of the carbon dioxide molecules, and that steam afforded the means of producing comparative cool molecules. The burning of dry cyanogen and the direct union of carbonic oxide and oxygen in contact with heated platinum seemed to show that steam was not essential, but this and the function of the steam were matters of inference. No direct proof of what happened in the flame was forthcoming.

Prof. Bone, whose first research on gaseous combustion, carried out at the Owens College, was the study of the slow union of carbonic oxide and oxygen when circulated over heated surfaces, now brings forward direct evidence of two kinds. He shows, first, that a very well-dried mixture of the two gases, which cannot be inflamed by an ordinary spark, can be exploded (at all events partially) when the electric discharge is made sufficiently powerful. In such conditions the flame traverses the bulb containing the mixture, though not with violence, and a large percentage of the gas combines in the flame. Again, Prof. Bone and Mr. Weston have shown that as the moisture is gradually removed from the mixture, the energy of the condenser discharge required to ignite it progressively increases. Lastly, the spectra of the flames of the well-dried mixture, the moist mixture, and of mixtures containing hydrogen have been photographed. The flame of the dried mixture burning under 25 atmospheres pressure shows a *continuous* spectrum and no steam lines. The flame of the undried mixture shows a strong *continuous* spectrum overlying a '*steam-line*' spectrum. On the addition of hydrogen the continuous spectrum grows less and the lines emerge, so that there is direct evidence that two reactions are taking place simultaneously in the ordinary flame—the direct oxidation of carbonic oxide by oxygen, and the indirect oxidation by steam. The intense electric discharge, on one hand, and the high pressure on the other, can confer on carbonic oxide the power of direct union with oxygen; in the presence of much steam the indirect reaction is predominant; with traces of steam both reactions occur together.

University and Educational Intelligence.

BIRMINGHAM.—The degree of D.Sc. has been awarded to Sydney Raymond Carter for numerous published papers on the oxidising properties of sulphur dioxide and other subjects.

LEEDS.—Sir Berkeley Moynihan, Bart., has resigned the professorship of surgery on his retirement from the full staff of the Leeds General Infirmary. In recording its regret at Sir Berkeley's retirement, the Council referred to his brilliant career as student in the Yorkshire College, with which the Leeds Medical School became incorporated, and after. "Throughout his career he has followed the tradition of the Leeds Medical School in bringing scientific knowledge into the service of surgery. With this he has associated a consummate skill in the art of surgery, thereby contributing substantially to the efficacy of surgical methods and the accuracy of diagnosis."

LONDON.—A lady, who desires to remain anonymous, has offered the University the sum of 10,000*l.* towards the establishment of a chair of dietetics.

Subject to certain conditions, the offer of Mr. J. G. Wilson to present to the University a 24-inch reflector telescope has been accepted. Lady Godlee is giving a sum of money, to be held in trust for University College and University College Hospital Medical School, to found a Rickman Godlee Lectureship in memory of her husband, the late Sir Rickman J. Godlee. The managing director of the Vultex Products, Ltd., on behalf of Mr. Patrick Gow, is to give a sum of money for three years for lectures on colloidal chemistry.

The following doctorates have been conferred:—*D.Sc. in Botany* on Mr. T. G. Hill, University reader in plant physiology, for a thesis entitled "The Water Economy of Maritime Plants"; *D.Sc. in Physics* on Mr. S. C. Roy (King's College), for a thesis entitled "On the Total Photo-electric Emission of Electrons from Metals as a Function of Temperature of the Exciting Radiation"; *D.Sc.* (*Engineering*) on Mr. L. B. Pfeil (Imperial College, Royal School of Mines, and Battersea Polytechnic), for a thesis entitled, (1) "The Deformation of Iron, with particular reference to Single Crystals;" and (2) "The Effect of Cold Work on the Structure and Hardness of Single Iron Crystals, etc."; *D.Sc. in Chemistry* on Mr. T. H. Durrans, for a thesis entitled "The Preparation of Sulphuryl Chloride and the Chlorination of Substances of the Aromatic Series"; together with subsidiary contributions.

Dr. Percival Hartley has been awarded the William Julius Mickle Fellowship for 1927 in respect of the work which he has carried out during the past five years on special problems in connexion with diphtheria and other problems of a more general character in connexion with serology and immunity. The Fellowship this year is of the value of about 280*l*.

THE Educational Commissioner with the Government of India in his Report for 1924–25 gives a new and very convenient summary of statistics showing totals of 88,750 students, 5700 teachers and 7500 graduations in arts and science of the fifteen universities. 52 per cent. of the students, 50 per cent. of the teachers, and 48 per cent. of the graduations belonged to the two universities of Calcutta and Madras; Bombay and the Panjab account for 25 per cent. of the students, 21 per cent. of the teachers, and 20 per cent. of the graduations; leaving 29 per cent., 23 per cent. and 32 per cent respectively as the share of the remaining eleven universities. These eleven, namely, the recently reconstituted Allahabad University and the ten new universities of Aligarh, Benares, Dacca, Delhi, Hyderabad (Osmania University), Lucknow, Mysore, Nagpur, Patna, Rangoon, had in the aggregate not much more than two-thirds of the number of students of the single university at Calcutta. An act, constituting a new "Andhra" university was passed in 1926. Every one of the universities had a faculty of arts; all except the Osmania University of Hyderabad (Deccan) had a faculty of science; all except Aligarh and Mysore a faculty of law; all except Aligarh, Allahabad, Benares, Dacca, Delhi, Nagpur, and Osmania, a faculty of medicine. There were faculties of education at Aligarh, Madras, Nagpur, Patna, and Rangoon; of theology at Aligarh, Benares, and the Osmania University; of agriculture at Madras and the Panjab; of forestry at Rangoon; of engineering at Calcutta, Madras, Mysore, Patna, and Rangoon; of economics at Allahabad and Rangoon; of commerce at Allahabad, Lucknow, and the Panjab. The total expenditure on universities, arts colleges, professional colleges, and intermediate colleges in India in 1924–25 was Rs. 83,76,000, Rs. 1,06,28,000, Rs. 65,16,000, and Rs. 28,00,000 respectively; in all Rs. 2,83,20,000 or, say, 2,124,000*l*. The sources from which the expenditure was met were: Government funds Rs. 1,43,29,000, district board and municipal funds Rs. 76,000, fees Rs. 1,08,43,000, other sources Rs. 30,73,000. Universities, notably Bombay and Calcutta, have received in recent years substantial additions to their resources through the generosity of private donors, but it will be seen that they are in the main dependent on Government funds and fees.

Contemporary Birthdays.

December 26, 1838.	Sir W. Boyd Dawkins, F.R.S.
December 26, 1881.	Sir Thomas Lewis, F.R.S.
December 28, 1882.	Prof. A. S. Eddington, F.R.S.
December 28, 1853.	Dr. Alexander Scott, F.R.S.
December 30, 1850.	Dr. William Garnett.
December 31, 1849.	Prof. Sydney H. Vines, F.R.S.

Sir WILLIAM BOYD DAWKINS, honorary professor of geology and palæontology in the University of Manchester, celebrates his eighty-eighth birthday to-morrow. We offer our very hearty congratulations. A fellow of the Geological Society for sixty-five years, he will, next year, attain diamond jubilee fellowship of the Royal Society. He is the author of two classical works, "Cave Hunting" and "Early Man in Britain."

Sir THOMAS LEWIS, born at Cardiff, was educated at Clifton College; his medical training was conducted at University College Hospital, London. Eminent in long-continued developmental studies relating to the mechanism and clinical disorders of the mammalian heart-beat, he has established conclusions of prime importance in physiology and practical medicine. Sir Thomas was Croonian lecturer at the Royal Society in 1917, delivering an address on "The Excitation Wave in the Heart."

Prof. EDDINGTON was born at Kendal. A student at Owens College, Manchester, he graduated at Trinity College, Cambridge, as senior wrangler, and was Smith prizeman. He was chief assistant at the Royal Observatory, Greenwich, from 1906 until 1913, leaving this post to become Plumian professor of astronomy in the University of Cambridge. Prof. Eddington was president of the Royal Astronomical Society, 1921–23; in 1924 he received its gold medal for his work on star-streaming, on the internal constitution of a star, and on generalised relativity. In the same year he was awarded the Henry Draper medal of the National Academy of Sciences of the United States.

Dr. A. SCOTT, a native of Selkirk, and educated there at the Grammar School, graduated at the University of Edinburgh, and also at Trinity College, Cambridge. From 1896 until 1911 he was superintendent of the Davy-Faraday Research Laboratory, Royal Institution. Dr. Scott was president of the Chemical Society, 1915–17, after many years of service to the Society in various administrative capacities.

Dr. GARNETT, born at Portsea, was educated at the City of London School and Royal School of Mines. Proceeding to St. John's College, Cambridge, he graduated fifth wrangler, becoming later a fellow of his college. Entering the Cavendish Laboratory, he had the distinction of being the first demonstrator of physics there under James Clerk Maxwell. After teaching at University College, Nottingham, he did valuable work as principal of the Durham College of Science. The advancement of technical education in London and elsewhere claimed earnest attention at his hands; from 1904 until 1915 he was educational adviser to the London County Council. Dr. Garnett is Hon. D.C.L., Durham.

Prof. VINES, distinguished as a botanist, is a Londoner. Educated privately, he graduated at Christ's College, Cambridge. For many years he was Sherardian professor of botany in the University of Oxford. He was president of Section K (Botany) at the Bradford meeting of the British Association in 1900, when he gave, in his address, a conspectus of botany in the nineteenth century. Prof. Vines was president of the Linnean Society, 1900–4.

Societies and Academies.

LONDON.

Geological Society, November 17.—C. J. **Stubblefield** and O. M. B. **Bulman**: The Shineton shales of the Wrekin district, with notes on their development in other parts of Shropshire and Herefordshire. In the Wrekin district, the Shineton shales represent almost the whole of the Tremadocian succession, as developed in the Tremadoc district. The subdivision of shales in this main outcrop are:—(6) Arenaceous beds; (5) zone of *Shumardia pusilla*; (4) Brachiopod beds; (3) zone of *Clonograptus tenellus*; (2) transition beds; (1) zone of *Dictyonema flabelliforme* In the smaller outcrops of the shales lying on the west and south-west, only the lower part of the sequence has been identified. In the Wrekin district a thick mass of shales has been compressed against a north-eastern ridge formed of earlier Cambrian and pre-Cambrian strata, resulting in isoclinal folding with faulting in the north-eastern part of the shale outcrop. In the south-west of the district the shales are less disturbed, except in the immediate neighbourhood of the Church Stretton fault. Six new species of trilobites have been established, of which three belong to new genera; one new brachiopod and three new hyolithids are described.—W. J. **Arkell**: The Corallian rocks of Oxfordshire, Berkshire, and North Wiltshire. The subdivisions adopted are: (5) upper Calcareous grit; (4) *Trigonia-clavellata* beds; (3) Osmington Oolite series; (2) Berkshire Oolite series; (1) lower Calcareous grit. It is particularly emphasised that the Coral Rag is a facies deposit which may occur at any date, and that the use of 'the Coral Rag' as a stratigraphical term is not permissible. The substitution of the term by Blake and Hudleston's 'Osmington Oolite Series,' is suggested. Coral associations started in Yorkshire at the time of the lower Calcareous grit, and migrated southwards during the Corallian epoch, failing to become established in Dorset until the closing phase of the upper Calcareous grit. The chief feature of the Berkshire Oolite series, the Trigonia beds of Berkshire, are contrasted with the much later Trigonia beds of Dorset; whereas the former belong to the Argovian, the latter must be assigned to the Sequanian, the intervening Osmington Oolite series undoubtedly representing the Rauracian.

Linnean Society, November 18.—Miss E. R **Saunders**: The origin of the double garden stock A plant which appeared in the present season in an F_2 family from the cross, pure-breeding glabrous single cream ♀ × double-throwing glabrous white ♂, is of considerable interest, for the normal single and fully double condition were here exhibited in the same individual. The cross was made in 1923 and the resulting seeds sown the same autumn. The F_1 plants, which were purple and hoary (the factorial constitution of the parents being RHK and CK respectively), flowered in 1924. The seeds collected from one of these plants, which was covered, were not sown until the spring of 1926, when they yielded 179 hoary and 100 glabrous, of which 214 were single and 58 double. One of the hoary single-flowered plants produced six primary lateral axes in addition to the main axis; some of the flowers on the main axis showed characters intermediate between those of the single and those of the double flower. The sixth lateral branch produced mainly double flowers indistinguishable from those borne by the ordinary double-flowered plant. It is therefore possible that the mutation occurring here in only one branch may at some time have occurred throughout a whole individual, and so have given rise at one step to the double-flowered type.—Miss A. E. **Chesters**: The vascular supply of the bracts of some species of Anemone. In types exhibiting a large leafy involucre the vascular system of the peduncle is dominated by that of the involucre. In species like *A. Hepatica*, in which the involucre closely approximates to a calyx, the incoming bundles take a less prominent part in the formation of the vascular ring of the axis. The resemblance between the course of the bract bundles of *A. Hepatica* and the sepal bundles of *Ranunculus Ficaria* is very striking. The vascular supply of the bracts of *Eranthis hyemalis* resembles that of *A. nemorosa* in all essentials, suggesting that the modifications shown in the vascular system of *A. Hepatica* and *A. angulosa* are correlated with the reduction of the involucral leaves rather than with the difference in position. The evidence appears to support the view of the homology of the involucre of *A. Hepatica* and the calyx of *Ranunculus Ficaria*.

Physical Society, November 26.—H. C. **Hepburn**: Electro-endosmosis and electrolytic water transport. Determinations were made of liquid transport produced by passing an electric current through aqueous solutions of copper sulphate divided perpendicular to the flow of electricity by a diaphragm of powdered glass. The probable factors that determine the liquid transport are investigated over a wide range of concentrations, by an examination of the dependence of the flow at constant applied voltage and of the electric charge of the diaphragm on the electrolyte concentration, and also by a study of the relation between the flow per faraday and the dilution of the electrolyte.—L **Hartshorn**: The input impedances of thermionic valves at low frequencies. Accurate measurements of input admittance (or of input impedance) under various conditions can be made by means of the Schering capacity bridge. The input circuit is regarded as being equivalent to a condenser with a definite phase angle, ϕ, or "loss angle," $\delta = 90° - \phi$, and the results are expressed by stating the effective capacity and value of tan δ for each set of experimental conditions The effective capacity may vary from about 10$\mu\mu$F. to 100$\mu\mu$F. for an *R* valve, and the phase angle may vary from about 80° leading to 126° leading, depending mainly on the load in the anode circuit. Values of phase angle greater than 90° correspond to a negative resistance or negative power factor, and occur when the load in the anode circuit is inductive.

CAPETOWN.

Royal Society of South Africa, September 29.—T. R. **Sim**: The Bryophyta of South Africa.—E. Percy **Phillips**: Some notes on South African grasses. The characters and distribution of the various South African grasses, and the economic questions associated with them are discussed, and the effects of veld burning described.—J. H. **Power**: Some tadpoles from Griqualand West.

October 20.—John **Phillips**: Faurea McNaughtonii Phill. ("Terblanz"), a note on its ecology and distribution. This stately forest tree (Proteaceæ: sect. Persoonioideæ) is of peculiar regional and local distribution.—M. R. **Levyns**: Note on the genus Lobostemon (Lehm.) A new classification, based on floral characters, is used. It is proposed to restrict the genus Lobostemon to those forms in which a definite scale or swelling is present on the corolla at the base of each stamen, and to constitute a new genus for those forms in which a scale or swelling is absent.—**P. R. v. d. R. Copeman**: Studies in the growth of grapes. Equations have been developed for the growth changes in the acid, sugar, and soluble solid content of the juice and in the total solids in the berry for six different varieties of grapes analysed during three seasons. The growth of the grape berry may be divided into two distinct cycles. In the first cycle the soluble solids formed consist mainly of acid and protein. During the second cycle the changes in the soluble solids are practically entirely due to the changes in the sugar and acid. Growth constants can be derived which serve as a means of comparison between the different varieties for the different seasons.—**H. O. Monnig**: On a new Physaloptera from an eagle and a Trichostrongyle from the cane rat, with notes on *Polydelphis quadricornis* and the genus Spirostrongylus.—**D. F. Bleek**: Bushmen of Central Angola. These Bushmen are Kung, speaking a language similar to the like-named inhabitants of the South-West Protectorate. They are much influenced by the surrounding Bantu tribes, on whom they are becoming more and more dependent. Their religious beliefs are akin to those of other Bushmen, save for an acquired fetish worship. The tribe will probably be absorbed by the Bantu races.

ROME.

Royal National Academy of the Lincei, Communications received during the vacation.—**U. Cisotti**: Inversion of Poisson's formula on rigid motions.—Giorgio **Abetti**: Observations on the motions of metallic vapours in sunspots.—**L. A. Herrera**: Chemotaxis and phagocytosis in imitation of leucocytes. The microscopic amœba-like forms produced in petrol and olive oil by the injection of drops of alkaline water are due to currents and movements produced by rapid penetration into the osmotic pockets of the oil rendered more fluid by the petrol. The results indicate that phagocytosis must be regarded as of mechanico-physico-chemical character. Acetic acid acts as an anti-body or opsonin which determines the chemotaxis of the oily 'amœbæ.' It seems probable that similar currents are produced between the natural leucocytes and bacteria.—Tommaso **Boggio**: The geodetic deficit.—**E. Bompiani**: The geometry of surfaces considered in ruled space.—Alessandro **Terracini**: The linear projective element of a surface.—**E. Raimondi**: General formulæ for the calculation of the dynamic effect of a current flowing between a strip and an indefinite plane wall.—Renato **Mancinelli**: The Evershed effect in sunspots.—Mario **Picotti**: Results of the physico-chemical investigations made in the Italian cruiser *Marsigli* in the Straits of Messina. The amount of oxygen dissolved in the water of the Straits of Messina rises to maximum values in April and in September, in which months plankton are exceptionally plentiful. The value of pH lies mostly between 8·1 and 8·2, but values below 8·1 are sometimes encountered in the depths and values above 8·25 at the surface.—Marya **Kahanowicz**: Spectrum of the Pickering type in argon. Under a suitable pressure and when strongly excited, argon gives rise to an enhanced spectrum of the Pickering type. The emissive atom exhibits hydrogenoid behaviour, an electron revolving about the nucleus.—**G. Wataghin**: The aberration of light and the theory of relativity. The relativistic formula for aberration, established by Einstein for plane-waves, is valid also for spherical waves. The theory of aberration may be developed on the basis merely of the hypothesis that light is propagated in a straight line with respect to any inertial system whatever. Various particular aspects of the theory are discussed.—Bianca **Nannei**: Method for the measurement of variations in the calorific capacity in magnetic fields.—Marcelle **Philibert**: Apparent doubling of the optic axis of calcite with Federow's plate.—**G. Carobbi**: Investigations on some noteworthy Vesuvian sublimates. The presence of traces of soluble vanadium compounds is observed for the first time, and that of soluble titanium compounds and boric acid confirmed, in deposits on Vesuvius.—Gaetano **Charrier**: 1-*N*-Phenyl-αβ-naphtho-1:2:3-triazolequinone.—Raoul **Poggi** and Angiolo **Polverini**: The determination of phosphorus and arsenic in organic substances. The method suggested consists in oxidising the substance by means of concentrated sulphuric acid and potassium persulphate, and afterwards determining the phosphorus or arsenic by the ordinary methods.—**G. Scagliarini** and **G. Tartarini**: Compounds of titanium halides with oxygenated organic substances.—Edoardo **Benedetti**: The action of the high frequency oscillating electromagnetic field on vegetable seeds. Experiments made with maize, wheat, barley, and rice show that the oscillating field results in both accelerated growth and increased percentage germination.—Umberto **D'Ancona**: The reproduction of *Alosa finta* (Cuv.).

SYDNEY.

Royal Society of New South Wales, October 6.—**A. R. Penfold** and **R. Grant**: The germicidal values of some Australian essential oils and their pure constituents; together with those of some essential oil isolates, and synthetics (Part 4). The Rideal-Walker co-efficients of some Australian essential oils and perfume synthetics have been determined. The following coefficients were measured: Western Australian sandalwood oil, 1·5; East Indian sandalwood oil, 1·5; *Zieria macrophylla*, 2·0; zierone, 2; isomenthol, 20; phloracetophenone-dimethyl-ether, 10; hydrocinnamic-aldehyde, 7 (5·3); hydroxycitronellal, 6 (4); C_8 aldehyde, 16 (22); C_9 aldehyde, 9·5 (23); C_{10} aldehyde, 7 (9·25); C_{11} aldehyde, 7 (9·25); C_{12} aldehyde (methylnonyl acetic), 1 (3·5); C_{12} aldehyde (laurinic), 3 (5); C_8 alcohol, 25 (26), C_9 alcohol, 13 (19); C_{10} alcohol, 5 (6·25); C_{11} alcohol, 4·5 (5·75); C_{12} alcohol, 2·75 (3·5). The dispersions consisted of 1 per cent. of the constituents in 7·5 per cent rosin-soap solution. The numerals in brackets refer to the dispersions in absolute ethyl alcohol.

Official Publications Received.

BRITISH AND COLONIAL.

Royal Agricultural Society of England. Report of the Council to the Annual General Meeting of Governors and Members of the Society, to be held at the Royal Agricultural Hall, Islington, London, N., on Wednesday, December 8, 1926, at 2.30 P.M. Pp. 20. (London.)

Journal of the Chemical Society: containing Papers communicated to the Society, November 1926. Pp. viii+iv+2763-2978. (London: Gurney and Jackson.)

Transactions of the Institution of Chemical Engineers. Vol. 3, 1925. Pp. 187. (London.)

Calendar of the Royal Society of Medicine, 1926-27. Pp 77. (London.)

Department of the Interior, Canada: Topographical Survey. Bulletin 58: The March of the Compass in Canada, and Daily Variation Tables. By W. H. Herbert. Pp. 20. (Ottawa: F. A Acland.) 10 cents.

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol 51, Part 2, November. Pp. 177-356+xciii-cliv+44 plates. (London.) 7s. 6d.

Tide Tables for the Eastern Coasts of Canada for the Year 1927: including the River and Gulf of St Lawrence, the Atlantic Coast, the Bay of Fundy, Northumberland and Cabot Straits; and Information on Currents. Issued by the Tidal and Current Survey Branch of the Hydrographic Survey, in the Department of Marine and Fisheries of the Dominion of Canada. (Thirty-first Year of Issue.) Pp. 76 (Ottawa: F. A. Acland.)

Proceedings of the Society of Psychical Research. Part 100, Vol. 36 December. Pp. 345-592. (London: Francis Edwards.) 8s. net.

Journal of the Indian Institute of Science. Vol. 9A, Part 5: The Fat from 'Salvadora Oleoides'; Khakan Fat. By C. K. Patel, S. Narayana Iyer, J. J. Sudborough and H. E. Watson. Pp. 117-132. 12 annas. Vol. 9A, Part 6: The Constituents of some Indian Essential Oils. Part 19: The Essential Oil from the Rhizomes of 'Kaempferia galanga,' by Puthan Madhathil Bhaskara Panicker, B. Sanjiva Rao and John Lionel Simonsen; Part 20: The Essential Oil from the Rhizomes of 'Curcuma aromatica,' Salisb., by B. Sanjiva Rao, Vishnu Purushottam Shintre and John Lionel Simonsen; Part 21: The Essential Oil from the Wood of 'Erythroxylon Monogynum,' Roxb., by B. Sanjiva Rao, Vishnu Purushottam Shintre and John Lionel Simonsen. Pp. 133-148. 12 annas. Vol. 9B, Part 2: The Characteristics of Beam Transmitting Aerials. By J. K. Catterson-Smith. Pp. 9-19+4 plates. 1 rupee. (Bangalore.)

The Medical and Scientific Archives of the Adelaide Hospital. No. 5 (for the Year 1925). Pp. 34. (Adelaide: R. E. E. Rogers.)

Hull Museum Publications. No. 142: Record of Additions, No. 69. Edited by T. Sheppard. Pp. 16+14. (Hull.)

Canterbury College (University of New Zealand). Records of the Canterbury Museum, Vol. 3, No. 1. Pp. 81+17 plates. (Christchurch, N.Z.)

The Wellcome Bureau of Scientific Research and Museum of Medical Science (including Tropical Medicine and Hygiene), 25-28 Endsleigh Gardens, London. Pp. 92. (London: The Wellcome Foundation, Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 1, No. 1: The Glacial Geology of the Southern Uplands of Scotland, West of Annandale and Upper Clydesdale. By Dr. J. Kaye Charlesworth. Pp. 23+1 map. 3s. 6d. Vol. 55, Part 1, No. 2: The Readvance, Marginal Kame-Moraine of the South of Scotland, and some later Stages of Retreat. By Dr. J. Kaye Charlesworth. Pp. 25-50+1 map. 3s. 6d. Vol. 55, Part 1, No. 3: The Petrology of Iceland. By Dr. G. W. Tyrrell and Dr. Martin A. Peacock. Preface; and Part 1: The Basic Tuffs, by Dr. Martin A. Peacock. Pp. 51-76+2 plates. 4s. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Philosophical Transactions of the Royal Society of London. Series B, Vol. 215. B425: The Aloinae; a Cytological Study, with Especial Reference to the Form and Size of the Chromosomes. By Nesta Ferguson. Pp. 225-253+plates 15-19. (London: Harrison and Sons, Ltd.)

Kent Education Committee. Report of an Investigation of the Free Place Scholarship Examination, 1926, in the County of Kent. By Andrew Bell. Pp. 55. (Maidstone: Director of Education.) 1s.

Transactions of the North East Coast Institution of Engineers and Shipbuilders. Edited by E. W. Fraser-Smith. Vol. 42, Part 2, November. Pp. xxviii+25-98. (Newcastle-upon-Tyne.) 5s.

The Imperial College of Tropical Agriculture. Prospectus for 1927-28, also Principal's Report for 1925-26 and Register. Pp. 29+2 plates. (St. Augustine, Trinidad, B.W.I.; London: 14 Trinity Square, E.C.3.)

The Imperial College of Tropical Agriculture. Speeches at a Luncheon to the Prime Ministers and Representatives of the Dominions and India to the Imperial Conference, 1926. Pp. 12. (St. Augustine, Trinidad, B.W.I.; London: 14 Trinity Square, E.C.3.)

FOREIGN.

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University: Publications de la Faculté des Sciences de l'Université Masaryk. Rok 1926. Čís 70: Iter Turcico-Persicum. Pars 3: Plantarum collectarum enumeratio. Scripsit Dr. Fr. Nábělek. Pp. 75+7 tab. Čís. 71: O krystalech pyropu od Agua Suja v Brasilii (Sur les cristaux du pyrope de Agua Suja en Brésil). Napsal Vojtěch Rosický. Pp. 9. Čís. 72: Sur les correspondances analytiques entre deux plans projectifs, Première partie. Par Otakar Borůvka. Pp. 40. Čís. 73: Katalytická redukce dimethylglyoximu 2, 3-diaminobutan (Réduction catalytique du dimethylglyoxime 2, 3-diaminobutane). Napsali J. Frejka a L. Zahlová. Pp. 48. Čís. 74: Jak působí světlo na povrchové napětí rostlinných šťav (The Influence of Light on the Surface Tension of Plant Sap). Napsal Ferd. Herčík. Pp. 18. Čís. 75: Kopulace žabronožky smění, Chirocephalus Grubii Dyb (Copulation chez Chirocephalus Grubii Dyb). Napsal Bruno Valoušek. Pp. 15. Čís. 76: Onobrychis generis revisio critica, Partes secunda et tertia. Scripsit G. Širjaev. Pp. 155. Čís. 77: O některých skapolitech moravských (Sur quelques scapolites de Moravie). Napsali B. Konečný a V. Rosický. Pp. 26. Čís. 78: Vztah mezi atm. srážkami a nadm. výškou na Moravě a ve Slezsku (Le rapport entre les précipitations atmosphériques en Moravie et en Silésie et l'altitude au dessus du niveau de la mer). Napsal Fr. Říkovský. Pp. 15. Čís. 79: "Asterophyllites Dumasi Zeill. var. moravicus nov. var." z permu boskovické brázdy ("Asterophyllites Dumasi Zeill. var. moravicus nov. var." du Permien de la fosse de Boskovice). Napsal Dr. Josef Augusta. Pp. 12. (Brno: A. Píša.)

Biologické spisy vysoké školy zvěrolékařské, Brno (Publications biologiques de l'École des Hautes études vétérinaires, Brno). Svazek 4, Spis 51-60 (Tome 4, Fascicule 51-60), 1925. Pp. ii+35+29+12+11+22+20+30+23+27+14. (Brno: A. Píša.) 40 Kč.

Sborník vysoké školy zemědělské v Brně (Bulletin de l'École supérieure d'agronomie, Brno). Sign. C7: Druhý příspěvek k rozšíření zoocecidií v Čechách (Deuxième contribution à l'extension des Zoocécidies dans la Bohême). Napsal Dr Ed. Baudyš. Pp. 105. Sign. C8: Pátý příspěvek k zoocecidiologickému prozkoumání Moravy a Slezska (Recherches sur les Zoocécidies de Moravie et de Silésie, Cinquième contribution). Napsal Dr. Ed. Baudyš. Pp. 48. (Brno: A. Píša.)

University of California Publications. Publications of the Lick Observatory, Vol. 14, Part 2: The Spectra of Nova Geminorum (1912). By William H. Wright. Pp. 23-91+plates 2-6. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.)

University of California Publications in American Archaeology and Ethnology. Vol. 23, No. 2: Historic Aboriginal Groups of the California Delta Region. By W. Egbert Schenck. Pp. 123-146. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.) 30 cents.

Diary of Societies.

TUESDAY, DECEMBER 28.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. V. Hill: Nerves and Muscles: How we feel and move: (1) Nerves and the Messages they carry.

THURSDAY, DECEMBER 30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. V. Hill: Nerves and Muscles: How we feel and move: (2) Muscles and how they move

FRIDAY, DECEMBER 31.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Questions and General Technical and Practical Discussions.

SATURDAY, JANUARY 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. V. Hill: Nerves and Muscles: How we feel and move: (3) The Heart and some other Muscles.

TUESDAY, JANUARY 4.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Royal Agricultural Society) (at Royal Society of Arts), at 7.—Dr. B. A. Keen: The Place of the Tractor in Soil Cultivation.

CONFERENCES.

DECEMBER 30 TO JANUARY 7.

ANNUAL CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College).

Thursday, December 30, at 3.—Sir Henry A. Miers: The Choice of What is Good for Others (Presidential Address).

Friday, December 31, at 11.30 A.M.—Earl of Clarendon: Empire Settlement and Development.—King Alfred School Society, at 2.—J. Wicksteed: The Evolutionary Value of Co-Education.—Royal Drawing Society, at 5.30.—H. E. Peacock and P. Griffith: The Education and Development of Æsthetic Ability in Young People.

Saturday, January 1.—Educational Handwork Association, at 2.—J. H. Everett: The Teaching of Practical Elementary Science.—Leplay House, at 3.—Discussion: The Periodical Observation. Its Use for Observational and Regional Survey Work.—International Language (Ido), at 5.—G. H. Richardson: International Language: The Present Situation and the Prospect.

Monday, January 3.—Eugenics Society, at 11 A.M.—Prof. E. W. MacBride: The Nature and Origin of Racial Differences.—British Psychological Society (Education Section), at 6.—Discussion: S. J. F. Philpot, Miss Barbara Low, and others: The Cinema in Relation to the Mind of the Child.—British Association for Physical Training, at 5.30.—C. S. Thomson: Hygiene and Physical Training.

Tuesday, January 4.—School Nature Study Union, at 3.—Dr. E. J. Salisbury: Salt Marsh Vegetation.

Wednesday, January 5.—Society for Experiment and Research in Education, at 10.30 A.M.—J. H. Whitehouse and others: Creative Education.—Child Study Society, at 5.30.—Miss Lilian Barker: The Girl Delinquent.—British Esperanto Association, at 5.30.—Rev. Prof. T. G. Bailey: Esperanto in the World to-day.

Thursday, January 6.—National League for Health, Maternity, and Child Welfare, at 5.—Miss Gardner, Dr. R. J. M. Horne, and others: Discussion: Open Air Schools.—London Head Teachers' Association, at 5.—W. A. Brockington and Prof. Godfrey Thomson: Technique of Examination.

Friday, January 7.—British Broadcasting Company, at 11.—J. C. Stobart and others.

GEOGRAPHICAL ASSOCIATION (at London School of Economics, Houghton Street, Aldwych, W.C.2).

Thursday, January 6, at 11.30 A.M.—Major C. Patrick: Mapping from Air Photographs.—At 5.—Miss Eileen Power: Trans-Asiatic Caravan Routes in Ancient and Modern Times.—At 8.—J. Fairgrieve: Geography Teaching in Primary Schools.—Sir Henry G. Lyons: Geography in the Universities.

Friday, January 7, at 10.—Prof. H. J. Fleure: The Teaching of Geography.—At 11.45.—Sir C. F. Close: Population Problems of the Empire (Presidential Address).—At 2.—Col. Jack: The Work of the Ordnance Survey Department.

Saturday, January 8, at 10.—Prof. T. P. Nunn: Boy Scout Geography.—At 11.30.—Mrs. Ormsby: Regional Survey in a Large City.

JANUARY 4, 5, 6, AND 7.

SCIENCE MASTERS' ASSOCIATION (Annual Meeting) (at Oxford).

Tuesday, January 4, at 8.15.—Brig.-Gen. H. Hartley: Presidential Address.

Wednesday, January 5, at 9.45 A.M.—Prof. F. Jenkin: The Astrolabe as an Introduction to Astronomy.—C. N. Hinshelwood: Catalysis.—Prof. R. A. Peters: Recent Advances in our Knowledge of Vitamines.—At 5.15.—J. H. Morrell: Short Wave Work.—At 8.15.—Prof. E. B. Poulton: Protective Resemblances and Mimicry in Insects.

Thursday, January 6, at 9.45 A.M.—F. Twyman: Spectrum Analysis by Emission Spectra.—E. J. Holmyard: Alchemy.—N. V. Sidgwick: Atomic Structure and the Periodic Law.—At 5.15.—R. S. Capon: Aeroplane Performance Testing.—At 8.15.—Prof. H. H. Turner: Eclipses, with special reference to the Total Eclipse of June 29, 1927.

Friday, January 7, at 9.45 A.M.—G. M. B. Dobson: The Upper Atmosphere.

Supplement to NATURE

No. 2957 JULY 3, 1926

Some New Possibilities in Solar Research.

By Dr. GEORGE E. HALE, For. Mem. R.S.

FORTY years ago I began a series of visual and photographic studies of the sun. Recently I have returned to this work, after an interval of enforced absence. My instrumental equipment is now augmented by the addition of a spectrohelioscope, a simple device for monochromatic vision which we owe in its essence to the pioneers of solar research. This renders visible a host of important phenomena hitherto concealed from view by the overpowering brilliancy of the sun's disc. Chief among these are the radiating and absorbing regions of the hydrogen atmosphere, visible with the spectroscope in profile at the sun's limb, and revealed in projection by spectroheliograms of the disc, but now accessible, wherever they may be situated, to visual observation with instruments of moderate size.

All readers of NATURE who are familiar with its early volumes will remember the discoveries of Janssen and Lockyer in 1868. At the total solar eclipse of that year, Janssen, who was observing in India, was so impressed by the brilliancy of the lines in the spectrum of the prominences that he determined to look for them in full sunlight. He did so, and was at o[illegible]ded. The bright light of the sky around th[illegible] which ordinarily hides the prominences from us, gives the spectrum of scattered sunlight. Entering the spectroscope through a slit from one to three-thousandths of an inch wide, it is spread out into a band from a few inches to forty feet in length, depending upon the dispersive power of the spectroscope. Its intensity may thus be reduced indefinitely. The bright lines of the gaseous prominences, however, are essentially monochromatic. High dispersion separates them more and more widely, without greatly weakening them. They thus become readily visible on a fainter background of dispersed skylight. The principle involved was first stated by Lockyer in 1866 and successfully tested by him in 1868, before the news of Janssen's discovery had reached Europe. This application of the spectroscope opened a new and productive era in solar physics, enlisting the active efforts of astronomers in England, France, Italy, Germany, and the United States.

Naturally these observers wished to see not merely the spectra of the prominences, but also their forms. In his well-known book, "Contributions to Solar Physics" (p. 578), Lockyer describes how the first steps were taken:

> "In my first paper I gave some drawings procured by causing the slit to pass slowly over the prominence. By this means a number of sections of varying length was obtained, which, placed side by side, gave an idea of its shape The slit then used was extremely narrow, and was radial to the sun's limb. It was obvious that in this way the true shape of the prominence could not be seen unless the slit were moved with sufficient rapidity to allow of persistent images. At the very outset Janssen and myself attempted to accomplish this, Janssen by giving a rotatory motion to a direct vision spectroscope, I by giving an oscillating motion to the slit, in which I was followed by Young, who afterwards expanded it."

Prof. Young's account of his instrument is as follows:

> "The eye-piece of the instrument has an apparatus attached, which, however, thanks to the high dispersive power, I find unnecessary.
>
> "It was early proposed by Janssen to use a vibrating or rotating slit in order to make visible the form of a solar prominence, but as Zollner has shown, the mere opening of the slit answers just as well, the light of the protuberance being diluted to precisely the same extent in either case.
>
> "It occurred to me in connexion with a suggestion of Professor Morton, that by interposing at the focus of the eye-piece a diaphragm which should move with the vibrating slit, the light of the neighbouring portions of the spectrum might be cut off and this dilution avoided. Mr. Clark has devised and constructed a very beautiful mechanical arrangement by which this simultaneous and accordant motion of slit and diaphragm is effected by the rotation of the small fly-wheel shown in Fig. 1.
>
> "But I find, that although seen in this way, the prominences appear very bright; yet the working of the apparatus always causes a slight oscillation of the equatorial, which interferes with the definition of details, and I prefer to work with the slit simply opened." (Young, NATURE, Dec. 8, 1870.)

The introduction by Zollner and Huggins of the wide slit method and the superb views it afforded of the prominences at the limb led to its universal adoption, and the oscillating slit was abandoned. Although Lockyer and Young often examined the spectra of sun-spots and other regions of the photosphere, and repeatedly described reversals and distortions of hydrogen and other lines, I can find no indication that the oscillating slit device was ever tested for the observation of the forms of eruptions or other phenomena on the disc. Nevertheless, the credit for building the first spectrohelioscope (as I have named the instrument) and applying it to the observation of prominences at the limb belongs to my old friend Prof. Young, who was also the first to take photographs of the forms of the prominences through an open slit (*loc. cit.*).

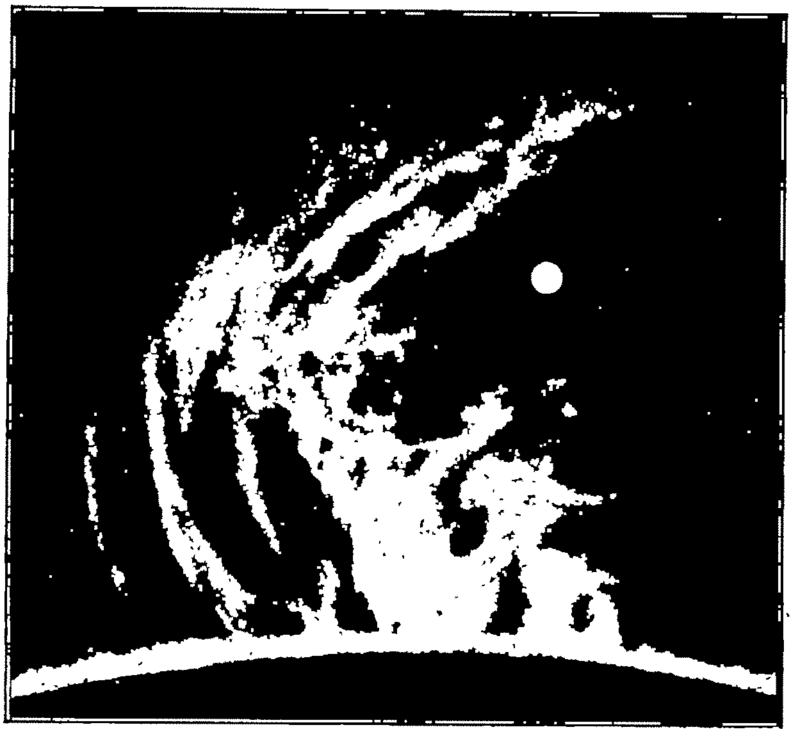


Fig. 1.—Active prominence, 140,000 miles high, photographed by Ellerman at Mount Wilson, July 9, 1917, with the *K* line of calcium. The small disc represents the comparative size of the earth.

THE SPECTROHELIOGRAPH.

The principle of the spectroheliograph, which does not differ greatly from that of Young's instrument with oscillating slit, occurred to me in 1889.[1] It involves the use of a spectroscope with a fixed second slit, through which a single line is admitted to a photographic plate. The whole spectroscope is mounted on steel balls, and moved slowly by a motor across the solar image, which, like the photographic plate, remains stationary. Or the spectroscope may be fixed in position, and the solar image and plate moved at the same speed across the first and second slits respectively. A monochromatic image of the sun is thus gradually built up on the plate from countless successive images of the narrow second slit.

After some preliminary experiments at the Harvard Observatory, I obtained photographs of prominences with a simple spectroheliograph at the Kenwood Observatory in the spring of 1891. In January 1892, with an improved spectroheliograph, I succeeded in photographing the chromosphere and prominences (Fig. 1) surrounding the sun and the bright flocculi[2] revealed on the disc by the use of the *H* or *K* line of calcium.

About this time Deslandres introduced the velocity spectrograph for photographing the *H* or *K* line in successive sections of the sun. Evershed soon constructed and systematically employed a spectroheliograph, and in 1893 Deslandres also began work with a spectroheliograph, which he employed for photography with the calcium lines and with some of the narrower dark lines. In 1903, with the Rumford spectroheliograph attached to the 40-inch refractor of the Yerkes Observatory, Ellerman and I first photographed the bright and dark hydrogen flocculi on the disc and noted especially the long dark flocculi (Fig. 2) identified as prominences projected against the sun (named 'filaments' by Deslandres, who has studied them extensively at Meudon with the spectroheliograph and velocity spectrograph). Five years later, at Mount Wilson, aided by plates sensitised for photography in the red, Ellerman and I discovered large vortices surrounding sunspots (Figs. 3 and 10). The Hα line, with which the vortices were found, is much more

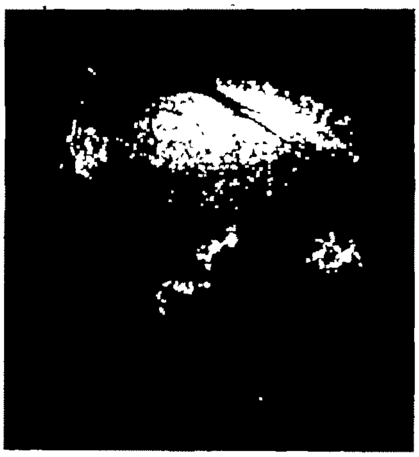


Fig. 2.—Hydrogen (*H*α) flocculi, photographed with the 13-foot spectroheliograph at Mount Wilson, February 17, 1926, at $10^h\ 00^m$. All of these could be seen in Pasadena with the spectrohelioscope

effective than the more refrangible hydrogen lines for the study of the hydrogen atmosphere of the sun Its situation in the red also adapts it for visual observations, particularly at low altitude stations where smoke and haze may seriously interfere with work at the violet end of the spectrum. With a spectroheliograph of high dipsersion, *Hα* shows also the 'alignments' discovered by Deslandres, which constitute a reticular structure of wide mesh associated with the filaments.

---

[1] I afterwards found that it had been first suggested by Janssen, embodied in a practicable design by Braun (not constructed), and unsuccessfully tested by Lohse.

[2] Flocculi is a general term applying to all markings, bright or dark (excepting sunspots), photographed by the spectroheliograph on the sun's disc.

The spectroheliograph, in addition to providing a method of photographing the chromosphere and prominences, at the sun's limb, has thus made possible the daily study of the solar atmosphere in projection against the disc. But useful as it has proved, the need for a similar means of visual observation has persisted for many years.

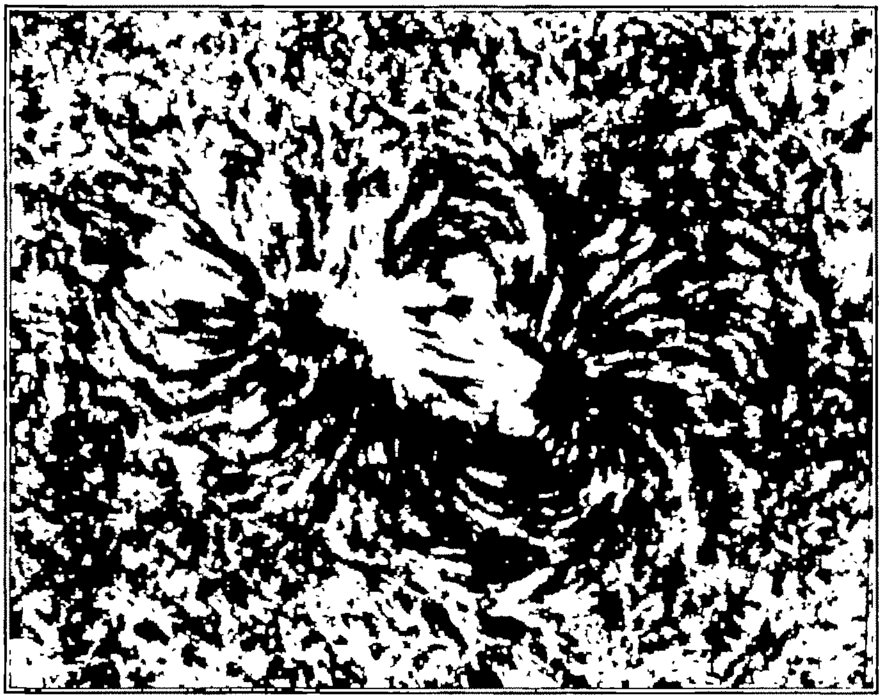


Fig. 3 —Hydrogen (*Hα*) vortices surrounding the bipolar sunspot of September 1924, photographed by Lewis Humason at Mount Wilson with the 13-foot spectroheliograph.

THE SPECTROHELIOSCOPE.

My first attempts to observe the hydrogen flocculi visually were made on Mount Wilson with the 60-foot tower telescope and 30-foot spectroheliograph soon after the discovery of the *Hα* vortices in 1908 A disc carrying a large number of radial slits was mounted just above the wide first and second slits on a vertical bearing standing midway between them. Each of these radial slits, when near the axis of the collimator, thus produced a spectrum, and by adjusting the grating (or prism) the *Hα* line could be brought into coincidence with the corresponding slit on the opposite end of the same diameter. A given displacement of the first slit produced an equal displacement of the *Hα* line in the opposite direction. Thus, when the disc was rotating, the observer, looking through a positive eye-piece focussed on the slits coinciding with the *Hα* line, saw an image of a portion of the sun in hydrogen light. Unfortunately, the slits were too wide and too few in number, and for many years I had no opportunity to bring the method into effective form

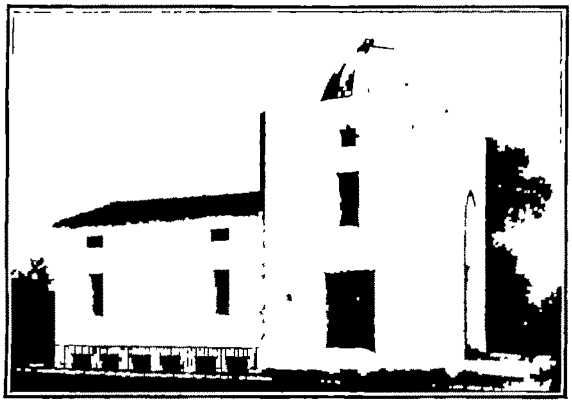


Fig 4 —Solar Laboratory in Pasadena The second mirror of a coelostat beneath the dome sends parallel rays vertically downward to a 12-inch objective, giving a 2-inch solar image on the slit of the spectrohelioscope in the basement By a simple change, a Cassegrain reflector of 18 inches aperture, giving a solar image either 6¼ inches or 16¼ inches in diameter, can be substituted for this objective

In 1923 I renewed the effort, with results which have been described in these pages (NATURE, October 25, 1924, p 628). At that time, however, the apparatus was crudely mounted, and its consequent inefficiency, at a period of low solar activity, gave me no measure of its actual powers. Recently the same optical parts, now adequately mounted in my new Solar Laboratory in Pasadena (a branch of the Mount Wilson Observatory), have yielded results of greater interest

A very brief description of the instrument will suffice. Imagine a reflecting spectroscope of 6 inches aperture and 13 feet focal length, standing vertically in a well beneath the laboratory (Fig. 5). A solar image 2 inches in diameter is formed on the slit by a 12-inch objective.

A cœlostat, with second mirror, mounted beneath a dome at the summit of a low tower (Fig. 4) sends parallel rays of sunlight vertically downward to the 12-inch objective, which stands 18 feet (its focal length) above the slit. Electric slow motions, controlled by buttons within easy reach of the observer, permit the objective to be focussed and the solar image to be moved in any direction across the slit. Thus all parts of the limb or disc can be examined in quick succession.

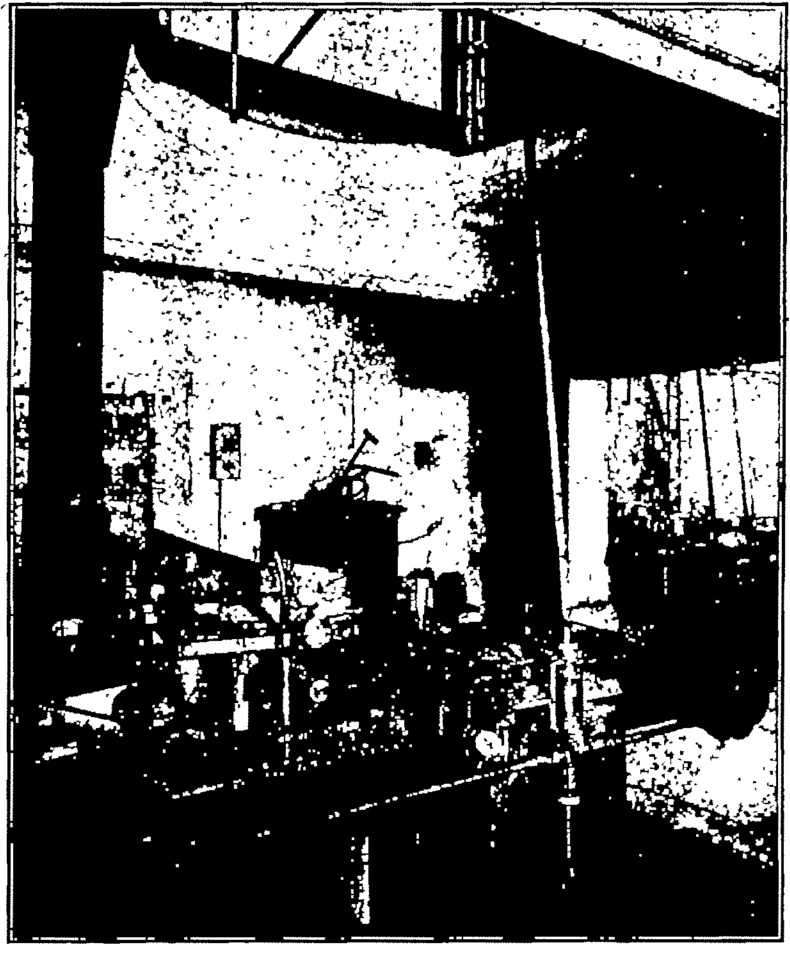


Fig. 5.—Upper end of combined spectrohelioscope, spectrograph, and spectroheliograph, mounted vertically in a well 10 feet in diameter and about 80 feet deep. The oscillating slit-bar and binocular eye-piece may be seen near the middle of the instrument. These are ordinarily employed with a reflecting spectroscope of 13 feet focal length, also designed for use as a spectroheliograph. By turning its optical parts out of the way, the instrument is transformed into a Littrow spectrograph of 75 feet focal length, suitable for researches on the magnetic fields in sunspots.

The second slit lies in the plane of the spectrum, formed by a large plane grating, ruled by Jacomini on the ruling machine of the Mount Wilson Observatory. The first order spectrum, which is very bright, is usually employed. The *Hα* line is brought into coincidence with the second slit, which is narrower than the (dark) line. The slits are carried at opposite ends of a horizontal bar, which can be oscillated (usually through a range of a quarter of an inch) about a bearing half-way between them (Fig. 6). As the optical arrangements are such that the second slit constantly bisects the oscillating *Hα* line, a monochromatic window, one-quarter of an inch wide, is thus provided through which to view the sun. A positive eye-piece magnifying about 2·5 diameters, mounted on the binocular body of my Spencer microscope, is used for observing the hydrogen atmosphere through this window. The speed of the driving motor is fast enough to give a persistent image. As the (visible) length of the window thus employed is about half an inch, a considerable portion of the 2-inch solar image can be seen at once.

I was agreeably surprised when I first tried this apparatus on January 16 of the present year. I knew from previous experience that the prominences at the limb and the more conspicuous dark and bright flocculi on the disc would be visible, but I was scarcely prepared for the delicate details of structure, both dark and bright, which appeared in good contrast on the disc. At that time (as in the earlier work) I was using five slits at each end of the bar, instead of one. These were only one-twelfth of an inch apart, restricting the field of view to this width. The central image in the eye-piece, corresponding to the $H\alpha$ line, was flanked on either side by brighter images of the same region,

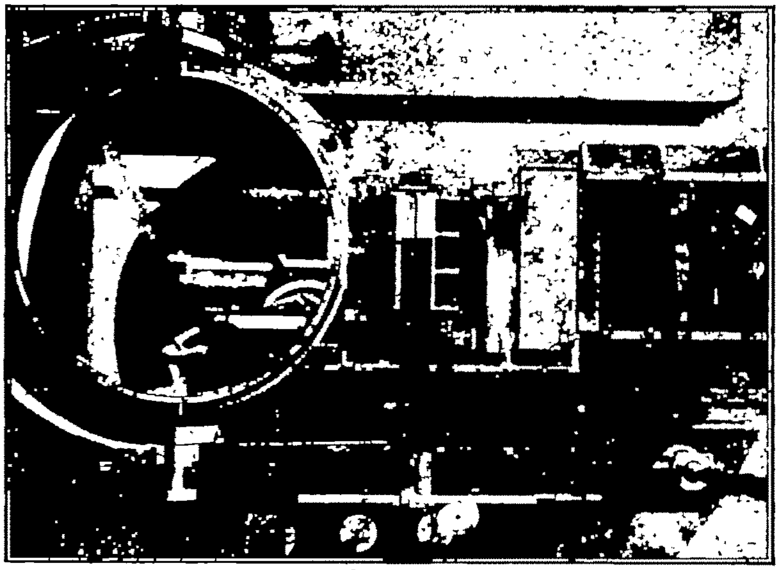


FIG. 6.—Plan of spectrohelioscope. The oscillating slit-bar, mounted on a bearing movable by the micrometer screw near the centre of the photograph, is driven by a motor at the left (shown in Fig. 5). The observer looks through the binocular eye-piece, which is focussed on the second slit. The 18-inch concave mirror of the Cassegrain reflector, the driving mechanism and sliding plate-holders of the spectroheliographs, and the buttons for electric control, may also be seen in the photograph.

formed by the light of the continuous spectrum. Thus, in examining a spot region the hydrogen flocculi above and about the spots could be seen in the central image while the underlying spots and photosphere appeared in the side images—a convenient means of comparison. Frequently in the hydrogen image the spots are entirely concealed by flocculi, and in tracing the spiral structure in a vortex to its objective, it is advantageous to be able to see the spots simultaneously. For this and other reasons two or more second slits may sometimes be preferred to one. By means of a special device, however, similar comparisons can be easily made with only one second slit.

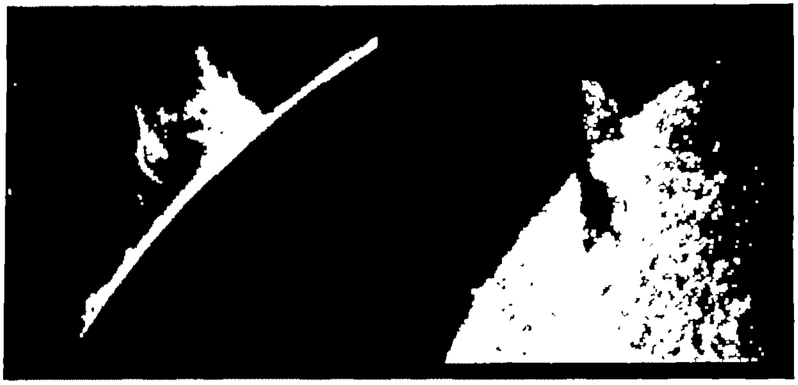


FIG. 7.—Solar prominence partly projected upon the disc, photographed by Ellerman at Mount Wilson with the 15-foot spectroheliograph (using $H\alpha$) May 22, 1916. At the left is a longer exposure of the same prominence, made with the disc covered.

EXPLORING THE SOLAR ATMOSPHERE.

As a quick and effective means of exploring the entire solar atmosphere the spectrohelioscope is unrivalled. In a few minutes one may run completely around the limb, not only observing the chromosphere and prominences projecting beyond it, but also following with equal ease those which extend on to the disc and appear there as dark absorbing masses. Such a prominence, from a spectroheliogram taken some years ago by Ellerman on Mount Wilson, is illustrated in Fig. 7. It will presently appear why objects of this nature can often be better seen with the spectrohelioscope than they can be photographed with the spectroheliograph.

The utility of the spectrohelioscope as a scouting auxiliary of the spectrograph or spectroheliograph is thus apparent. Hitherto the observer with these instruments has often worked blindly, not knowing in advance what phenomena of the solar atmosphere lie between him and the visible structure of the photosphere. A few minutes of visual observation may now enable him to select interesting regions for special study, or to avoid areas where eruptions, vortices, or other active phenomena may interfere with measurements requiring a more normal state of tranquillity. Such selections can also be made with the spectroheliograph, but far less quickly and effectively. The fact that very different phenomena are observed when the second slit is set on different parts of the $H\alpha$ line is a vital factor here.

EFFECTS OF LEVEL AND OF RADIAL MOTION.

In our early work with the spectroheliograph, M. Deslandres and I independently utilised the principle of photographing cross-sections of the calcium flocculi at different levels by setting the second slit in successive exposures at various distances from the centres of the H and K lines. As these lines widen in descending through the calcium atmosphere toward the photosphere, it is obvious that if the second slit is set at a given distance from the centre, none of the higher calcium vapour, which gives a narrower line, can be included in the photograph. Similar work was afterwards undertaken with the hydrogen lines, where the velocity of the gas in the line of sight is often of greater significance than its level.

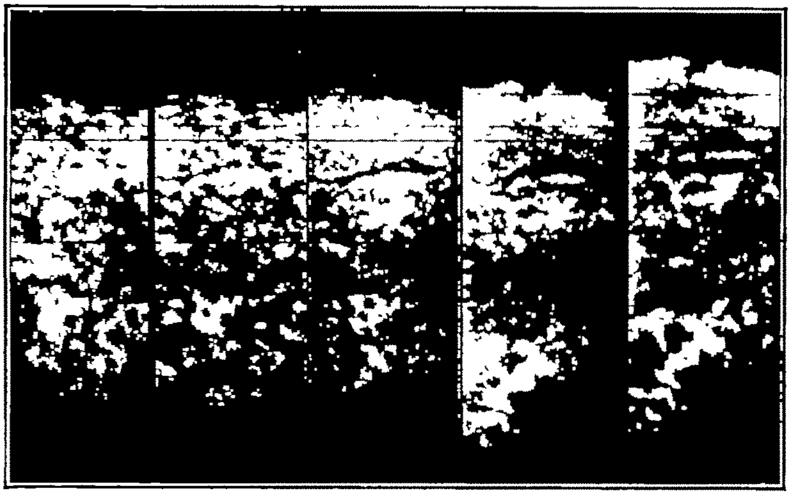


FIG. 8.—Five exposures by Ellerman with the 13-foot spectroheliograph, showing the changes in the flocculi corresponding to second-slit position, ranging from λ6564·36 (left) to the centre of $H\alpha$ (May 29, 1916)

Fig. 8 illustrates the different appearances of a given region of the solar atmosphere when photographed with the second slit at various distances from the centre of $H\alpha$. Many studies of this kind have been made at Mount Wilson, and these have been supplemented by other investigations based upon photographs taken with a single first slit, an optical system giving two spectra of the same region of the sun, and two second slits, one set on the red side of $H\alpha$ in one spectrum, the other on its violet side in the second spectrum, equidistant from the centre of the line. Two photographs of the same region of the hydrogen atmosphere thus obtained simultaneously often show remarkable differences, as Fig. 9 illustrates. In this picture of an active spot region the bright eruptive flocculi appear in both photographs, because the corresponding bright $H\alpha$ line was wide enough to overlap both of the second slits. The dark flocculi, produced by the cooler gas at a much higher level, gave a narrower line, displaced to the red because of the rapid descent of this gas. The structure of this rapidly falling gas is consequently shown only in the lower photograph, made with the second slit set on the red side of the line.

The power of the spectroheliograph thus to single out gaseous masses moving rapidly in the line of sight is one of its most valuable properties. This effect can be minimised, if it is desired to record on a single plate all bright and dark flocculi moving at moderate radial velocities, by using the lowest dispersion and widest second slit compatible with good definition and contrast.[3] But the discriminating power of high dispersion is very advantageous in many cases, and a means of utilising it without the limitations incident to the simultaneous use of only two second slits, or the delays involved in making a series of exposures like that in Fig. 8, is clearly desirable, especially in the case of rapidly changing eruptions. This is afforded by the spectrohelioscope, because of the ease of quickly shifting the position of the $H\alpha$ line on the second slit while observations are in progress. Of the various devices I have employed for this purpose, perhaps the simplest is a piece of plane parallel glass, mounted on trunnions just below the oscillating second slit. When this glass plate is tipped up or down, the line is displaced to red or violet. A scale in the eye-piece shows the exact position of the line on the slit. This is readily converted into a 'blink' apparatus for comparing the images of the flocculi corresponding to the red and violet edges of the line. An electro-magnet for tipping the plate and two adjustable stops to define its limits serve for this purpose.

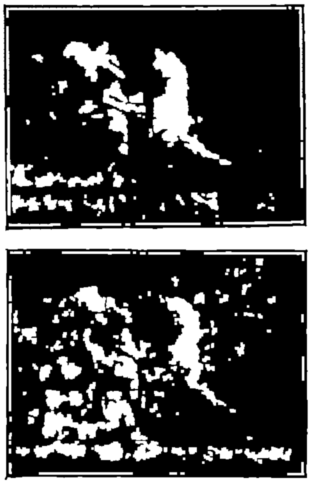


FIG. 9.—Two photographs of the hydrogen flocculi associated with an active sunspot group, made simultaneously with light from the violet (upper) and red (lower) sides of the $H\alpha$ line. The bright eruptive regions are similar in the two cases, while the lower photograph shows also the dark flocculi caused by the absorbing gas at higher levels, descending toward the photosphere.

With a device of this kind, or with a micrometer screw which permits the oscillating bar (and thus the second slit) to be displaced toward red or violet (shown near the centre of Fig. 6), it is fascinating to watch the changes in the appearance of the flocculi, and to distinguish between ascending and descending gases. In fact, we have here a special means of analysing the $H\alpha$ line and of separating the complex elements of which it is composed. Areas in the solar atmosphere which give rise, for example, to bright $H\alpha$ lines displaced toward the red frequently lie in the line of sight or in such close proximity that they cannot be distinguished in photographs of the $H\alpha$ line in the spectrum of the region. Thus in measuring the displacement of this line near spot groups or in other parts of the sun's disc we are dealing with an integrated effect, representing the superposition of the various $H\alpha$ lines given by the superposed or closely contiguous areas in question. With the spectrohelioscope many of these areas can be separately distinguished and their radial velocities determined by moving the line back and forth over the second slit and noting the displacement from its centre, towards red or violet, when a given bright or dark structure reaches its maximum of intensity. Furthermore, the width of the bright or dark $H\alpha$ line corresponding to any detail of structure can also be measured by taking the scale readings, to red and violet, at which this structure disappears. Indeed, it would not be difficult, by a simple photometric device, to determine the exact intensity curve of the line given by any of the small flocculi.

---

[3] Or (if higher dispersion is employed) the $H\alpha$ line may be caused automatically to move back and forth across the narrow second slit during the exposure.

I am referring to observations within the boundaries of the dark $H\alpha$ line and its two wings (each of which is about as wide as the dark line itself), and not to the large local displacements which are often seen in or near active spot groups. It should be added, however, that the spectrohelioscope is also well adapted for the observation of the rapidly moving gases which give rise to these large displacements. The form of the gas moving at any given velocity can be seen by setting the oscillating slit at the corresponding distance from the centre of the line.

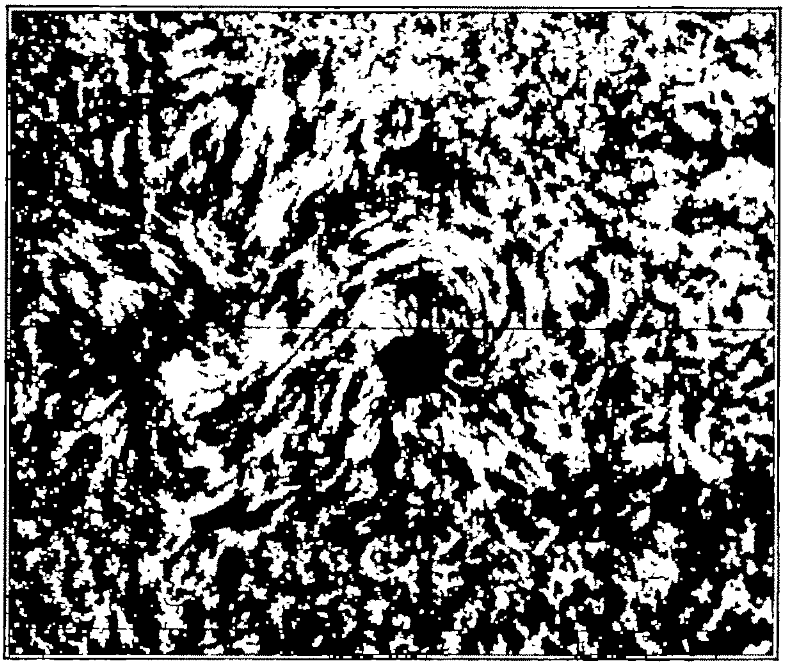


FIG 10.—Hydrogen ($H\alpha$) vortex photographed by Benioff at Mount Wilson with the 13-foot spectroheliograph. Simple vortices of this character are selected for determining the law of storms in the solar atmosphere.

PROMINENCES, FILAMENTS, VORTICES, AND ERUPTIONS.

Even for the observation of prominences projecting outside the limb, the oscillating slit has some advantages over the wide slit. This is because the former shows them in essentially monochromatic light, and thus often permits details to be seen which are confused with a wide slit because of the superposition of gaseous masses moving at different velocities in the line of sight. By setting the oscillating slit on different parts of the line, portions of the prominence moving at different velocities can be seen separately, as in the case of the flocculi just cited. Prominences in which there are marked internal differences of radial velocity sometimes do not appear at all on the disc at the slit position which shows them best outside the limb. A turn of the micrometer screw, however, suffices to reveal them in strong contrast, either as filaments or in other forms.

This suggests the use of a spectrohelioscope as a guiding device for a spectroheliograph, permitting the $H\alpha$ line to be frequently readjusted on the second slit of the latter instrument during exposures, so as to record all phenomena at the limb and on the disc in strongest contrast. The spectrohelioscope itself may also be used for photography, either in the form described here, provided with an auxiliary camera and right-angle prism for visual observations between exposures on small areas; or as a spectroheliograph with oscillating slits, capable of photographing the entire solar disc. With the former arrangement, the changes in the appearance of given areas when $H\alpha$ is moved across the second slit may be recorded, perhaps even in the form of moving pictures.

I cannot dwell, however, on the remarkable phenomena thus brought to view. Some of them are illustrated in Figs. 2 and 11, but these spectroheliograms are quite inadequate to show the delicate details,[4] and they of course fail to indicate the effect of shifting the line on the slit. Brief reference should be made, however, to observations of vortices and eruptions.

I have previously described in NATURE our researches at Mount Wilson on the law of sunspot polarity.[5] This is part of a more general investigation on the law of whirling storms in the sun, which we find to be much more complicated than the terrestrial law. The bipolar vortices which constitute typical sunspots are of opposite polarity in the northern and southern hemispheres of the sun, and these polarities are reversed at each sunspot minimum. The available evidence favours the view that this magnetic change is due to a reversal in the direction of whirl in the vortices that produce the spots and their magnetic fields. These vortices in the photosphere are accompanied by secondary vortices in the overlying atmosphere, recorded (as in Fig. 10) by the spectroheliograph. From a preliminary study[6] it appears that the direction of whirl in about 80 per cent. of the high-level vortices accompanying single spots (or the preceding spots of bipolar groups) corresponds with that of terrestrial storms, and does not reverse at sunspot minima.

---

[4] This remark refers to our spectroheliograms with 2-inch solar image. The details of the vortex structure are best shown by our spectroheliograms of the 6¾-inch solar image given by the 60-foot tower telescope on Mount Wilson (see Figs. 3 and 10). I am not yet certain whether the most delicate details on such photographs can be so well seen with the spectrohelioscope.

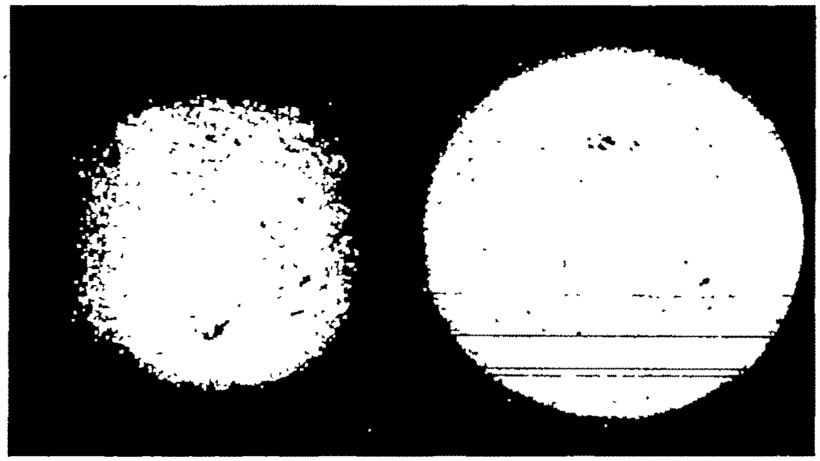


FIG. 11.—Bright eruption in great sunspot group at 22° N latitude, photographed at Mount Wilson with the 13-foot spectroheliograph, January 24, 1926, at 9h 34m Pacific standard time. The image on the right is a direct photograph of the sun, obtained simultaneously with hydrogen ($H\alpha$) image on the left. This eruption was detected independently in Pasadena with the spectrohelioscope.

The above results were derived from an examination of spectroheliograms, but I have found the spectrohelioscope a very useful means of continuing the investigation. If, as often happens, a prominence (or filament) occurs as a dark flocculus near a spot, its spiral form may at once indicate the direction of whirl in the vortex. Owing to differences in radial velocity, a slight change in the position of the $H\alpha$ line on the oscillating slit is frequently necessary to show such a vortex clearly. For detailed studies of vortex structure and changes of form, both in plan on the disc and in cross-section at or near the limb, the spectrohelioscope has also shown its efficiency.

This instrument is also of great service for the detection of such violent outbursts on the sun as I observed on January 24 (Fig. 11) and 25, 1926, preceding the great aurora and magnetic storm of January 26 and 27 already described in NATURE (February 6, p. 208). The eruption, which continued for several hours on January 25, surpassed in brilliancy all solar phenomena I have ever before seen, and exhibited rapid changes of form.[7] Because of the ease of glancing occasionally during the day at probable regions of activity, and of instantly finding the best possible position of the second slit on $H\alpha$, the spectrohelioscope should greatly assist in determining the true relationship between solar eruptions and terrestrial auroras and magnetic storms. If, as I hope, an inexpensive instrument can be built for the use of amateurs, the chances of detecting the exact moments of critical outbursts will be greatly multiplied. A small spectrohelioscope for this purpose, and improved oscillating and rotating slits to replace the oscillating bar hitherto employed with the 13-foot spectrohelioscope, are now under construction and will soon be ready for trial.

---

[5] "Sunspots as Magnets, and the Periodic Reversal of their Polarity," NATURE, January 19, 1924, p. 105.

[6] Hale, "A Test of the Electromagnetic Theory of the Hydrogen Vortices surrounding Sunspots," *Proc. Nat. Acad. Sciences*, 11, 691-696, 1925.

[7] For a brief description of these observations, and some suggestions regarding other applications of the spectrohelioscope, see "Visual Observations of the Solar Atmosphere," *Proc. Nat. Acad. Sciences*, 12, 286-295, 1926.

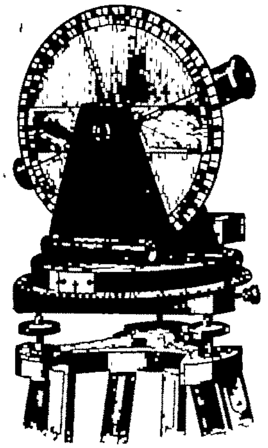
Printed in Great Britain by R. & R. CLARK, LIMITED, *Edinburgh*.

Student's Theodolite

Write for leaflet describing this instrument, which has many advantages over others on the market. It has been designed by a teacher of geography and is made by a firm of theodolite makers.

Price £3 10 0
or with Plane Table
£4 0 0

Sent on approval
to any teacher



⁂ Although this instrument has only recently been introduced, the demand has already been very large.

C. F. CASELLA & CO. LTD.
49-50 Parliament Street, London, S.W.1

HOPKIN & WILLIAMS, Ltd.

16 & 17 Cross St., Hatton Garden, London, E.C.1
***Works*: Ilford, Essex.** Telegrams: "Cerium, Smith, London" Telephone: Holborn 6084 and 6085

The Leading British House for

CHEMICAL REAGENTS

PURE, FINE, AND RARE CHEMICALS

Manufacturers of Guaranteed
Chemical Reagents for Analysis and Research.

Made and supplied to standards and specifications described in the publication

"Analytical Reagents: Standards and Tests."

Compiled by
EDMUND WHITE, B.Sc. (Lond.), F.I.C.
Published by
HOPKIN & WILLIAMS, LTD.

NEW EDITION 1925.
CLOTH BOUND. INTERLEAVED.

Price 1/6 post free from the Publishers.

SPECIAL RESEARCH CHEMICALS 1926

An enlarged List of BOOTS' RESEARCH CHEMICALS has been prepared because of the rapid expansion of this important side of our activities.

More than 1000 Chemicals are included, and over 80% of them are made in our own laboratories.

Letters of appreciation received, and the extension of our business, indicate that the guaranteed purity of our products has become widely known.

FOR NEW LIST WRITE TO WHOLESALE SALES DEPARTMENT

BOOTS PURE DRUG COMPANY LIMITED

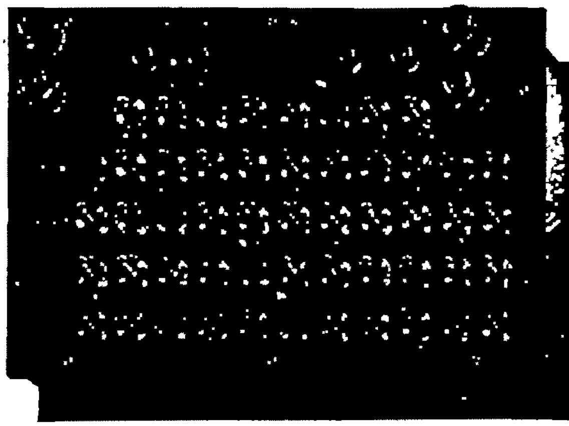
Manufacturing Chemists and Makers of Fine Chemicals

NOTTINGHAM

Telephone: *7000 Nottingham.*
Telegrams: *"Drug," Nottingham.*

GAMBRELL BROS. LTD.

Established 1898.



Class "A" Wheatstone Bridge.
4-decade Standard Type.

The following are some of our standard lines:

Please send for Lists in which you are interested.

LIST	
"G"	Galvanometers, moving coil, pointer and reflecting.
"OG"	Galvanometers, "Onwood" pattern.
"GA"	Galvanometer Accessories, including Lamps, Scales, Universal Shunts, etc.
"K.S"	Keys and Switches.
"IR"	Gambrell's "Independent" Plug Contact Resistance Boxes and Wheatstone Bridges.
"HR"	Megohms and High Resistances.
"SR"	Switch pattern Resistance Boxes and Wheatstone Bridges, all grades, including Direct Reading.
"P.K"	Potentiometers, Kelvin Low Resistance Bridges, Kelvin Double Ratio Box, Volt Ratio Boxes, Standard Cells, Low Resistance Shunts.
"RR"	Rheostats and Single Resistances.
"C"	Condensers, Standard and Secondary.
"V.A"	Voltmeters, Ammeters, Milliameters.
"T.A"	Apparatus for Electro-Titration.

MERTON ROAD, SOUTHFIELDS,
London, S.W.18.

Phones: PUTNEY 3641-2 (Instrument).
VICTORIA 9938 (Wireless).

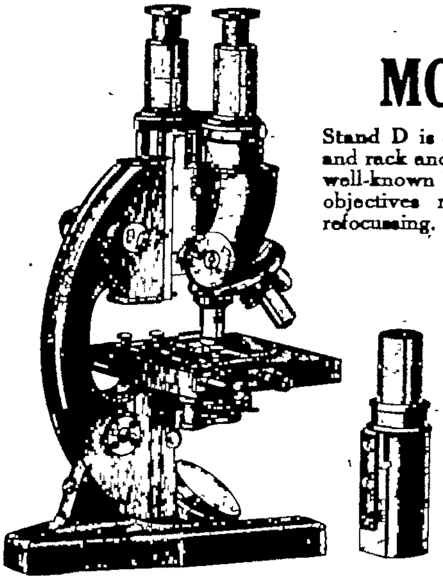
Radio Sales Dept. for Wireless Apparatus 76 VICTORIA ST., LONDON, S.W.1.

CARL ZEISS
JENA

BRITISH INDIA

BRITISH INDIA

NEW MODEL MONO-BINOCULAR STAND



'Stand DSG

Stand D is of entirely novel design, and fully inclinable. The limb is shaped, and rack and pinion focussing is provided to a simplified type of substage. The well-known Meyer toothed-wheel slow motion is supplied. The nosepiece and objectives remain in position when the bodies are changed, thus obviating refocussing. The stand is supplied in three types:

- DSA with simplified mechanical stage.
- DSC with fixed square stage.
- DSG with square-pattern, built-in, mechanical stage.

Full particulars and Rupee prices from the SOLE DISTRIBUTORS for BRITISH INDIA:

ADAIR, DUTT & CO. LTD.
(Incorporated in England)
Stephen House, Dalhousie Square East,
CALCUTTA
and 174 Hornby Road, Fort,
BOMBAY

Head Office: 47 Victoria Street, London, S.W.1,
where Government indents may be sent.

MICROSCOPES, MICROTOMES AND ACCESSORY APPARATUS

PHYSIOLOGICAL, PSYCHOLOGICAL
and
ANTHROPOMETRICAL APPARATUS

Catalogues free

REPAIRS

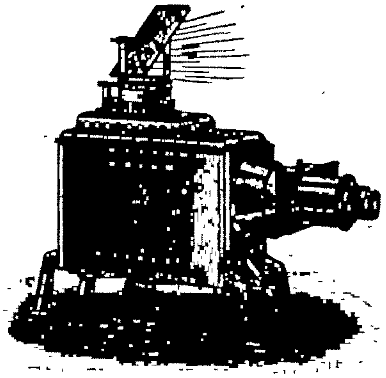
to any make of Microscope or Objective and other Scientific Apparatus a Speciality.

Estimates submitted

HAWKSLEY & SONS, LTD.
83 WIGMORE STREET, LONDON, W.1.

JANUS EPIDIASCOPE

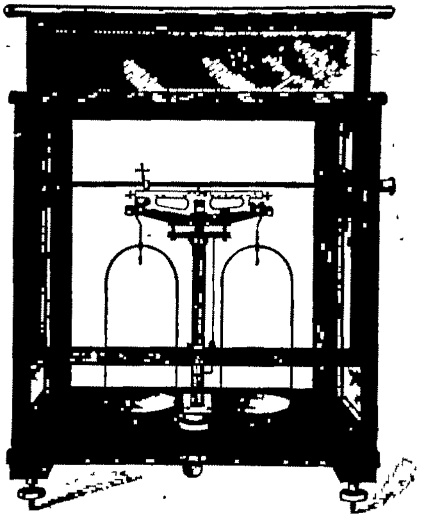
(Patented in Germany, England, and in other countries.)



With 500 Watt Incandescent Lamp
for the projection of
LANTERN SLIDES AND PAPER PICTURES
(postcards, book-illustrations, or any other opaque articles)
VERY EASY TO USE
Gives brilliant pictures up to 8 × 8 feet.
The best Lantern
FOR SCHOOLS, UNIVERSITIES, LECTURERS, ETC.

ED. LIESEGANG, DÜSSELDORF (Germany)
Founded 1854. Postbox 124.

A NEW OERTLING BALANCE



No. 43

PRICE £16:16:0

This Balance has been carefully constructed, and has all the essentials contained in higher priced instruments. Capacity 200 grm. Sensitivity 0·0001 grm.

Write for our 1926 Catalogue (post free) giving particulars of the above and all our other Models.

L. OERTLING LTD.
88-90 Turnmill Street
LONDON, E.C.1

Phone: CLERKENWELL 1959. Est. 1849.

J·M·Dent & SONS LTD.

A SHORT HISTORY OF CHEMISTRY

By ROSE STERN, B.Sc.
North London Collegiate School

WITH DIAGRAMS AND PORTRAITS

Cloth Boards. 160 Pages. **2s. 6d.**

SECOND LARGE EDITION

Miss Stern has planned her book to meet the need for a simple treatment of the subject. It is written from the humanistic point of view, and presents the essential outlines of the history of chemistry without the mass of facts which load the standard works.

From the "Chemical News":

"There are few good histories of chemistry, and hardly one can claim to be suitable for young readers. The attention of Science Masters and Mistresses is therefore directed to Miss Stern's interesting little volume on the subject. Indeed, none of the contents of the book can be criticised; the subject has been presented so admirably, and gives a clear idea of the gradual growth of chemical knowledge.

SCIENCE

AN INTRODUCTORY TEXT-BOOK

By E. J. HOLMYARD, M.A., M.Sc., F.I.C.
Late Scholar of Sidney Sussex College, Cambridge, Head of Science Dept. Clifton College; Examiner in Chemistry (Matriculation) to the University of London, Member of the Royal Asiatic Society.

Cloth Boards. 240 Pages. **4s.**

EXTRACT FROM AUTHOR'S PREFACE:

This little book is an attempt to present science as a whole to young students. No division of the work into the usual water-tight compartments has been made, and reference has been made throughout to phenomena of everyday life. The difficulty of teaching General Science has been, I believe, mainly due to the fact that too much was attempted. Teachers have not courageously recognised that in an elementary course on General Science many things must perforce be omitted, and the consequence has been that the average scheme degenerates into a collection of snippets from chemistry, physics and biology. I do not hope to have overcome these difficulties altogether, but I have tried to surmount them by taking the four Aristotelian elements as the framework of my scheme. A short treatment of biological subjects has followed naturally.

The greater portion of the course described has been in use for some years at Clifton College, for the most part with gratifying success.

ALDINE HOUSE, BEDFORD ST., LONDON, W.C.2

ARNOLD BOOKS

PRACTICAL PHOTOMICROGRAPHY. By J. E. Barnard, F.R.S., F.Inst P., F.R.M.S., Lecturer in Microscopy, King's College, London; Director of the Department of Applied Optics, National Institute for Medical Research, and Frank V. Welch, F.R.M.S. With Plates and other Illustrations. 2nd Edition **18s.** net.

SURVEYING. By W. N. Thomas, M.Sc., A.M.Inst.C.E., Demonstrator in Engineering in the University of Oxford. New Edition. **25s.** net.

"It may be recommended as being at once sufficiently elementary, theoretical, practical and advanced to be both a sound text-book and useful book of reference."—*The Engineer.*

A HANDBOOK OF CONIFERÆ INCLUDING GINKGOACEÆ. By W. Dallimore, Assistant at the Royal Gardens, Kew, and A. B. Jackson, A.L.S. With 32 Plates and 120 Illustrations in the text. **42s.** net.

THE MIGRATIONS OF FISH. By Alexander Meek, M.Sc., F.L.S., F.Z.S., Professor of Zoology, Armstrong College, Newcastle-on-Tyne, and Director of the Dove Marine Laboratory. With Illustrations and Maps. **18s.** net.

GROWTH. By G. R. de Beer, B.A., B.Sc., F.L.S., John Wilfred Jenkinson Lecturer in Embryology in the University of Oxford. With Plates and Diagrams. **7s. 6d.** net.

EDWARD ARNOLD & CO.
41 & 43, MADDOX ST, LONDON, W·1

DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

Trustees: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Prof. A. C. Seward, Sc.D., F.R.S., Prof. R. S. Conway, Litt.D., F.B.A.

A *free* specimen copy of "Discovery" will be sent to anyone on request.

Contents of the July "Empire University Number" include:

A MESSAGE FROM THE RT. HON. L. S. AMERY, M.P.
THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE. SIR ARTHUR SHIPLEY, G.B.E., F.R.S.
A NEW FRAGMENT OF ROMAN HISTORY. R. S. CONWAY, LITT.D., F.B.A.
POLAR RESEARCH PROBLEMS. R. W. JAMES, M.A.

Forthcoming special issue:

August—BRITISH ASSOCIATION NUMBER, to which Sir Oliver Lodge will contribute.

Illustrated. 1s. Monthly.
Annual Subscription 12s. 6d. post free.

BENN BROTHERS LTD.
154 Fleet Street, London, E.C.4

THE
DINOFLAGELLATES
OF NORTHERN SEAS

By MARIE V. LEBOUR, D.Sc., F.Z.S.

Naturalist at the Laboratory of the Marine Biological Association of the United Kingdom, Plymouth.

Cloth, 8vo, 250 pp.; 53 text-figures, 35 plates.

Price 12s. 6d. net. Post free 13s.

Published by the Marine Biological Association of the United Kingdom, October 1925.

Copies may be obtained from THE DIRECTOR, Marine Biological Laboratory, Citadel Hill, Plymouth; MESSRS. DULAU & Co., LTD., 34-36 Margaret St., Cavendish Square, London, W.1; or any Bookseller.

Now ready. **Third Edition.**

A TEXT-BOOK OF
EXPERIMENTAL PSYCHOLOGY

By CHARLES S. MYERS, M.A., M.D., Sc.D., F.R.S.,
and F. C. BARTLETT, M.A.

In two parts. **Price 16s net.**

The two parts are also sold separately:—Part I, Text-book, **10s 6d** net, Part II, Laboratory Exercises. With 40 Figures and Diagrams, **7s** net.

"The edition just issued is probably the most complete text-book of experimental psychology in this or any other language. Every page is loaded with trustworthy statements of verified fact, yet the argumentation is so well ordered, and the style so concise and clear, that the book can be read with ease and pleasure."
Nature on the Second Edition.

Prospectus on application.

CAMBRIDGE UNIVERSITY PRESS
Fetter Lane, London, E.C.4

That Book you want!

Foyles can supply any Scientific Book that is in print and most of those that are out of print. They have a Special Department for this class of literature under a Manager who has experience and knowledge of the Natural Sciences. Call and consult him, or write and you will get an intelligent reply. Books sent on approval. Over a million volumes Second-hand and New on every conceivable subject in stock. Twenty-one Departmental Catalogues issued, any of which will be sent gratis and post free on mentioning interests.

That Book you do not want!

Foyles will buy it.—A single volume to a library.

Expert valuers sent any distance.

FOYLES, 121 Charing Cross Road, London.

¶ **W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE,** will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ **CATALOGUE 269.** Scientific Books and Publications of learned Societies.

Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone: [illegible]

J. POOLE & CO.
ESTABLISHED 1854
NEW & SECOND-HAND
SCIENTIFIC AND EDUCATIONAL
BOOKSELLERS

ENQUIRIES BY LETTER
RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

PATENTS AND CHEMICAL RESEARCH.

By HAROLD E. POTTS, M.Sc.,
CHARTERED PATENT AGENT.

Demy 8vo. Cloth **2/6** net.

"There can be no question of the Author's grasp of the fundamentals of patent law; the discrimination with which he has selected his leading cases when discussing the validity of patents demonstrates this."—*Nature.*

THE UNIVERSITY PRESS OF LIVERPOOL, LIMITED,
HODDER AND STOUGHTON, LIMITED, LONDON.

GENERAL DISCUSSIONS OF THE FARADAY SOCIETY.

A list of REPRINTS available can be obtained from Messrs. GURNEY & JACKSON, 33 Paternoster Row, London, E.C.4, Official Publishers to the Society. Information relating to the Society may be obtained from the SECRETARY, 90 Great Russell Street, London, W.C.1.

MAN **An illustrated monthly record of Anthropological Science, 2s. net per part, 20s. a year, post free anywhere.**

CONTENTS OF JULY ISSUE.

ORIGINAL ARTICLES: A Settlement of the Dolmen Period (*Illustrated.*)—Britain during the last Forest-Phase—A Fertility Rite in Modern Egypt. (*With Plate H.*)—Inventions: Obtrusive, Directional, and Independent.—REVIEWS.—CORRESPONDENCE.—NOTES.

THE ROYAL ANTHROPOLOGICAL INSTITUTE,
52 Upper Bedford Place, Russell Square, London, W.C.1

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

CHEMICAL AND TECHNICAL BOOKS

We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms.

Write for Catalogue—

WILLIAM BRYCE, Scientific Bookseller,
54-54a Lothian Street, EDINBURGH.

G. C. DYMOND, F.I.C.P.A. H. E. POTTS, F.I.C.P.A.

W. P. THOMPSON & CO.,
CHARTERED PATENT AGENTS,
12 CHURCH STREET, LIVERPOOL,
and 50 LINCOLN'S INN FIELDS, LONDON.

J. V. ARMSTRONG, F.I.C.P.A. W. H. BEESTON, R.P.A.

A. P. THURSTON, D.Sc., F.R.Ae.S.,
Patent Agent, 329 HIGH HOLBORN, W.C.1.
Phone: Holborn 2542 Patents, Trade Marks and Designs.

THE BRITISH DRUG HOUSES, LTD.

Makers of Fine Chemicals

Graham Street, London, N.1

has allocated this space to

THE SOCIETY OF CHEMICAL INDUSTRY

for the announcement of the

ANNUAL GENERAL MEETING AND CONGRESS OF CHEMISTS

in London, July 19–25, 1926.

Special attention is directed to the Meeting on July 20, dealing with
"Scientific and Industrial Problems presented by the Hormones—the Natural Drugs of the Body."

Any reader of this journal, who is interested, is invited to apply for full programme of the Congress to The General Secretary, Society of Chemical Industry, Central House, Finsbury Square, London, E.C.2.

If you have any

DEFECTIVE MICRO. OBJECTIVES

either Apochromatic or Achromatic, by

ZEISS, LEITZ, REICHERT, or OTHER MAKERS

we are prepared to examine and report on them with a view to repair.

JAMES SWIFT & SON LTD.,
University Optical Works,
81 TOTTENHAM COURT ROAD, LONDON, W.1

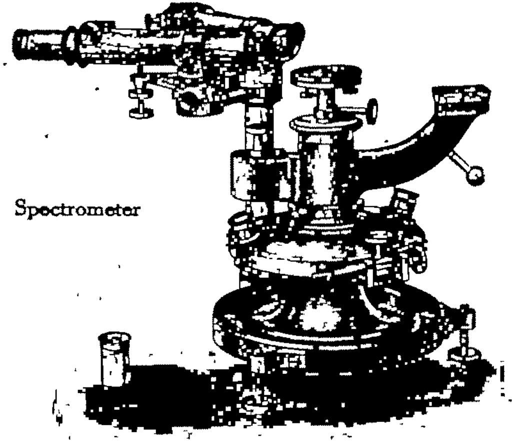
Max Kohl A.G.

Chemnitz A1 (Germany)

Manufacturers of

Physical Apparatus

Laboratory Furniture
Induction Coils · Oil Air Pumps
Experimental Switchboards
Projection Apparatus



Spectrometer

Special Lists on request

W. Edwards & Co
SECOND-HAND DEPT.

POINTOLITE OUTFIT

Comprising 100 C.P. lamp fitted on tray for lantern, universal resistance to suit D.C. voltages 100 to 240 V. Complete with flexibles and fittings. Excellent condition. £5 15 0

8A ALLENDALE ROAD, DENMARK HILL,
LONDON, S.E.5. TELEPHONE BRIXTON [illegible]

A DICTIONARY OF APPLIED PHYSICS. Edited by SIR RICHARD GLAZEBROOK, K.C.B., Sc.D., F.R.S. In 5 Vols. Medium 8vo. Fully Illustrated. £3 : 3s. net each. The set of five volumes, £14 : 14s. net.

Vol. I. MECHANICS—ENGINEERING—HEAT.
" II. ELECTRICITY.
" III. METEOROLOGY, METROLOGY, and MEASURING APPARATUS.
Vol. IV. LIGHT, SOUND, and RADIOLOGY.
" V. AERONAUTICS, METALLURGY—GENERAL INDEX.

⁂ Full descriptive Prospectus post free on application.

SECOND EDITION NOW READY.

VECTORIAL MECHANICS. By L. SILBERSTEIN, Ph.D., Late Lecturer in Natural Philosophy at the University of Rome; Mathematical Physicist, Eastman Research Laboratory, Rochester, N.Y. Second Edition. 8vo. 10s. net.

⁂ ***Send for Macmillan's Classified Catalogue, post free on application.***
MACMILLAN & CO., LTD., LONDON, W.C.2.

"POSTLIP"
(No. 633 Mill)
ENGLISH FILTER PAPERS

Manufactured in
ANNUALLY INCREASING QUANTITIES
for upwards of 50 years.

White and Grey Plain, Antique, Crinkled, and Embossed.

All sizes in Squares, Circles, and Folded Filters. Rolls made to order.

Pure Filterings for Laboratory Work and in quantities for all industrial purposes.

See Report of TESTS made by The National Physical Laboratory, a copy of which will be sent on application, together with free samples if required.

EVANS, ADLARD & CO., LTD.
POSTLIP MILLS,
WINCHCOMBE, CHELTENHAM, ENGLAND.

RADIUM

As Sole Agents for the British Empire (excluding only Canada) of the

RADIUM BELGE—UNION MINIÈRE DU HAUT KATANGA

—the operating proprietors of the Rich Belgian Congo deposits—

We are ready to Supply at short notice:—

RADIUM ELEMENT in all forms for physical and medical purposes.

A PRACTICAL HANDBOOK

Radium: Its Production and Therapeutic Application

55 pages, 10 plates, numerous figures of applicators, etc.

POST FREE ON REQUEST

Some of the most important institutions in the Empire have purchased Radium from us.

WATSON & SONS
(ELECTRO-MEDICAL) LTD.
SUNIC HOUSE, PARKER ST.,
KINGSWAY, LONDON, W.C.2.

Telephone: Regent 1227. *Telegrams: "Skiagram, Westcent, London."*

GURNEY & JACKSON'S
IMPORTANT NEW CHEMICAL BOOKS.

A TEXT-BOOK OF ORGANIC CHEMISTRY

By Prof. JULIUS SCHMIDT.
Professor of Chemistry in the Technische Hochschule, Stuttgart

English Edition by
H. GORDON RULE, Ph.D.(Munich), D.Sc.(Edin.)
Lecturer in Organic Chemistry, University of Edinburgh

Extra royal 8vo. 824 pages. Price **25s.** net.

A TEXT-BOOK OF INORGANIC CHEMISTRY

By FRITZ EPHRAIM, Ph.D.
Professor of Chemistry in the University of Berne

English Edition by P. C. L. THORNE, M.A.(Cantab.), M.Sc.(Lond.), Lecturer in Chemistry, Sir John Cass Technical Institute, London.

Extra royal 8vo. 818 pages. Price **28s.** net.

Extract from Prof. Partington's Review of German Edition in the Journal of the Society of Chemical Industry:

"The reviewer can recommend this book to all chemists as both interesting and useful. Advanced students will find it of very great value: they will discover something new on nearly every page."

LONDON: 33 PATERNOSTER ROW, E.C.4.
EDINBURGH: TWEEDDALE COURT.

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals. General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Just published: Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). In preparation: Part VII: Chemistry and Chemical Technology, including Photography.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

Just Issued
from the Natural History Department of
DULAU & COMPANY LTD.
54-56 Margaret St., Cavendish Square, London, W.1.
CATALOGUE No. 143:
PHYTO-PATHOLOGY AND HORTICULTURE.
Post free on request.

THE PRECIOUS METALS
GOLD, PLATINUM, SILVER.

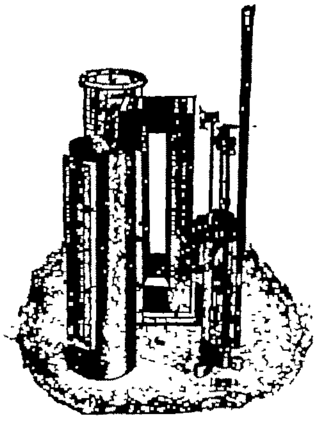
SPINK & SON, LIMITED
(By Appointment)
16, 17 & 18 PICCADILLY, LONDON, W.1.
Established 153 years.

VALUE, PURCHASE or ASSAY the above in any form.

Parcels can be safely sent by registered post.

ROSENHAIN
FUEL CALORIMETER
FOR COAL AND LIQUID FUELS

This apparatus provides reliable information regarding a sample of coal or liquid fuel. The operation is simple, rapid and certain and gives accurate results. Further particulars are given in List No. 158-N, sent on request.



18 × 18 × 40 cm.

CAMBRIDGE
INSTRUMENT CO LTD.
WORKS:- LONDON, & CAMBRIDGE
Head Office & Showrooms:- 45, GROSVENOR PLACE LONDON, S.W.1
AMERICAN COMPANY:
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

DELIVERY FROM STOCK.

FOR EFFICIENCY AND ECONOMY

USE PYREX

Because of its superior strength in resisting heat and rough usage, PYREX is the ideal laboratory glassware for schools, colleges and industrial institutions

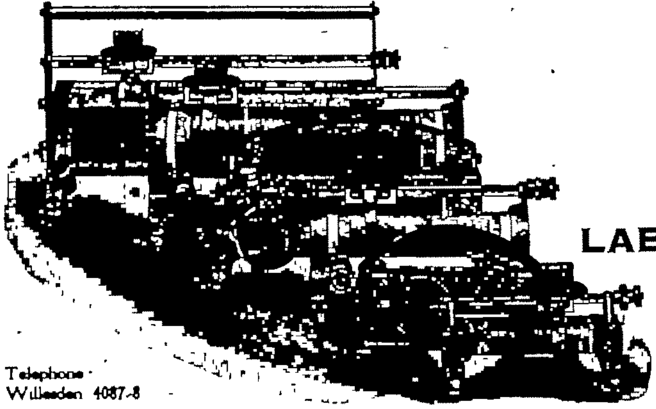
PYREX minimises breakage from mechanical shock. It is highly resistant to sudden cooling, and a PYREX Rod heated to 300° C. will not break when plunged into cold water.

PYREX will withstand water, mineral acids, carbonates, alkalis, ammonia and ammonium salts to a remarkable degree.

PYREX is stocked by all reliable dealers in laboratory apparatus.

Illustrated Catalogue and N.P.L. Report sent on request.

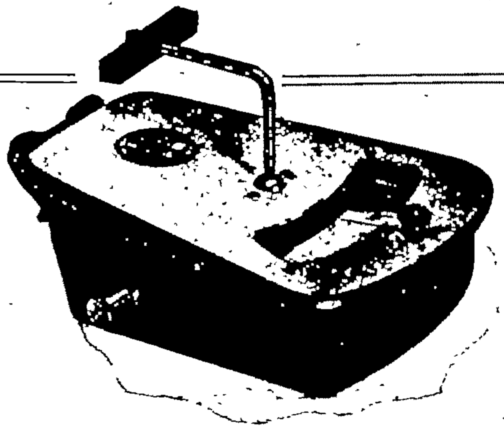
MANUFACTURED BY
JAMES A. JOBLING & CO., LTD., Wear Flint Glass Works, SUNDERLAND.



ZENITH
LABORATORY RESISTANCES
CATALOGUE OF ALL TYPES ON REQUEST
THE ZENITH MANUFACTURING CO.
Contractors to the Admiralty, War Office, Air Ministry, Post Office, L.C.C., &c.
ZENITH WORKS, VILLIERS ROAD,
WILLESDEN GREEN, LONDON, N.W.2

Telephone:
Willesden 4087-8

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.



THE MICROID
DETECTOR GALVANOMETER

Dustproof Aluminium Case, scale 6 cm. long, 40 angular degrees, divided in 100 equal parts. Sensitivity variable by control magnet over a range of 10 to 1. Standard winding 10 ohms.

15s. 6d. each

A characteristic example of 10 *ohms resistance gives* 1 *to* 0·01 *scale divisions per microamp.*

THE MICROID SERIES

This is one of a remarkable series of newly designed electrical instruments. You are invited to write or to call at our showrooms centrally situated in London, Glasgow, Manchester, Edinburgh, and Liverpool, where every assistance will be gladly given in the choice of these and other apparatus.

WRITE FOR LIST No. 2M

JOHN J. GRIFFIN & SONS LTD

Kemble Str
Kingsway

LONDON
W.C...2

BAIRD & TATLOCK LTD

GLASGOW
45, Renfrew St.
EDINBURGH
7, Teviot Place

MICROID

MANCHESTER
34 Gt. Ducie St.
LIVERPOOL
61 Brownlow Hill

WHAT THE EXPERTS SAY

"The Leica Automatic Film Camera is a superlative piece of mechanism. It is in all respects a singularly efficient, practical instrument, capable of covering a wide category of work. The finder gives an exceedingly brilliant, sharp image of the field in all conditions of lighting."—*The Photographic Journal* (the official organ of the Royal Photographic Society), March 1926.

"A camera which is unique and efficient, both terms being scientifically accurate. The camera is a marvel of diminutiveness and portability, and eminently suited for travellers and tourists"—*The Camera*, May 1926.

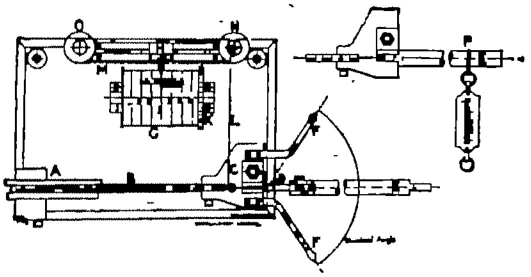
"A camera of decidedly novel design and a high-class instrument of precision. The definition at full aperture is excellent, and the view finder places the subject correctly in all cases"—*The Amateur Photographer*, May 27, 1925.

"An innovation in pocket cameras, with an excellent direct-vision finder. The design and workmanship are of the highest description."—*The British Journal of Photography*, June 1925.

Ask for the Leica booklet, post free.

OGILVY & CO., 20 Mortimer St., London, W. 1

METAL TESTING IN
WORKS & LABORATORIES



Capt. Sankey's Machine provides a reliable shop test. It is automatic, portable, inexpensive, and can be worked by unskilled labour. The personal element is removed, and a record is obtained which can be filed for reference.

Pamphlet from

C. F. CASELLA & CO.
49—50 PARLIAMENT STREET,
LONDON, S.W.1

THE
EMERALD
Valve Wave-meter
200-600 metres
Designed by Lieut.-Col. K. E. EDGEWORTH, D.S.O., M.C., A.M.I.E.E.
(Patents applied for.)

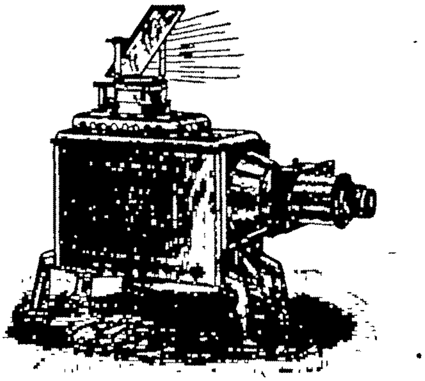
The Instrument is being placed on the market with a view to meeting the demand for an accurate and permanent standard of wave-length at a reasonable price. Its special features are:—

1.—The wave-length is read directly on the geared dials without the use of calibration charts.
2.—The calibration is not affected by moderate changes in high or low tension voltage
3.—The valve can be replaced without affecting the calibration.
4.—The accuracy is high In the present pattern, covering 200-600 metres, the readings are correct within 1 metre.
5.—The construction is robust, the condenser bearings are of ample size to provide against wear, and the whole instrument is designed with a view to permanence and accuracy.
6.—The instrument is effectively screened, and is free from effects due to stray capacity

Price - - - £5 17s. 6d.
Marconi Licence, 12/6. Dull Emitter Valve, 14/-
Description Pamphlet on application.
HEATH & CO.
(Agents for the Inventor)
New Eltham, London, S.E.9.
Showroom No. 2 Tower Royal, Cannon St., E.C. (nr. Cannon St Stn).

NOTE.—The following alternative patterns will be available in a few weeks: 20-60 metres, 40-120 metres, 100-300 metres, 400-1200 metres, 1000-3000 metres

JANUS
EPIDIASCOPE
(Patented in Germany, England, and in other countries.)



With 500 Watt Incandescent Lamp
for the projection of
LANTERN SLIDES AND PAPER PICTURES
(postcards, book-illustrations, or any other opaque articles)
VERY EASY TO USE
Gives brilliant pictures up to 8 x 8 feet
The best Lantern
FOR SCHOOLS, UNIVERSITIES, LECTURERS, ETC.
ED. LIESEGANG, DÜSSELDORF (Germany)
Founded 1854 Postbox 124.

FOR NEW KIND OF THOUGHT IN SCIENCE
Read NEW REVELATIONS IN ASTRONOMY AND GRAVITATION, by William Henry Parkes
Price 2/-, post free from the Author at
9 Lancaster Court, Newman Street, London, W.1.

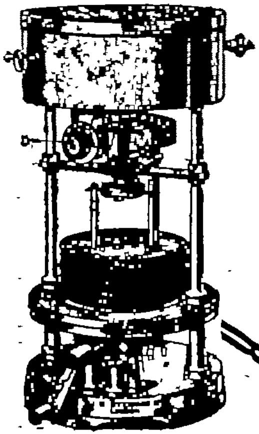
GERMAN BOOKS
AND PERIODICALS
supplied by
W. MULLER, Foreign Bookseller,
26 Hart Street, Bloomsbury, London, W.C.1
References in all countries.

NATURAL SCIENCE
BOOKS AND PERIODICALS
INCLUDING THE PUBLICATIONS
OF THE LEARNED SOCIETIES
CATALOGUES GRATIS LIBRARIES PURCHASED
BERNARD QUARITCH LTD.
11 Grafton Street, New Bond Street, London, W.1

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

For ascertaining easily and accurately the Lubricating Value of Oils

also the Oiliness, or Efficiency, by determining the Static Friction between any desired Metals.



The Deeley
FRICTION MACHINE
(PATENT)

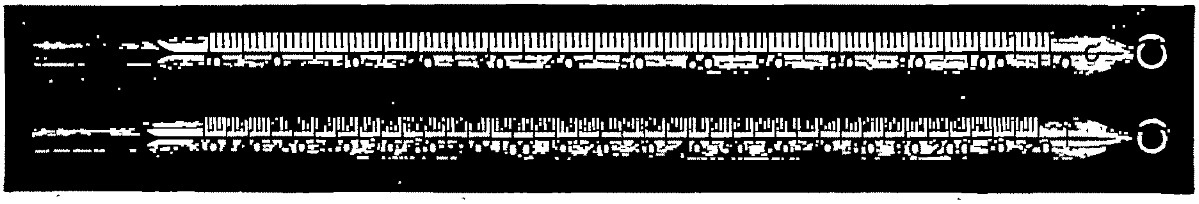
Descriptive Pamphlet of the Machine, stating the principles upon which it is based, together with directions for testing Oils, will be forwarded on application to the Sole Manufacturers:

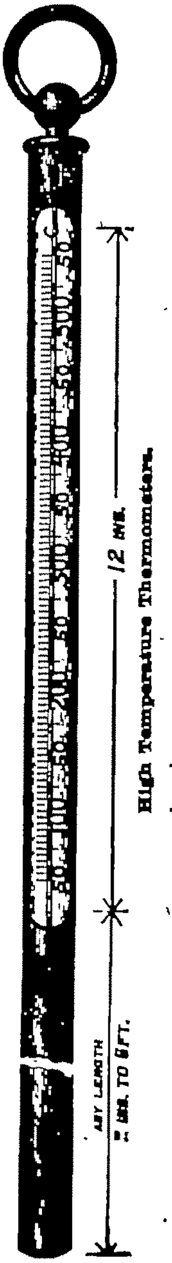
J.H.STEWARD, Ltd.,
Scientific Instrument Makers,
406 & 457 STRAND,
LONDON, W.C.2.
ESTABLISHED 1852

THERMOMETERS FOR CHEMICAL LABORATORIES

With Normal Glass Bulbs.

OUR OWN MANUFACTURE. BEST QUALITY (GUARANTEED ACCURATE) AT REASONABLE PRICES

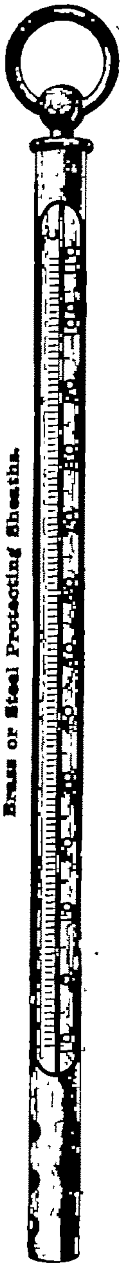




SETS OF STANDARD THERMOMETERS

divided to $\frac{1}{5}$° and $\frac{1}{10}$°

With National Physical Laboratory Certificates.



New Revised Catalogue of Chemical Laboratory Thermometers, showing Reduced Prices, post free on request.
☞ *See Editorial Notice, NATURE, April 21, 1923, page 545.*

Special Thermometers of any Length or Range made to order in a few days.

PASTORELLI & RAPKIN LTD.

Contractors to various Departments of H.M. Government

46 HATTON GARDEN, LONDON, E.C.1.

Actual Manufacturers of

THERMOMETERS FOR ALL INDUSTRIAL PURPOSES

Barometers, Barographs, Thermographs, Hygrographs, Hydrometers, Standard Meteorological Instruments, Etc.

ILLUSTRATED PRICE LISTS ON APPLICATION

'Phone—Holborn 1981. ESTABLISHED 1750. Telegrams—Rapkin, London.

Any instrument sent on approval if desired.

Carriage paid and safe delivery guaranteed of all instruments within the British Isles.

MACMILLAN'S NEW AND RECENT BOOKS.

1926 ISSUE NOW READY.

THE STATESMAN'S YEAR BOOK. Edited by SIR JOHN SCOTT KELTIE, LL.D., and M. EPSTEIN, M.A., Ph.D. With Maps. Crown 8vo. 20s. net.

PRINCIPLES OF ECONOMICS. By DR. N. G. PIERSON. Translated by A. A. WOTZEL. Vol. I. Third Impression. 8vo. 15s. net.

*** Previously published Vol. II. 15s. net.

THE PHYSIOLOGY OF THE CONTINUITY OF LIFE. By D. NOËL PATON, M.D., B.Sc., LL.D., F.R.S., Regius Professor of Physiology, University of Glasgow. With Illustrations. 8vo. 12s. net.

EVOLUTION. By J. GRAHAM KERR, F.R.S., Regius Professor of Zoology in the University of Glasgow. With 2 Plates in colour and 53 Illustrations in the Text. 8vo. 12s. net.

THE GIST OF EVOLUTION. By HORATIO H. NEWMAN, Ph.D. (Professor of Zoology, University of Chicago). Crown 8vo. 6s. 6d. net.

A BIPOLAR THEORY OF LIVING PROCESSES. By GEORGE W. CRILE. Edited by AMY F. ROWLAND. Illustrated. 8vo. 21s. net.

*** An attempt to present certain conclusions based upon researches which have been in progress continuously from 1898 to the present time.

CRYSTALLINE FORM AND CHEMICAL CONSTITUTION. By A. E. H. TUTTON, D.Sc., M.A. (Oxon), F.R.S., Past President of the Mineralogical Society, London; Author of "Crystallography and Practical Crystal Measurement." With 72 Illustrations. 8vo. 10s. 6d. net.

MINERALOGICAL MAGAZINE.—"The book is well printed and illustrated, and it gives a very clear and readable account of the subject. It should be seen by all students of chemistry as well as those of crystallography."

THE FAMILIES OF FLOWERING PLANTS. I. DICOTYLEDONS. Arranged according to a New System based on their Probable Phylogeny. By J. HUTCHINSON, F.L.S., Assistant in the Herbarium, Royal Botanic Gardens, Kew. With Illustrations by W. E. TREVITHICK and the Author. 8vo. 20s. net. KEY TO THE FAMILIES OF THE DICOTYLEDONS. Reprinted from "The Families of Flowering Plants." 8vo. Manilla Cover. 2s. net.

THE THEORY OF SOUND. By LORD RAYLEIGH, Sc.D., F.R.S. Vol. I. New Impression. 8vo. 15s. net.

*** Previously published Vol. II. 15s. net.

AN INTRODUCTION TO THE THEORY OF INFINITE SERIES. By T. J. I'A. BROMWICH, M.A., Sc.D., F.R.S., Fellow and Lecturer of St. John's College, Cambridge. Second Edition Revised with the assistance of T. M. MACROBERT, D.Sc., Lecturer in Mathematics in the University of Glasgow. 8vo. 30s. net.

THE PHŒNIX.—"The second edition of Dr. Bromwich's excellent book will be welcomed by younger mathematical students who have been denied the privilege of possessing a copy of the first edition. . . . The new edition adds to the value of a book which occupies a foremost place amongst mathematical text-books."

HIGHER MATHEMATICS FOR STUDENTS OF ENGINEERING AND SCIENCE. By FREDERICK G. W. BROWN, M.Sc. (London), F.C.P., Senior Mathematical Master, West Ham Secondary School. Crown 8vo. 10s.

EDUCATION.—"Everything in the book is well done. It shows that the author is a mathematical enthusiast and is bent on teaching mathematics in the proper way. . . . Mr. Brown has compiled a book that will be of inestimable service to many a teacher."

ICE AGES, RECENT AND ANCIENT. By A. P. COLEMAN, M.A., Ph.D., F.R.S., Emeritus Professor of Geology, University of Toronto. With Illustrations and Maps. 8vo. 17s. net.

*** ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

SCIENCE PROGRESS

A QUARTERLY RECORD OF SCIENTIFIC THOUGHT, WORK, AND AFFAIRS

Editor: Sir RONALD ROSS, K.C.B., F.R.S., &c.

No. 81 *JULY 1926* *7s. 6d. net*

Recent Advances in Science: Pure Mathematics, Meteorology; Physics; Organic Chemistry; Biochemistry; Physical Chemistry; Plant Physiology; Prehistoric Archæology.

Articles: The New Quantum Theory. By H. T. Flint, D.Sc. Notes on the Dielectric Constants of Liquids By L. F. Gilbert, B.Sc. A Summary of the Recent Work on the Biochemistry of the Pneumococcus. By M. H. Finkelstein. The Misleading and Picturesque in Anatomy. By Prof F Harris, M.D., D.Sc.

Popular Science: The Bushmen of the Kalahari. By Prof. E H L. Schwarz.

Notes: On the Writing up of Scientific Papers; The Encouragement of Discovery, Science Schools; Oyster-Breeding Experiments, Coal Survey; The British Universities Year Book, 1926, Notes and News.

Essays: The Life and Work of a Mechanistic Philosopher: Jacques Loeb; Recent Discoveries of Missing Elements.

Essay-Reviews: Modern Eugenics. By R. A. Fisher, Sc.D. Delinquents By (β_2) Mosquito-Control. By Sir R. Ross.

Reviews of 49 Books, etc.

Annual Subscription (including postage), **31s. 2d.**

JOHN MURRAY, Albemarle St., LONDON, W.1.

ANNOUNCEMENT.

Volume VIII. of *The Journal of General Physiology* will be a memorial to its founder, Dr. Jacques Loeb. This volume will contain papers by Dr. Loeb's pupils and his associates, together with a portrait and a sketch of his life. The volume will appear simultaneously with Volume IX. The publication of this volume began September 18, 1925.

Subscribers to the Journal, and others, may obtain the extra volume by sending their subscriptions (price $5.00) to

THE JOURNAL OF GENERAL PHYSIOLOGY,
AVENUE A AND 66TH ST., NEW YORK, N.Y.

ADLARD & SON

& WEST NEWMAN

LIMITED

SCIENCE PRINTERS.

Home and Export.

23 Bartholomew Close, London, E.C.1.

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. **Part I: Sets of Scientific Periodicals, General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.**

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."

NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact sciences, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

THE RESEARCH FOUNTAIN PEN (Patented).

Price 20s. free by post.

A hardy and most durable self-filling and safety pen which is ***entirely cleanly*** and ***entirely reliable***. In certain localities the Research Pen is known as the "doctor's pen," and it certainly supplies him with the much needed want of a pen which ***never makes a blot*** and which is so reliable that it ***requires no shaking*** to start it writing. For out-of-doors use the Research Pen offers the further advantages that it is scrupulously cleanly for the fingers and the penholder in the filling (and at all times), that it holds double the quantity of ink of other self-filling pens, and that the quantity of ink within the pen may at any time be clearly seen through its transparent bakelite walls. All of which new qualities, it may be remarked, are equally valuable in-doors as out-of-doors

But it is as a pen for the library and the office that the Research Pen excels to the utmost, and we say with all the confidence which testimonials of the most definite and grateful character can give, that the Research Pen is immeasurably superior to every form and fashion of dip pen. Former fountain pens could scarcely be said to compete seriously with the dip pen for office, etc., use. The dip pen gave the maximum of reliability, it could not flood, and it was distinctly less liable to blot. The advantage of continuous writing without re-dipping as given by former fountain pens was greatly offset by the longer periods when there was too little ink on the nib, and when in consequence a greater pressure on the paper was required and writing was rendered more difficult. Now in the dip pen, the shortness of ink on the nib could at any moment be restored by re-dipping, and the dip pen was par excellence the only pen for the artist, the draughtsman, and the fine writer. Nothing can exceed the ease of writing of a dip pen newly raised out of the inkpot; unfortunately, it only lasts for 1 or 2 words. Other fountain pens—in their periods of alternate flooding and scantiness—pass and repass this desirable position when writing is at its best. The chief merit of the Research Pen is that it maintains—unlike dip pens and unlike all other fountain pens—a full and ***uniform*** quantity of ink on the nib; it equals the dip pen at its best, and it remains indefinitely at that best. There is no flooding. It exceeds the dip pen as a pen for the artist, etc.

The Research Pen establishes a new and much higher standard in EASE and SPEED of writing; no trouble is experienced in filling and using the pen, and no statement is made regarding the pen which is not strictly true.

Writers should state if broad, medium, or fine pointed gold nib is desired, and if of hard, medium, or soft spring. Nibs may be changed until suited. Relief nibs, and nibs for manifold writing, are also supplied.

A. MUNRO, Fountain Pen Manufacturer,
248 Corporation Street, BIRMINGHAM.

"In years to come the publication of this monumental work will rank as one of the milestones in British applied science."—*Nature.*

Sir Richard Glazebrook's
DICTIONARY
OF
APPLIED PHYSICS

Can NOW be purchased on the Convenient System of
DIVIDED PAYMENTS

CONTENTS

Vol. I. Mechanics—Engineering—Heat.
" II. Electricity.
" III. Meteorology, Metrology, and Measuring Apparatus.
" IV. Light—Sound—Radiology.
" V. Aeronautics—Metallurgy—General Index.

THE COMPLETE WORK
IN 5 VOLUMES
Delivered
at once
FOR A FIRST PAYMENT OF
21/-
AND 14 FURTHER MONTHLY PAYMENTS OF 21/- THUS COMPLETING THE SUBSCRIPTION
PRICE - £15 15 0

Authoritative Reviews:

"This encyclopædic work differs from many that have preceded it in that it is produced by those who have worked strenuously and successfully to promote knowledge. Originality of treatment and masterly handling are everywhere exhibited."—*Engineering.* (Vol 1.)

"A book which every electrical engineer ought to possess . . . A mine of information in a field which, at present, is not adequately covered by any one work."—*The Electrician.* (Vol. 2)

"As a summary of our present knowledge of certain aspects of meteorology, the work is of great value. It will perhaps be regarded in future as a milestone showing the stage reached by the science at the end of the great war"—*The Meteorological Magazine.* (Vol. 3)

SINGLE VOLUMES
ALSO SUPPLIED ON DIVIDED MONTHLY PAYMENTS AS FOLLOWS:
Immediate
Delivery
AGAINST A FIRST PAYMENT OF
2/6
AND 13 FURTHER MONTHLY PAYMENTS OF 5/- THUS COMPLETING THE
SUBSCRIPTION PRICE
£3 7 6

7 DAYS
FREE ☛
EXAMINATION

To the GLOBE PUBLISHING COMPANY, LIMITED,
Gloucester House, 19 Charing Cross Road, London, W.C.2.

Please send me for 7 days free examination
A complete copy of the "Dictionary of Applied Physics" in 5 volumes.
Volume .... .. : .... of the "Dictionary of Applied Physics."
(*Strike out lines not applicable*)

It is understood that I can examine the $\frac{\text{work}}{\text{volume}}$ for seven days after I receive it, and that I can return it to you on the eighth day if I decide not to keep it. Should I decide to retain the volume(s) I undertake to send you a first payment of $\frac{\text{21/- for the complete work}}{\text{2/6 for Volume. .....only}}$ on the eighth day and to complete the purchase of the $\frac{\text{complete work}}{\text{Volume}}$ by remitting $\frac{14}{13}$ further monthly payments of $\frac{\text{21/-}}{\text{5/-}}$ until the full price $\frac{\text{£15:15:0}}{\text{£3:7:6}}$ is paid. (I am not under 21 years of age.)

NAME ....
ADDRESS ....
N.100 ....

ANNOUNCEMENT OF THE CONTENTS OF THE JULY NUMBER OF THE

PHILOSOPHICAL MAGAZINE AND JOURNAL OF SCIENCE

Conducted by Sir OLIVER JOSEPH LODGE, D.Sc., LL.D., F.R.S.; Sir JOSEPH JOHN THOMSON, O.M., M.A., Sc.D., F.R.S.; JOHN JOLY, M.A., D.Sc., F.R.S., F.G.S.; RICHARD TAUNTON FRANCIS, F.R.S.E.; and WILLIAM FRANCIS, F.L.S.

DOUBLE NUMBER. (320 *pages.*) *Price* ***10s. 6d.***

The Resistivity and Conductivity of Dilute Amalgams at various Temperatures. By T. L. EDWARDS, M.Sc.
The Magnetic Susceptibilities of some Alkalis. By W. SUCKSMITH, B.Sc.
Determination of the Size and Weight of Single Submicroscopic Spheres of the Order of Magnitude $r = 4\cdot10^{-8}$ cm., to $5\cdot10^{-6}$ cm., as well as the Production of Real Images of Submicroscopic Particles by means of Ultraviolet Light. By FELIX EHRENHAFT, Dr.Phil., and EMANUEL WASSER, Dr Phil. (Plate I.)
The Loud-Speaker as a Source of Sound for Reverberation Work. By A. H. DAVIS, D.Sc., and N. FLEMING, B A.
On the Calculation and Application of High Resistances of Small Self-Inductance for all Frequencies. By RAYMOND M. WILMOTTE, B A.
Atomic Structure and the Magnetic Properties of Co-ordination Compounds. By L. C. JACKSON, M Sc., Ph.D, A.Inst.P.
X-Ray Term Values, Absorption Limits, and Critical Potentials. By EDMUND C. STONER, Ph.D.
The Crystalline Structure of Anhydrite. By E. C. S. DICKSON, B A, Ph.D., and W. BINKS, B.Sc.
A New Method of obtaining a Luminous Discharge in Gases at very Low Pressures. By E. W. B. GILL, M A, B.Sc., and R. H DONALDSON, M.A.
Shape of Waves from Large Explosions. By T. CARLTON SUTTON, M.Sc., F.Inst.P.
The Transmission of Sound through the Head. By H. BANISTER, B Sc. (Lond.), Ph.D.(Cantab.).
Minimization of Magnetic Leakage and of its Effect in the Magnetic Testing of Bars and Rods. By EDWARD HUGHES, B.Sc, Ph.D., A.M.I.E.E.
The Effect of a Magnetic Field on the Electrical Resistance of Mercury and some Amalgams. By PHYLLIS JONES, B.Sc, and T. J. JONES, M Sc
The Analysis of the Copper Spectrum. By W. M. HICKS, F.R S
Fluctuation Theory of Scattering of Light in Gases. By JAKOB KUNZ, Ph.D.
On the Relation to Physics of the Notion of Convergence of Series. By HAROLD JEFFREYS, D.Sc., F.R.S
Professor Lees' Criticism of 'The Surface History of the Earth.' By Prof. J. JOLY, M.A, D.Sc, F.R.S.
Orthogonal Potentials. By P. J. DANIELL, Sc.D.
Interatomic Distances in Crystals. By Prof. W. L. BRAGG, M.A., F.R.S.
The Compton Scattering and the Structure of Radiation. By T. L. ECKERSLEY, M.A.
Note on the Molecular Association of Benzoic Acid in Benzene. By J. A. WILCKEN, B Sc., Ph D.
Further Studies on the Deformation of Tungsten Single Crystals. By F. S. GOUCHER. (Plates II.-V.)
Improved Grating for Vacuum Spectrographs. By R. W. WOOD and THEODORE LYMAN. (Plate VI.)
On the Origin of the E.M.F. of a Photoelectric Cell containing a Fluorescent Electrolyte. By Prof. A. GRUMBACH.
On the Determination of the Current Voltage characteristic of a Siemens Ozonizer. By R. WINSTANLEY LUNT, M.Sc., Ph.D.
A simple Vacuum Arc Mercury Still for Laboratories. By H. P. WARAN, M.A., Ph.D., D.Sc., F.Inst.P.

With 7 Plates and numerous Illustrations in the Text.

Subscription for 1926, £4, including six double numbers, post free to any part of the world. Any double numbers issued beyond six charged extra.

FOR BACK NUMBERS APPLY TO THE PUBLISHERS:

TAYLOR & FRANCIS,

Red Lion Court, Fleet Street, London, E.C.4

Scientific Publications

Practical Physiological Chemistry. By S. W. COLE, M.A., University Lecturer in Medical Chemistry, Cambridge.

7th Edition, entirely revised and rewritten. Well illustrated. Demy 8vo, cloth. 16s. net. (Postage 1s.)
"This excellent practical book."—*Lancet.*

Fundamentals of Bio-Chemistry in Relation to Human Physiology. By T. R. PARSONS, B.Sc., M.A.

Crown 8vo, cloth. 10s. 6d. net. (Postage 6d.) An invaluable little book dealing with the chemical processes at work in the body. With a new chapter added on "Insulin." 2nd Edition.
"An admirable introduction."—*Medical Review.*
"This is a book to read and have. . . . In essentials the book is admirable."—*Lancet.*

The Internal Secretions of the Sex Glands. *The Problem of the Puberty Gland.* By ALEXANDER LIPSCHUTZ, M.D.

Illus. Demy 8vo. cloth. 21s. net. (Postage 9d.) An entirely new edition of a remarkable book. Strictly scientific but very readable
"The book is well planned and well written . . . the illustrations are beautiful and excellent . . . the author writes as a master."
Nature.
"The chapter on intersexuality . . . is particularly well done. . . . Profusely illustrated and containing an excellent bibliography, this book should appeal specially to the physiologist, and indeed to all students of the problems of sex and of genetics."
Edinburgh Medical Journal.

Practical Chemistry by Micro-Methods. By E. C. GREY, D.Sc.

Demy 8vo, cloth. 4s. 6d. net. (Postage 4d.) A new method, revolutionary, but simple, accurate and extremely economical.
"Strikes an entirely new note."—*Chemistry and Industry.*
"The method is simplicity itself."—*Medical World.*
"Excellent little work."—*Prescriber.*

Practical Physical and Colloid Chemistry for Students of Medicine and Biology. By L. MICHAELIS. Translated by T. R. PARSONS.

Demy 8vo, cloth. 7s. 6d. net (Postage 6d.) Illustrated by instructive practical exercises.
"An excellent book, ably translated."—*B. M. J.*

Notes on Geological Map-reading. By A. HARKER, LL.D., F.R.S., etc.

Demy 8vo, sewed. 3s. 6d. net. (Postage 3d.) A new edition revised. Illustrated.

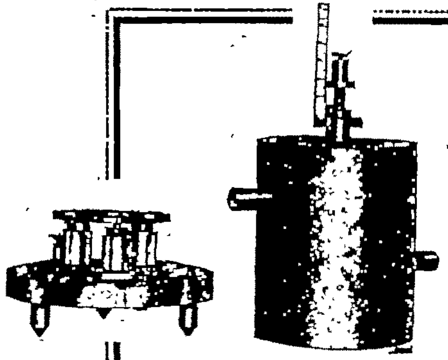
The Arab Civilization. By JOSEPH HELL. Translated by S. KHUDA BUKHSH.

Demy 8vo, cloth. 8s 6d. net. (Postage 6d.) In the translator's opinion the most up-to-date and able account of the Arab civilization.

W. HEFFER & SONS, LIMITED

CAMBRIDGE, ENGLAND

And of all Booksellers.



13×10×23 cm. 1·7 kg

APPARATUS
for the measurement of
RADIO-ACTIVITY

This apparatus is designed for obtaining comparative measurements of radio-activity for different substances. The substance is placed on the lower of two insulated plates between which a difference of potential is maintained, and the radio-activity is measured by determining, by means of an electrometer or electroscope, the leakage of electricity between the plates due to ionisation of the gas.

4a

MAY WE SEND FURTHER PARTICULARS?

CAMBRIDGE
INSTRUMENT Co. Ltd.
WORKS - LONDON, & CAMBRIDGE
Head Office & Showrooms - 45, GROSVENOR PLACE LONDON, S.W.1
AMERICAN COMPANY - Cambridge Instrument Co., Inc., Grand Central Terminal, New York

GAS SUPPLIES FOR LABORATORIES.

Mansfield Oil-Gas apparatus places in the hands of scientists whose laboratories are not supplied with town's gas, a means of securing a supply of gas which gives a perfect oxidising or reducing flame.

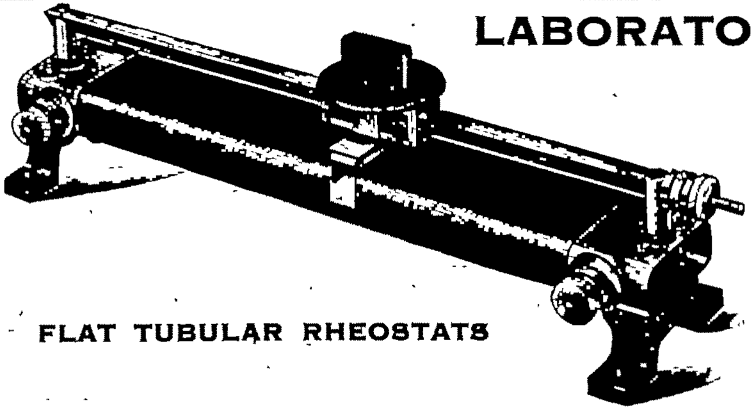
This plant has been supplied during the past 50 years to many of the important laboratories in the British Empire.

Write for particulars to
MANSFIELD & SONS, LTD.,
23 HAMILTON SQUARE, BIRKENHEAD.

ULTRA VIOLET RAYS

WHICH ARE STOPPED BY GLASS PASS THROUGH
WINDOLITE,
The Practical Glass Substitute
for windows in FACTORIES, SCHOOLS, and HOSPITALS;
for POULTRY HOUSES, BROODERS, and CATTLE SHEDS;
for all GARDEN USES.
Light. Flexible. Unbreakable.
Easy to cut and fix.
Particulars post free, or Sample 3 ft. by 2 ft. for 4/6.

WINDOLITE (Dept. M), 179/185 Great Portland St.,
LONDON, W.1.



LABORATORY RHEOSTATS

These Rheostats embody perfection in detail if made BY ISENTHAL

FLAT TUBULAR RHEOSTATS

LIST ON REQUEST

ISENTHAL & CO. LTD.
Contractors to the Admiralty, War Office, Air Ministry, Postmaster-General, &c.
Denzil Works, Willesden,
LONDON, N.W.10

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

WHATMAN

FILTER PAPERS

The range of WHATMAN Filter Papers now manufactured is the most complete produced by any mill in the world, and covers practically all the requirements of modern high-grade technical work.

They are obtainable from all Laboratory Furnishers and are packed in sealed and labelled packages.

Manufactured by W. & R. BALSTON, LTD., Maidstone, KENT.

Samples and Price List on application.

In case of difficulty apply to Sole Mill Representatives:—

Telephone:
CITY 7413 (3 lines).

H. REEVE ANGEL & CO., LTD., 9 Bridewell Place, LONDON, E.C.4.

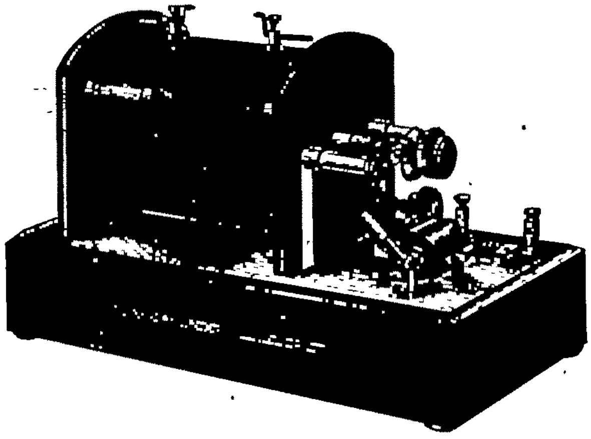
X-RAY APPARATUS

For Crystallography and Physical and Industrial Research

INDUCTION COILS AND TRANSFORMERS

Induction Coils from 1″ to 20″ spark.

Oil-immersed Transformers up to 10″ spark.



Coils up to 6″ spark length are complete with platinum or tungsten contacts.

Coils from 8″ upwards are arranged for use with motor mercury interrupters.

We specialise in X-Ray Apparatus (new and guaranteed second-hand) for Laboratories.

Please write for
1. Special List of New apparatus, including Coils, Transformers, Interrupters, X-Ray Tubes, etc.
2. Special List of guaranteed Second-hand apparatus.

Post free on request.

THE COX-CAVENDISH ELECTRICAL CO. (1924) LTD.

Telephone] 105 Great Portland Street, London, W.1 [Langham 1145

UNIVERSITY OF ST. ANDREWS.

LECTURESHIP IN PHYSICAL CHEMISTRY IN UNIVERSITY COLLEGE, DUNDEE.

The University Court of the University of St. Andrews invites applications for the vacant LECTURESHIP IN PHYSICAL CHEMISTRY in University College, Dundee. Salary £500. The Lecturer to be appointed will enter upon his duties as at October 1, 1926.

Further particulars will be furnished by the undersigned. Three printed or typewritten copies of the letter of application and relative testimonials should be lodged with the undersigned on or before August 16. Candidates are requested to submit at least three testimonials, or, alternatively, to furnish the names of three referees.

The University, St. Andrews
July 6, 1926

ANDREW BENNETT,
Secretary and Registrar.

KENT EDUCATION COMMITTEE.

COUNTY SCHOOL FOR GIRLS, BECKENHAM.

A CHIEF SCIENCE MISTRESS will be required in September to organise the Science work of the School and to teach to the Higher Certificate standard. Preference will be given to candidates holding an Honours Degree (First or Second Class) in Botany with subsidiary Chemistry. Owing to the lateness of the advertisement, a temporary appointment of a less well-qualified candidate may be made

Applications for a temporary post until Christmas, and for a permanent post in September or January, should be made at once to the Head Mistress. Letters should be marked "Science Post" Testimonials will be returned only if a stamped envelope is enclosed.

E. SALTER DAVIES, Director of Education.

UNIVERSITY OF DURHAM

(ARMSTRONG COLLEGE),

NEWCASTLE-UPON-TYNE.

LECTURESHIP IN ZOOLOGY.

The Council of Armstrong College invites applications for a LECTURESHIP as above Salary £250 or £300 per annum, according to experience and qualifications Duties to commence on October 1, 1926. Special qualifications in Marine Zoology desirable Ten copies of applications and of not more than three testimonials should be received not later than Saturday, August 28, 1926, by the undersigned, from whom further particulars may be obtained J Y T. Greig, Registrar, Armstrong College.

GOVERNMENT LABORATORY.

TEMPORARY ASSISTANT CHEMISTS wanted, age 20-25. Required to have degree of B.Sc. with not less than Second Class Honours or equivalent; weight will be given to experience in investigative work. Salaries men £160-£10-£220, women £140-£10-£180, plus usual Civil Service Bonus; at present £160 is equivalent to £258. 8s. and £140 to £231. Preference will be given to ex-Service men, and candidates will be allowed to deduct from their actual ages any time spent with the Forces between August 1914 and November 1918 Forms of application may be obtained from the Government Chemist, Clement's Inn Passage, London, W C.2, to whom they must be returned not later than July 31.

MIDLAND AGRICULTURAL AND DAIRY COLLEGE.

APPOINTMENT OF ADVISORY AGRICULTURAL ECONOMIST.

The Governors of the above College invite applications for the post of ADVISORY AGRICULTURAL ECONOMIST. Salary £400-£450 per annum, according to qualifications and experience, less 5 per cent. Superannuation contribution, the College contributing 10 per cent. thereto. Further particulars from Thos Milburn, Principal, Sutton Bonington, Loughborough

Applications are invited for the position of

ASSISTANT at the Commonwealth of Australia Observatory at Mount Stromlo Salary £804 to £900 per annum, less 10 per cent deduction for rent. Applications in triplicate, together with testimonials, should be addressed to the High Commissioner for Australia, Australia House, Strand, London, W C 2, and be received not later than July 22, 1926. Further particulars obtainable from Room 306, Australia House

UNIVERSITY COLLEGE OF WALES, ABERYSTWYTH.

Applications are invited for the post of ASSISTANT LECTURER IN PURE MATHEMATICS. Salary £250 to £300 per annum, according to qualifications and experience. For further particulars apply to the Secretary, to whom applications should be sent before July 29.

Laboratory Assistant, 15 years' experience,

Secondary and University, requires post, Chemistry, Physics or Experimental Instrument work. Box 138, c/o Nature Office.

KING'S PATENT AGENCY LTD., 146a

Queen Victoria Street, E.C.4. Advice handbook free. 40 years' refs.

CAMBRIDGESHIRE EDUCATION COMMITTEE.

SOHAM GRAMMAR SCHOOL.

Wanted, in September next, an ASSISTANT MASTER to take charge of the practical instruction in Rural Science (Nature Study, Horticulture, and the elements of Agricultural Science) The School, to which gardens, greenhouses, and land are attached, is being reorganised with a special rural side, and the Master appointed will be required to co-ordinate the practical out-of-door work with the Rural Science teaching in the laboratory and class-room. Candidates should hold a degree or other qualifications in Agricultural Science and Horticulture, and must have practical experience.

Salary will be paid in accordance with the Burnham Scale.

Application forms, which will be sent by the undersigned on receipt of a stamped addressed foolscap envelope, should be returned to him as soon as possible.

County Hall, Cambridge.
July 12, 1926.

H. MORRIS,
Secretary for Education

INDIA AND CEYLON.

Applications are invited for the position of DIRECTOR OF PROPAGANDA for Calcium Cyanamide

(a) in India;
(b) in Ceylon.

Applicants should possess a thorough knowledge of agriculture and should preferably hold a degree in this subject. Preference will be given to applicants who have also some experience of Indian agricultural conditions Adequate salaries and expenses will be paid. Applications, stating full particulars of qualifications, age and date upon which duties could be commenced, should be sent to Director of Propaganda for Calcium Cyanamide, Adelaide House, King William Street, E.C.4.

B.Sc. 1st Class Honours Botany (Mycology),

Chemistry, two years' research experience, requires post. Accept any reasonable offer. Box No. 2959, c/o Nature Office.

The Director-General, India Store Depart-

ment, Branch No. 65, Belvedere Road, Lambeth, S.E 1, invites tenders for PRISMATIC BINOCULARS. No 3 Mark 1 Tenders due on July 23, 1926 Tender forms obtainable from the above.

WANTED FOR PUBLIC WATER COM-

PANY, CHEMIST AND BACTERIOLOGIST, with experience of Chlorination Apply, giving experience and salary required, to Box No. 137, c/o Nature Office.

Standard Exhibition Naturkundliches

Heimatmuseum Leipzig, Lortzingst. 3. Evolution of palaeolithic flint implements from many countries. For sale. Apply to Dr O. Hauser, Weimar, Elisabethstr. 11.

THE DINOFLAGELLATES OF NORTHERN SEAS

By MARIE V. LEBOUR, D.Sc., F.Z.S.

Naturalist at the Laboratory of the Marine Biological Association of the United Kingdom, Plymouth.

Cloth, 8vo, 250 pp., 53 text-figures, 35 plates.

Price **12s. 6d.** net. Post free 13s.

Published by the Marine Biological Association of the United Kingdom, October 1925

Copies may be obtained from The Director, Marine Biological Laboratory, Citadel Hill, Plymouth, Messrs. Dulau & Co, Ltd, 34-36 Margaret St., Cavendish Square, London, W 1, or any Bookseller.

Just Issued

from the Natural History Department of

DULAU & COMPANY LTD.

54-56 Margaret St., Cavendish Square, London, W.1.

CATALOGUE No. 143:
PHYTO-PATHOLOGY AND HORTICULTURE.

Post free on request.

CHEMICAL AND TECHNICAL BOOKS

We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms,

Write for Catalogues—

WILLIAM BRYCE, Scientific Bookseller,
54-54a Lothian Street, EDINBURGH

J. POOLE & CO.
ESTABLISHED 1854
NEW & SECOND-HAND
SCIENTIFIC AND EDUCATIONAL
BOOKSELLERS

ENQUIRIES BY LETTER
RECEIVE IMMEDIATE ATTENTION

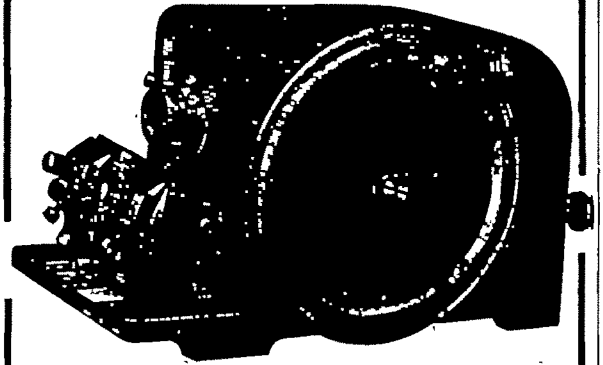
86 Charing Cross Road, London, W.C.2

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

THE PRECIOUS METALS
GOLD, PLATINUM, SILVER.

SPINK & SON, LIMITED
(By Appointment)
17-18 PICCADILLY, LONDON, W.1.
Established 153 years.
VALUE, PURCHASE or ASSAY the above in any form.
Parcels can be safely sent by registered post.

MICROSCOPES, MICROTOMES AND ACCESSORY APPARATUS



Spencer Rotary Microtome No. 820

SECOND-HAND MICROSCOPES
By makers of repute, from £10

PHYSIOLOGICAL APPARATUS

REPAIRS
to any make of Microscope or Objective and other Scientific Apparatus a Speciality

HAWKSLEY & SONS, LTD.
83 Wigmore Street, London, W.1

SCIENCE PROGRESS
A QUARTERLY RECORD OF SCIENTIFIC THOUGHT, WORK, AND AFFAIRS

Editor: Sir RONALD ROSS, K.C.B., F.R.S., &c.

No. 81 *JULY 1926* *7s. 6d. net*

Recent Advances in Science: Pure Mathematics, Meteorology; Physics; Organic Chemistry; Biochemistry; Physical Chemistry; Plant Physiology; Prehistoric Archæology.

Articles: The New Quantum Theory. By H. T. Flint, D.Sc. Notes on the Dielectric Constants of Liquids. By L. F. Gilbert, B.Sc. A Summary of the Recent Work on the Biochemistry of the Pneumococcus. By M. H. Finkelstein. The Misleading and Picturesque in Anatomy. By Prof. F. Harris, M.D., D.Sc.

Popular Science: The Bushmen of the Kalahari. By Prof. E. H. L. Schwarz.

Notes: On the Writing up of Scientific Papers; The Encouragement of Discovery; Science Schools; Oyster-Breeding Experiments; Coal Survey; The British Universities Year Book, 1926; Notes and News.

Essays: The Life and Work of a Mechanistic Philosopher: Jacques Loeb; Recent Discoveries of Missing Elements.

Essay-Reviews: Modern Eugenics. By R. A. Fisher, Sc.D. Delinquents. By (B.). Mosquito-Control. By Sir R. Ross.

Reviews of 49 Books, etc.

Annual Subscription (including postage), 31s. 2d.

JOHN MURRAY, Albemarle St., LONDON, W.1.

¶ W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE, will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ CATALOGUE 269. Scientific Books and Publications of learned Societies.

Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone: [illegible]

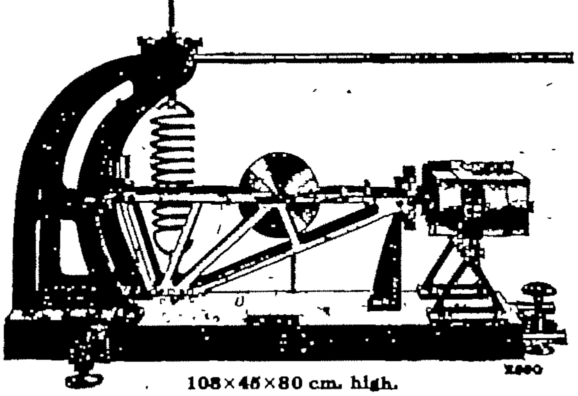
That Book you want!

Foyles can supply any Scientific Book that is in print and most of those that are out of print. They have a Special Department for this class of literature under a Manager who has experience and knowledge of the Natural Sciences. Call and consult him, or write and you will get an intelligent reply. Books sent on approval. Over a million volumes Second-hand and New on every conceivable subject in stock. Twenty-one Departmental Catalogues issued, any of which will be sent gratis and post free on mentioning interests.

That Book you do not want!
Foyles will buy it.—A single volume to a library.
Expert valuers sent any distance.
FOYLES, 121 Charing Cross Road, London.

GALITZIN SEISMOGRAPHS

AS SUPPLIED TO:
Seismological Observatory,
West Washington, U.S.A.;
Naval Observatory,
Kobe, Japan;
R. Osservatorio Geofisico,
Pavia, Italy.
Instituto Geografico,
Madrid, Spain.



108×45×80 cm. high.

The illustration shows a seismograph for indicating the vertical component of disturbance.

Further particulars, with illustrations and detailed drawings of the horizontal component seismograph, will be forwarded on request.

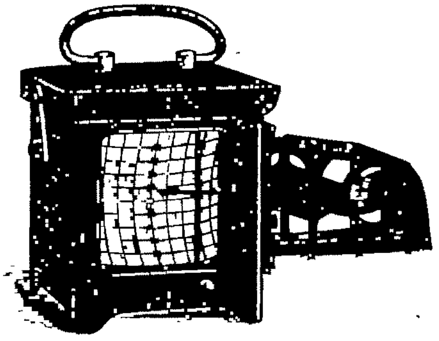
These instruments are similar in design to those made by the late Prince Boris Galitzin for the recording of small seismic disturbances. The instruments record the two horizontal components and also the vertical component of disturbance. Efficient electro-magnetic damping is provided, which does not impair the sensitiveness of the instruments.

CAMBRIDGE INSTRUMENT Co. Ltd.

WORKS— LONDON, & CAMBRIDGE
Head Office & Showrooms:— 45, GROSVENOR PLACE LONDON, S.W.1
AMERICAN COMPANY:
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

37

CASELLA'S THERMOGRAPH



£7 : 10 : 0

C. F. CASELLA & CO. LTD.
49 & 50 Parliament Street
LONDON, S.W.1

B.D.H. CHEMICALS

FOR RESEARCH AND ANALYSIS

BRITISH MANUFACTURE

Over 3500 Substances for use in Research and Analysis are kept in stock, and we are continually adding to the list of our manufactures. The reliable quality of the B.D.H. Organic Chemicals and Analytical Reagents has led to their adoption by those who place the highest value on scientific accuracy.

A copy of our latest Catalogue will be supplied on application.

THE BRITISH DRUG HOUSES, LTD.
Makers of Fine Chemicals,
Graham St., City Road, London, N.1.
Chemical Works: Wharf Road, London, N.1.

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

GRIFFIN and BAIRD & TATLOCK

beg to announce the publication of

A NEW CATALOGUE

OF PHYSICAL INSTRUMENTS AND APPARATUS

LIST NO. 50—SCIENTIFIC APPARATUS

JOHN J. GRIFFIN & SONS LTD

Kemble Str
Kingsway
LONDON
W.C. 2

BAIRD & TATLOCK LTD

GLASGOW
45, Renfrew St
EDINBURGH
7 Teviot Place

MICROID

MANCHESTER
54, Gt. Ducie St.
LIVERPOOL
64, Brownlow Hill

CAMERAS OF DISTINCTION

HEIDOSCOPE STEREO-REFLEX CAMERAS

are the finest quality stereoscopic cameras manufactured. They are instruments of precision, obtainable in two sizes with paired Zeiss Tessars F/4·5
45 × 107 mm., £44 : 16 : 0, and 6 × 13 cm., £48 : 0 : 0.

LEICA ROLL FILM CAMERA

The smallest focal plane camera. It is made as carefully as a microscope by a microscope manufacturer. Thirty-six exposures without reloading. Anastigmatic lens F/3·5. Simple and perfect in use. Complete equipment for 108 exposures may be carried in one's pocket. Price £20 : 0 : 0

LEITZ PHOTO DISTANCE METER

The most accurate and convenient range finder. May be attached to any make of camera or used in the hand. At six feet the accuracy of reading is within one inch.
Price £2 : 0 : 0

Descriptive booklets of the above post free

Microscopes—Microtomes—Dark Ground Condensers—Photomicrographic Apparatus—Hæmatological Appliances—Dissecting Stands and Lenses—Microscopical, Medical and Dental Illuminating Apparatus—Micro-Projection Apparatus—Epidiascopes—Colorimeters—Prismatic Field Glasses, Modern Deaf Appliances, etc.

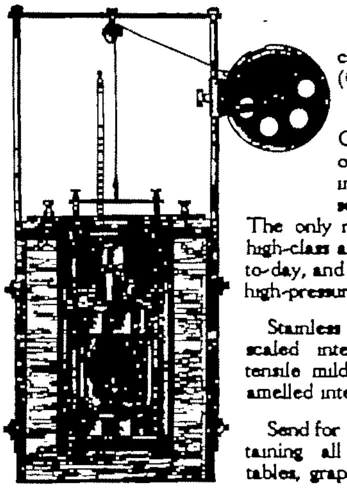
OGILVY & CO.

Optical Engineers,

20 Mortimer Street, London, W.1.

THE

MAHLER-COOK BOMB CALORIMETER



For determining the calorific value of Fuels (Coal, Coke, Oils, etc.).

The original Bomb Calorimeter, used all over the World and first introduced by the present makers in 1900. The only reliable, accurate, and high-class apparatus on the market to-day, and made by Engineers and high-pressure experts.

Stainless steel Bombs with descaled internal finish, or high tensile mild steel Bombs with enamelled interior.

Send for Illustrated Booklet containing all working instructions, tables, graphs, etc.

High Pressure Apparatus, Centrifuges, Microtomes, Electroscopes, Steam Meters, Electric Furnaces, etc.

CHAS. W. COOK & SONS,

ROYAL HOTEL WORKS,
ASHBY-DE-LA-ZOUCH, LEICS.

Diseases of Crop-Plants in the Lesser Antilles

This work, by WILLIAM NOWELL, D.I.C., is a handbook to the diseases affecting crop-plants in the tropics. Published on behalf of the Imperial Department of Agriculture. 362 pages, 150 illustrations.

Post **13/3** free

THE WEST INDIA COMMITTEE
14 Trinity Square, London, E.C.3

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals. General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

ADLARD & SON
& WEST NEWMAN
LIMITED

17 66
A & S

SCIENCE PRINTERS.

Home and Export.

23 Bartholomew Close, London, E.C.1.

W. OTTWAY & Co. Ltd.
(Established 1640)
Actual Makers of Astronomical and Terrestrial Telescopes
OTTWAY'S "SPOTTER" TELESCOPE

Fitted with 5 draw tubes. In Nickel Silver throughout, highly polished. Length fully extended 15″, length closed 4½″. Diameter of Object Glass 1″, magnification 20. Body covered in crocodile.

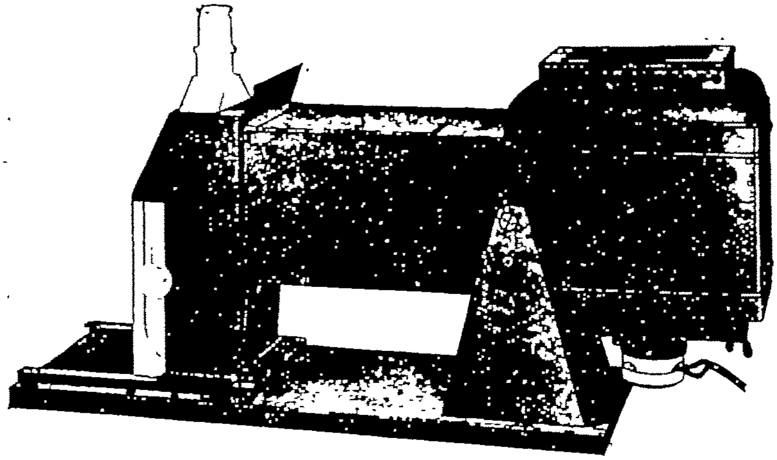
REDUCED PRICE £1 : 15 : 0 post free.

Illustrated Leaflets sent on request.

Orion Works, Ealing, London, W.5.

Bausch and Lomb

NEPHELOMETER AND COLORIMETER ILLUMINATOR
FOR BIOLOGICAL COLORIMETER



Also
Biological and
Duboscq Colorimeters,
Nephelometer Attachment
for Duboscq Colorimeter,
Colorimeter Lamp,
Hæmoglobinometer, etc.

Full particulars on application.

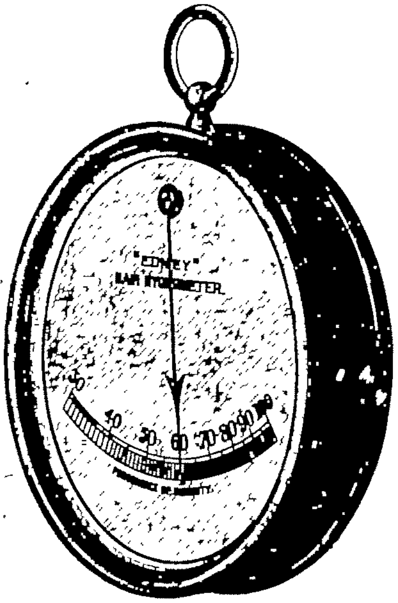
DELIVERY FROM STOCK.

Bausch & Lomb Optical Co. Ltd.
Contractors to British, Indian, Colonial and Foreign Governments.

37-38 HATTON GARDEN
LONDON E.C.1.
Our instruments may be obtained through all Dealers

"Edney" Hair Hygrometers

showing directly the PERCENTAGE of MOISTURE in the room or other position where placed



No. 1

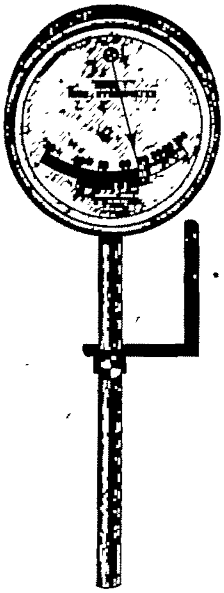
THE instruments are strongly made, and mounted in stout polished and lacquered brass cases, with 5-inch engraved and silvered metal dials which give a very open range, allowing the variations in humidity to be easily observed.

The action is by the contraction or expansion of a strand of 50 specially treated human hairs, which alters in length according to the percentage of moisture in the atmosphere.

This movement is conveyed by simple mechanism to a pulley on which the indicating hand is fixed.

Each instrument is tested against Standard Wet and Dry Bulb thermometers, and is guaranteed to give accurate readings.

A small adjusting screw is provided so that at any time the hand can (if required) be set to a standard.



No. 2

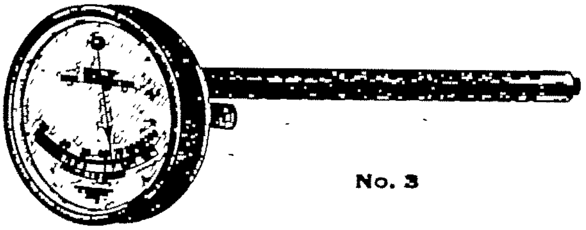
GUARANTEED ACCURATE

PRICES

No. 1 Pattern, for hanging in a room, complete **£2:2:0**

No. 2 Pattern, for fixing to wall, with bracket, 12-inch stem, complete **£2:15:0**

No. 3 Pattern, for passing through a door or wall, to show humidity of room without opening the door, 12-inch stem, complete **£2:15:0**



No. 3

SAFE DELIVERY FREE

Illustrated Descriptive List of above and other patterns of Hygrometers, also Hygrographs and Thermographs, post free from the Sole Manufacturers:

PASTORELLI & RAPKIN LTD.

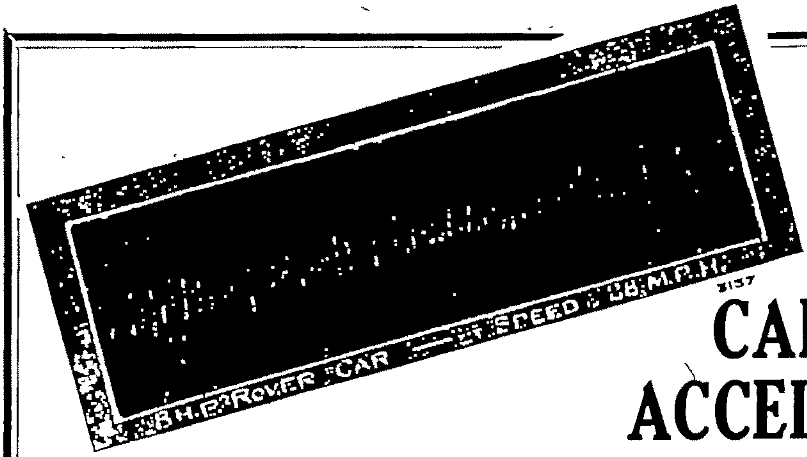
Established 1750. Contractors to various Departments of H.M. Government.

Actual Makers also of Thermometers, Barometers, Barographs, Hydrometers, and Standard Meteorological Instruments.

46 HATTON GARDEN, LONDON, E.C.1.

Telephone: Holborn 1981] ***Any instrument sent on approval if desired*** [*Telegrams:* Rapkin, London

Carriage paid and safe delivery guaranteed of all instruments within the British Isles.



CAMBRIDGE ACCELEROMETER

for measuring accelerations of
MOTOR VEHICLES,
RAILWAY COACHES,
AEROPLANES,
LIFTS, ETC.

Full particulars are given in our new List No. 149-N.

The Cambridge Accelerometer provides a convenient means of studying the springing of vehicles and the effect produced on them due to the surfaces upon which they travel. It can be used for measuring either vertical or horizontal accelerations. The records, which are clear and permanent, are obtained by means of a stylus acting upon a moving celluloid strip. The illustration is an enlargement (15x) of an actual record taken on an 8 H.P. Rover car travelling at 28 m.p.h.

CAMBRIDGE
INSTRUMENT CO LTD
Works:- London, & Cambridge
Head Office & Showrooms - 45, GROSVENOR PLACE LONDON, S.W.1
AMERICAN COMPANY:
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

MANSFIELD
OIL-GAS APPARATUS
FOR
LABORATORIES.

This plant is designed to provide a gas supply for laboratories which are out of reach of the ordinary town's gas supply.

The gas is made in a simple manner from any heavy oil, such as paraffin, and gives perfect oxidising and reducing flames.

MANSFIELD & SONS, LTD.,
23 HAMILTON SQUARE,
BIRKENHEAD.

ULTRA VIOLET RAYS

WHICH ARE STOPPED BY
GLASS PASS THROUGH
WINDOLITE,
The Practical Glass Substitute
for windows in FACTORIES, SCHOOLS, and HOSPITALS;
for POULTRY HOUSES, BROODERS, and CATTLE SHEDS;
for all GARDEN USES.
Light. Flexible. Unbreakable.
Easy to cut and fix.
Particulars post free, or Sample 3 ft. by 2 ft. for 4/6.

WINDOLITE (Dept. M), 179/185 Great Portland St.,
LONDON, W.1.

SIR HOWARD GRUBB, PARSONS
AND COMPANY,

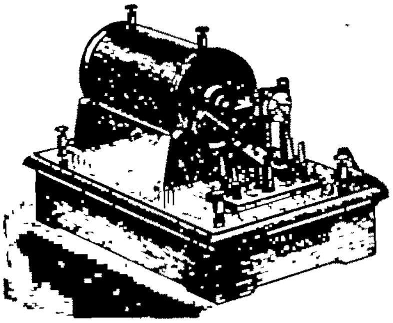
ENGINEERS & ASTRONOMICAL
INSTRUMENT MAKERS.

OPTICAL WORKS:
WALKER GATE,
NEWCASTLE-
ON-TYNE.

The illustration shows a crown glass disc of 45″ diameter, for an optical plane, being ground.

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

Max Kohl A.G.
Chemnitz A1 (Germany)
Manufacturers of
Physical Apparatus
Laboratory Furniture
Induction Coils · Oil Air Pumps
Experimental Switchboards
Projection Apparatus



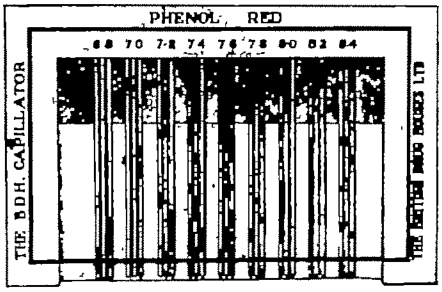
Induction Coil, with Platinum Interruptor, with Condenser and Ruhmkorff Commutator.

Special Lists on request

B.D.H. CAPILLATOR

THE B.D.H. "Capillator" provides an improved method for the colorimetric determination of Hydrogen Ion Concentration.

The "Capillator" consists of a series of capillary tubes filled with buffer solutions containing an indicator. These tubes are mounted in threes on a white card, and form a series of coloured strips, each strip being marked with its exact PH value. Each card illustrates the complete colour change of the indicator.

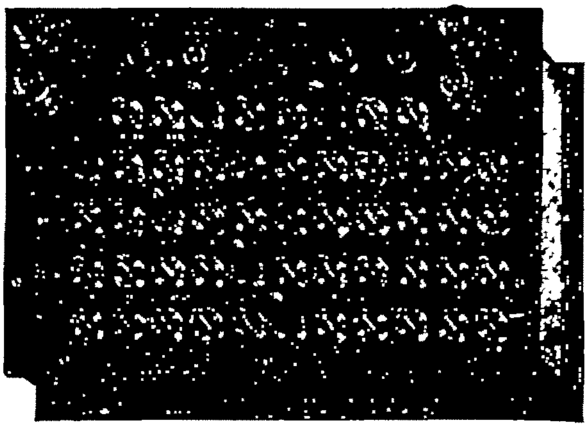


A determination of PH is carried out by mixing equal quantities of liquid and indicator, and comparing the colour produced with that of the standard tubes of the "Capillator." By means of the "Capillator" determinations of PH are carried out expeditiously and accurately, and as little as one drop of the liquid will suffice for a test.

Prices and further particulars will be supplied on application.

THE BRITISH DRUG HOUSES, LTD.
Makers of Fine Chemicals
Graham Street, LONDON, N.1

GAMBRELL BROS. LTD.
Established 1898.



Class "A" Wheatstone Bridge.
4-decade Standard Type.

The following are some of our standard lines:

Please send for Lists in which you are interested.

LIST	
"G"	Galvanometers, moving coil, pointer and reflecting.
"OG"	Galvanometers, "Onwood" pattern.
"GA"	Galvanometer Accessories, including Lamps, Scales, Universal Shunts, etc.
"K.S"	Keys and Switches.
"IR"	Gambrell's "Independent" Plug Contact Resistance Boxes and Wheatstone Bridges.
"HR"	Megohms and High Resistances.
"SR"	Switch pattern Resistance Boxes and Wheatstone Bridges, all grades, including Direct Reading.
"P.K"	Potentiometers, Kelvin Low Resistance Bridges, Kelvin Double Ratio Box, Volt Ratio Boxes, Standard Cells, Low Resistance Shunts.
"RR"	Rheostats and Single Resistances.
"C"	Condensers, Standard and Secondary.
"V.A"	Voltmeters, Ammeters, Milliameters.
"T.A"	Apparatus for Electro-Titration.

MERTON ROAD, SOUTHFIELDS,
London, S.W.18.

Phones: PUTNEY 3641-2 (Instrument).
VICTORIA 9938 (Wireless).

Radio Sales Dept. for Wireless Apparatus 76 VICTORIA ST., LONDON, S.W.1.

Journal of Scientific Instruments

(Published on the 15th day of each month.)

PRODUCED BY THE INSTITUTE OF PHYSICS, WITH THE CO-OPERATION OF THE NATIONAL PHYSICAL LABORATORY.

PRICE: SINGLE COPIES, 2s. 6d. ANNUAL SUBSCRIPTION, 30s., including postage. Send subscriptions to the CAMBRIDGE UNIVERSITY PRESS, Fetter Lane, London, E.C 4

CONTENTS OF JULY ISSUE.—VOL III, No. 10

SUPPLEMENTARY NOTE ON THE PASCHEN GALVANOMETER. By H A. DAYNES.

A SIMPLIFIED MOVING MAGNET GALVANOMETER WITH A HIGH FIGURE OF MERIT. By A C. DOWNING

A "MUMETAL" MAGNETIC SHIELD FOR A SENSITIVE GALVANOMETER. By PROF. A V. HILL

NOTE ON MICROSCOPE TUBE LENGTH. By T F CONNOLLY

A VACUUM-TUBE MULTIMETER FOR RADIO-FREQUENCY MEASUREMENTS. By M. V. COLBY

A NOTE ON THE MEASUREMENT OF CURRENTS BY THE ELECTRONIC EMISSION FROM HEATED WIRES. By JAMES TAYLOR

NEW INSTRUMENTS: VACUUM THERMO ELEMENT. Designed by DR MOLL.

A SELF-STARTING PHONIC MOTOR By D.C. GALL.

LABORATORY AND WORKSHOP NOTES.

LUBRICATION OF FINE MECHANISMS WITH MINERAL OIL.

NOTE ON THE CONSTRUCTION OF SMALL THERMO-COUPLES By J. DICKSON HANNAH.

POSSIBILITIES OF THE SUBDIVIDED MEGOHM. By E. H. W. BANNER

THE REVIVAL OF THE MOVING MAGNET GALVANOMETER.

NOTE ON THE MANUFACTURE OF QUARTZ JAWS FOR SPECTROMETER SLITS By G. H. CARRUTHERS.

CORRESPONDENCE.

THE NATIONAL PHYSICAL LABORATORY TEDDINGTON.

TABULAR INFORMATION ON SCIENTIFIC INSTRUMENTS: X. VIBRATION GALVANOMETERS

This journal is devoted to the needs of workers in every branch of science and manufacture involving the necessity for accurate measurements. Its scope includes Physics and Chemistry, Optics and Surveying, Meteorology, Electrical and Mechanical Engineering, Physiology and Medicine.

With the October number a new volume began. Vols. I. and II. can be obtained complete, bound in cloth, for 35s. each

That Book you want!

Foyles can supply any Scientific Book that is in print and most of those that are out of print. They have a Special Department for this class of literature under a Manager who has experience and knowledge of the Natural Sciences. Call and consult him, or write and you will get an intelligent reply. Books sent on approval. Over a million volumes Second-hand and New on every conceivable subject in stock. Twenty-one Departmental Catalogues issued, any of which will be sent gratis and post free on mentioning interests.

That Book you do not want!

Foyles will buy it.—A single volume to a library.

Expert valuers sent any distance.

FOYLES, 121 Charing Cross Road, London.

¶ W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE, will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ CATALOGUE 269. Scientific Books and Publications of learned Societies.

Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE Telephone. [illegible]

THE

DINOFLAGELLATES OF NORTHERN SEAS

By MARIE V. LEBOUR, D.Sc., F.Z.S.

Naturalist at the Laboratory of the Marine Biological Association of the United Kingdom, Plymouth.

Cloth, 8vo, 250 pp., 53 text-figures, 35 plates.

Price **12s. 6d.** net. Post free 13s.

Published by the Marine Biological Association of the United Kingdom, October 1925.

Copies may be obtained from THE DIRECTOR, Marine Biological Laboratory, Citadel Hill, Plymouth; MESSRS. DULAU & Co., LTD, 34-36 Margaret St., Cavendish Square, London, W 1; or any Bookseller

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals, General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement pp. 56. Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
NATURE.

Messrs Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connection with books rare and difficult to get.

HENRY SOTHERAN & CO.,

140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

J. POOLE & CO.

ESTABLISHED 1854

NEW & SECOND-HAND SCIENTIFIC AND EDUCATIONAL BOOKSELLERS

ENQUIRIES BY LETTER RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

Just Issued

from the Natural History Department of

DULAU & COMPANY LTD.

34-36 Margaret St., Cavendish Square, London, W.1

CATALOGUE No. 143: PHYTO-PATHOLOGY AND HORTICULTURE.

Post free on request.

SCIENTIFIC BOOKS

AND PERIODICALS

Including the Publications of the Learned Societies,

ON SALE BY

WHELDON & WESLEY Ltd.

2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2

Classified Catalogues sent post free. Books Purchased.

Recent Scientific and Technical Books.

Volumes marked with an asterisk have been received at "NATURE" *Office.*

Mathematics: Mechanics: Physics

Andrews, E. S. Mechanisms: a Text Book for the Use of Non-Technical Students. Large Cr. 8vo. Pp. viii + 194. (London: University Tutorial Press, Ltd., 1926.) 3*s.* 6*d.*

Ballard, P. B. Fundamental Arithmetic. Cr. 8vo. Pupil's Book 1. Pp. 65. Paper, 10*d.*; linen, 1*s.* Teacher's Book 1, with Notes and Answers. Pp. 48. 2*s.* (London: University of London Press, Ltd., 1926.)

Bocher, Maxime. An Introduction to the Study of Integral Equations. 8vo. (Cambridge: At the University Press, 1926.) 4*s* 6*d* net.

Carleman, T. Les fonctions quasi-analytiques: leçons professées au College de France. (Collection de Monographies sur la Théorie des Fonctions.) 8vo. Pp. 116 (Paris: Gauthier-Villars et Cie, 1926.) 36 francs.

Curtiss, David Raymond. Analytic Functions of a Complex Variable (The Carus Mathematical Monographs: published for the Mathematical Association of America.) Cr. 8vo Pp. ix + 173 (Chicago and London: The Open Court Publishing Co, 1926.) 10*s.* net.*

Donder, Th. de. Théorie des champs gravifiques (Mémorial des sciences mathématiques, Fascicule 14.) Roy 8vo. Pp. iii + 60. (Paris: Gauthier-Villars et Cie, 1926.) 12 francs.*

Grieve, A. Barrie. Analytical Geometry of Conic Sections and Elementary Solid Figures. Part 1. Cr. 8vo. Pp 180 (London: G. Bell and Sons, Ltd., 1926.) 5*s.*

Havelock, T. H. Theory of Ship Waves and Wave Resistance 8vo. (London: E. and F. N. Spon, Ltd., 1926.) 3*s* 6*d* net

Laemel, Rudolph. Introduction to the Theory of Relativity. (Cosmos Library.) Cr. 8vo Pp. 66. (London: Simpkin, Marshall and Co., Ltd, 1926.) 1*s.* net

Lay, Ed. J. S. The Pupils' Class-Book of Arithmetic. Book 7: For the Higher Classes. Cr. 8vo. Pp. 256. (London: Macmillan and Co., Ltd, 1926.) 2*s* 3*d.*

Leconte, Th., et Deltheil, R. Éléments de calcul différentiel et de calcul intégral. (Collection Armand Colin.) 2 vols Cr. 8vo. Tome 1. Pp. 220 Tome 2. Pp 220 (Paris: Armand Colin, 1926.) 24 francs.

Medical Research Council: Industrial Fatigue Research Board. Report No 37: Fan Ventilation in a Humid Weaving Shed; an Experiment made for the Departmental Committee on Humidity in Cotton Weaving. By S. Wyatt, assisted by J. A. Fraser and F. G. L. Stock Roy. 8vo. Pp. v + 31. (London: H M Stationery Office, 1926.) 1*s* 9*d.* net.*

Metz, André. Les nouvelles théories scientifiques et leurs adversaires: la relativité. Quinzième édition. Cr. 8vo. Pp 270 (Paris: Étienne Chiron, 1926.) 9 francs.

Pincock, J. C. Geometry for Secondary Schools Cr. 8vo. Pp viii + 309. (London, Calcutta and Sydney: George G Harrap and Co, Ltd., 1926.) 3*s.* 6*d.*

Pöschl, Theodor, Herausgegeben von. Berechnung von Behaltern nach neueren analytischen und Graphischen Methoden. Zweite Auflage (Berlin: Julius Springer, 1926.) 15 60 marks.

Potter, F. F., and **Rice, F. C.** Common-sense Arithmetic: a Junior Textbook. Cr. 8vo Pp. xvi + 320 (London: Sir Isaac Pitman and Sons, Ltd, 1926.) With Answers, 4*s.* 6*d.*; without Answers, 3*s.* 6*d.*

Reynolds, C. L. Electricity and Magnetism. (Bell's Natural Science Series.) Part 1. Cr. 8vo. Pp. 210 (London G. Bell and Sons, Ltd., 1926.) 3*s.*

Rufini, E. Il "Metodo" di Archimede e le origini dell' analisi infinitesimale nell' antichità. (Collezione Per la storia e la filosofia delle Matematiche, 4.) Cr. 8vo. Pp. viii + 294. (Roma: Alberto Stock, 1926.) 22.50 lire.

Sachs, G., und **Fiek, G.** Der Zugversuch. (Leipzig: Akademische Verlagsgesellschaft m b H., 1926.) 12 gold marks.

Sankey, E., and **Royds, Albert.** Elementary Mathematics: specially prepared for Central Schools, Senior Elementary Schools and Upper Standards (VI, VII, VIII). Part 2: For pupils of 12-14 years. Cr. 8vo Pp. viii + 120 (London: G. Bell and Sons, Ltd, 1926.) 1*s.* 6*d.*

Siddons, A. W., and **Hughes, R. T.** A Junior Geometry: based on the various Geometry Books by Godfrey and Siddons. Cr. 8vo. Pp. x + 234. (Cambridge: At the University Press, 1926.) 4*s*

Weiss, Pierre, et Foex, Gabriel. Le magnétisme. (Collection Armand Colin: Section de physique, No. 71.) Fcap. 8vo. Pp. viii + 215. (Paris: Armand Colin, 1926.) 8.40 francs.*

Engineering

Beaver, J. L. Elements of Alternating Currents and Alternating Current Apparatus. Med. 8vo. Pp. 370. (New York and London: Longmans, Green and Co., Ltd., 1926.) 18*s.* net.*

Belluzzo, Giuseppe. Steam Turbines. Translated by A. G. Bremner. Med. 8vo. Pp. xiv + 706 + 2 plates. (London: Charles Griffin and Co., Ltd, 1926.) 42*s.* net

Berg, Eskie. Electric Propulsion of Ships. Roy. 8vo. (London: E. and F. N. Spon, Ltd., 1926.) 3*s.* net

Blyth, Herbert. Modern Telpherage and Ropeways: with a Section on Cableways and Cable Cranes. Cr. 4to. Pp xvi + 156 + 55 plates. (London: Ernest Benn, Ltd., 1926.) 27*s* 6*d.* net.*

Broschat, Ernst. Der Behälterbau: ein Handbuch für die Berechnung und Ausfuhrung eiserner Flussigkeits- und Gasbehälter. Teil 1: Konstruktionselemente. Pp. 96 (Leipzig: Otto Spamer, 1926.) 7.50 gold marks

Campion, A. Cast Iron for Diesel Engines. Roy. 8vo (London: E. and F. N Spon, Ltd, 1926.) 3*s* 6*d* net

Ciniselli, Angelo. Macchine Utensili per la Lavorazione dei Materiali Metallici. (Milano: Ulrico Hoepli, 1926.) 28.50 lire.

Codd, Mortimer A. Electric Lighting, Starting and Ignition for Motor Vehicles. Med 8vo. Pp. 286. (London: E. and F. N. Spon, Ltd, 1926.) 18*s.* net

Constantinesco, G. Transmission of Power: the Present, the Future. Roy. 8vo. (London: E. and F. N. Spon, Ltd., 1926.) 5*s.* net

Cunningham, Brysson. Port Economics: an Elementary Study of Port Affairs (Pitman's Transport Library.) Demy 8vo. Pp. 144. (London: Sir Isaac Pitman and Sons, Ltd, 1926.) 6*s.* net.

Dehne, Gerhard. Die Deutsche Elektrizitätswirtschaft. Pp. 67. (Stuttgart: Ferdinand Enke, 1926.)

Department of Scientific and Industrial Research: Radio Research. Special Report No 4: Variations of Apparent Bearings of Radio Transmitting Stations. Part 3: Observations on Ship and Shore Transmitting Stations, November 1922–March 1924. By R. L. Smith-Rose Roy. 8vo. Pp viii + 53. (London: H.M. Stationery Office, 1926.) 2*s.* 6*d.* net.*

Donkin, C. T. B. The Elements of Motor Vehicle Design: a Text-book for Students and Draughtsmen. Demy 8vo. Pp 285. (London: Oxford University Press, 1926.) 12*s.* 6*d.* net.

Engberding, E. Luftschiff und Luftschiffahrt in Vergangenheit, Gegenwart und Zukunft: eine allgemein verständliche Einfuhrung in das moderne Luftschiffwesen und seine grossen Probleme; Bau und Verwendung der Luftschiffe Pp. xxiv + 272 (Berlin: VDI-Verlag G.m.b.H., 1926.) 9 gold marks

Gates, Philip. Workshop Operations and Lay-outs fot Economic Engineering Production. Cr. 8vo. Pp 208. (London: E and F. N. Spon, Ltd., 1926.) 7*s* 6*d* net

Hall, Cyril. Conquests of Engineering. Cr. 8vo Pp. 296. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1926.) 3*s* 6*d.* net

Harris, Percy W. How to build a Powerful Seven-valve Super Heterodyne Receiver. (Radio Press Series, No 12.) In envelope. (London: Radio Press, Ltd, 1926.) 5*s.* net.

Hemardinquer, P. La superhétérodyne et la superréaction. Pp. 171. (Paris: Étienne Chiron, 1926.) 18 francs.

Holst, C. P. The Balancing of the Multiple-Crank Steam Engine. (Leiden: E. J. Brill, Ltd., 1926.) 2 80 florins.

King, A. G. Practical Steam, Hot Water and Vapour Heating and Ventilation. Fifth revised and enlarged edition Roy. 8vo Pp 551 (London: Crosby Lockwood and Son, 1926) 25*s* net

Koch, Alexander. Von der Bewegung des Wassers und den dabei auftretenden Kraften, nach Arbeiten von Staatsrat. Herausgegeben von Max Carstangen (Berlin: Julius Springer, 1926) 28.50 gold marks

Kruger, Paul. Die Satzradersysteme der Evolventenverzahnung. (Berlin. Julius Springer, 1926) 8.40 gold marks

Lamé, Ct. M. Le vol vertical et la sustentation indépendante: hélicoptères, gyroptères, avions hélicoptères. Roy 8vo. Pp 170. (Paris Libr de la Vie technique et industrielle, 1926) 30 francs.

Lister, J. E., and Harris, C. Harman. Mechanical Draught. (Chemical Engineering Library: Second Series.) Cr 8vo. Pp. 138. (London: Ernest Benn, Ltd, 1926.) 6*s*. net *

Mayer, Max. Die Sicherheit der Bauwerke und ihre Berechnung nach Greuzkräften anstatt nach zulassigen Spannungen. (Berlin: Julius Springer, 1926.) 2 70 gold marks.

Milon, H. La téléphonie automatique (Bibliothèque des Annales des Postes, Télégraphes et Téléphones) 8vo. Pp. 414. (Paris: Gauthier-Villars et Cie, 1926) 90 francs.

Mines Department: Safety in Mines Research Board. Paper No. 21: Flameproof Electrical Apparatus for Use in Coal Mines Second Report: Perforated Plate Protection. By C S. W. Grice and R. V. Wheeler. Roy. 8vo Pp 26+4 plates (London: H M. Stationery Office, 1926) 1*s*. 3*d* net.*

Molesworth, Walter H., Edited by Spon's Electrical Pocket Book: a Reference Book of General Electrical Information, Formulae and Tables for Practical Engineers Second edition New impression. 18mo Pp 488. (London: E and F. N. Spon, Ltd., 1926) 7*s* 6*d*. net

Naske, Carl. Zerkleinerungsvorrichtungen und Mahlanlagen (Chemische Technologie in Einzeldarstellungen.) Vierte Auflage Pp x+375. (Leipzig: Otto Spamer, 1926) 36 gold marks.

O'Connor, Henry, the late. The Gas Engineer's Pocket-book: comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and use of Coal Gas, and the Construction of Gasworks. Fourth edition, completely revised and brought up to date by A. T Gilbert and H. B. Morris. Demy 8vo. Pp 408. (London. Crosby Lockwood and Son, 1926.) 18*s*. net

Purdie, H. Ayres. Electrical Contracting: a Guide and Handbook specially designed to meet the Needs of all those engaged in Business as Electrical Contractors Cr. 8vo, Pp. xxxii+375. (London: Ernest Benn, Ltd, 1926) 10*s* 6*d* net.*

Rousiers, Paul de. Les grandes industries modernes Tome 4: Les transports maritimes. Cr 8vo Pp. 278. (Paris: Armand Colin, 1926.) 12 francs

Rüdenberg, R. Aussendung und Empfang elektrischer Wellen Pp. iv+67 (Berlin Julius Springer, 1926.) 3 90 gold marks.

Santarella, L., e Miozzi, E. Ponti Italiani in Cemento Armato. (Milano: Ulrico Hoepli, 1926) 110 lire.

Schmeer, F. Deutscher Ausschuss fur Eisenbeton Versuche mit dem Giessverfahren fur Eisenbeton (Berlin: Wilhelm Ernst und Sohn, 1926) 3 90 gold marks.

Superheat Engineering Data: a Handbook on the Generation and Use of Superheated Steam and Related Subjects. Sm. 8vo. Pp. 202. (London and Manchester: The Superheater Co, Ltd., 1926) 5*s*

Thorpe, W. H. Steel Bridge Weights. Roy. 8vo (London: Crosby Lockwood and Son, 1926) 7*s*. 6*d*. net

Troup, John D. Coal and Ash-handling Plant. Demy 8vo. Pp 148. (London: Chapman and Hall, Ltd., 1926.) 13*s*. 6*d*. net

Underhill, Charles R. Power-Factor Wastes: a Practical Book for Manufacturing Executives, Plant Engineers and Electricians. Med 8vo Pp xiii+326. (New York: McGraw-Hill Book Co., Inc., London: McGraw-Hill Publishing Co., Ltd., 1926) 17*s* 6*d* net *

Webb, Walter Loring. Railroad Construction: Theory and Practice Eighth edition, revised. 8vo (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 25*s*. net.

Chemistry: Chemical Engineering

Associazione Italiana di Chimica generale ed applicata. Stanislao Cannizzaro: Scritti vari e lettere inedite nel Centenario della Nascita Sup Roy. 8vo. Pp vii+486. (Roma: Tip. "Leonardo da Vinci," 1926) 150 lire *

Chaplet, A. La chimie. Pp 192. (Paris Hachette et Cie, 1926.) 7 50 francs.

Coleman, J. Bernard, and Arnall, Francis. The Preparation and Analysis of Organic Compounds. Demy 8vo Pp xvi+352. (London: J. and A. Churchill, 1926) 15*s* net *

Cooper, William C. Qualitative Analysis (New World Science Series) 8vo. (London, Calcutta and Sydney. George G. Harrap and Co, Ltd, 1926.) 5*s*. net

Daniels, G. W. Refrigeration in the Chemical Industry. Demy 8vo. Pp 151. (London: Chapman and Hall, Ltd, 1926) 10*s* net.

Dupont, G. Les essences de térébenthine (Encyclopédie Léauté, 2e série) Cr 8vo Pp. 332. (Paris Gauthier-Villars et Cie, 1926) 24 francs.

Ensoll, Robert. The Technical Chemists' Pocket-book New impression Fcap. 8vo. Pp 204 (London E and F. N. Spon, Ltd, 1926.) 6*s*. net.

Ephraim, Fritz. A Text-Book of Inorganic Chemistry English edition by P. C. L Thorne Roy. 8vo Pp xii+805 (London and Edinburgh. Gurney and Jackson, 1926.) 28*s*. net *

Faloon, Dalton B. Zinc Oxide History, Manufacture and Properties as a Pigment. Demy 8vo Pp x+146 (London: Constable and Co., Ltd, 1926) 12*s* net

Faraday Society. Photochemical Reactions in Liquids and Gases: a General Discussion held by the Faraday Society, October 1925 Roy 8vo. Pp 435-658. (London Gurney and Jackson, 1926.) 15*s*. 6*d*. net.*

Freundlich, Herbert. Fortschritte der Kolloidchemie. Demy 8vo Pp iv+109 (Dresden und Leipzig. Theodor Steinkopff, 1926.) 5 50 gold marks.*

Friedländer, P., Begrundet von Fortschritte der Teerfarbenfabrikation und verwandter Industriezweige: an Hand der systematisch geordneten und mit kritischen Anmerkungen versehenen Deutschen Reichspatente Fortgefuhrt von Ed Fierz-David Pharmazeutischer Teil bearbeitet von Max Dohrn Teil 14, umfassend die Zeit vom 1 Juli 1921 bis 31 Januar 1925 Pp. xxv+1552 (Berlin. Julius Springer, 1926) 196 gold marks.

Fürth, Arthur. Die Braunkohle und ihre chemische Verwertung. (Fortschritte der chem. Technologie in Einzeldarstellungen, Band 11) Pp. 135 (Dresden und Leipzig Theodor Steinkopff, 1926) 7 gold marks

Grossmann, H. Stickstoffindustrie und Weltwirtschaft Auf Grund amtlicher amerikanischer Veroffentlichungen bearbeitet. Pp. 92. (Stuttgart: Ferdinand Enke, 1926.) 3 gold marks.

Hackspill, L., et Remy-Genneté, P. Petite industrie chimique: industrie des métalloides (Grandes Encyclopédies industrielles.) Roy. 8vo. Pp. 834. (Paris: J-B Baillière et fils, 1926.) 85 francs.

Haslam, Robert T., and Russell, Robert P. Fuels and their Combustion Med. 8vo. Pp. xiv+809 (New York: McGraw-Hill Book Co, Inc; London. McGraw-Hill Publishing Co, Ltd, 1926) 37*s* 6*d* net *

Hirsch, F. The Transport and Handling of Mineral Acids (Chemical Engineering Library: Second Series) Cr 8vo. Pp 140. (London: Ernest Benn, Ltd, 1926) 6*s* net *

Höber, Rudolf. Physikalische Chemie der Zelle und der Gewebe Sechste, neubearbeitete Auflage Roy 8vo Pp. xvi+955 (Leipzig: Wilhelm Engelmann, 1926.) 42 gold marks.*

Hoffschildt-Drechsler. Der junge Drogist: Lehrbuch fur Drogisten-Fachschulen, den Selbstunterricht und die Vorbereitung zur Drogistengehilfen- und Giftprufung Vierte Auflage, vollstandig umgearbeitet und auf den Lehrgang A des D D. V fur Drogisten-Fachschulen eingestellt von Georg Schneider Nebst einer Handelskunde neubearbeitet von Bruno Walter Pp. 411. (Berlin. Julius Springer, 1926.) 13 20 gold marks.

Jaffe, Bernard. Chemical Calculations. (New World Science Series) Cr 8vo. (London, Calcutta and Sydney: George G Harrap and Co , Ltd , 1926) 5*s* net.

Kleinlogel. Einflusse auf Beton die chemischen, mechanischen und sonstigen Einflusse von Luft, Wassern, Sauren, Laugen, Olen, Dampfen, Erden, Lagergutern und dergl. auf Zement, Mortel, Beton und Eisenbeton, sowie die Massnahmen zur Verringerung und Verhutung dieser Einflusse , ein Auskunftsbuch fur die Praxis Unter Mitarbeit von F. Hundeshagen und Otto Graf. Vollstandig neubearbeitete und bedeutend erweiterte Auflage (Berlin Wilhelm Ernst und Sohn, 1926) 19 50 gold marks

Lassberg, J. v. Die Warmewirtschaft in der Zellstoff- und Papierindustrie Zweite vollig neubearbeitete Auflage Pp 282 (Berlin · Julius Springer, 1926) 24 gold marks.

Lewis, Warren K., and **Radasch, Arthur H.** Industrial Stoichiometry Chemical Calculations of Manufacturing Processes (Chemical Engineering Series.) Med 8vo Pp xi + 174 (New York · McGraw-Hill Book Co , Inc , London . McGraw-Hill Publishing Co , Ltd , 1926.) 12*s* 6*d* net *

Lloyd, Dorothy Jordan. Chemistry of the Proteins and its Economic Applications Ex Cr 8vo Pp xii + 279 (London · J and A Churchill, 1926) 10*s* 6*d* net *

McDougal, A. T. The Marvels of Chemistry. (Science in Everyday Life, Vol 5) Cr 8vo Pp vii + 208 (London : Sir Isaac Pitman and Sons, Ltd , 1926) 2*s* 6*d* net

Mitchell, C. Ainsworth. Vinegar : its Manufacture and Examination Second edition, thoroughly revised Cr 8vo. Pp. xvi + 211 + 5 plates (London · Charles Griffin and Co , Ltd , 1926) 10*s* 6*d* net *

Ochs, Rudolf. Praktikum der qualitativen Analyse : fur Chemiker, Pharmazeuten und Mediziner. Demy 8vo Pp vii + 126 + 4 Tafeln. (Berlin : Julius Springer, 1926) 4 80 gold marks *

Pollitt, Allan A. Die Ursachen und die Bekampfung der Korrosion Aus dem Englischen ubersetzt und bearbeitet von W N Kreutzfeldt Pp viii + 182 (Braunschweig Friedr. Vieweg und Sohn A.-G., 1926) 11 gold marks

Rassow, B., und **Loesche, A.**, Bearbeitet von Jahresbericht uber die Leistungen der Chemischen Technologie fur das Jahr 1925. 71 Jahrgang Abteilung 1 Unorganischer Teil Pp 781 (Leipzig Johann Ambrosius Barth, 1926) 36 gold marks

Ravenna, C. Chimica vegetale. 8vo Pp xx + 694 (Bologna : Nicola Zanichelli, 1926.) 80 lire

Reinglass, P. Chemische Technologie der Legierungen mit Ausnahme der Eisen - Kohlenstoff - Legierungen. (Chemische Technologie in Einzeldarstellungen) Zweite Auflage Pp xi + 538 + 24 Tafeln (Leipzig · Otto Spamer, 1926) 36 gold marks

Reiss, Paul. Le *p*H intérieur cellulaire. Roy 8vo. Pp 135 (Paris . Les Presses universitaires de France, 1926) *

Ristenpart, Eugen. Chemische Technologie der Gespinstfasern Teil 3 · Die Praxis der Farberei unter Berucksichtigung der Apparatur. Dritte ganzlich neubearbeitete Auflage Zugleich 3 Auflage von Dr. Herzfeld "Das Farben und Bleichen," Teil 3 Pp 530. (Berlin : M. Krayn, 1926) 30 gold marks.

Rona, Peter. Praktikum der physiologischen Chemie Teil 1 . Fermentmethoden Pp 331. (Berlin · Julius Springer, 1926) 15 gold marks.

Ruff, Otto. Anleitung zum chemischen Praktikum Pp. 52 (Leipzig : Akademische Verlagsgesellschaft m b H , 1926) 3 60 gold marks

Scheid, Karl. Vorbereitungsbuch fur den Experimental-Unterricht in Chemie Dritte Auflage Roy 8vo. Pp viii + 480 (Leipzig und Berlin : B G. Teubner, 1926) 20 gold marks

Schmidt, Julius. Jahrbuch der Organischen Chemie Jahrgang 12 : Die Forschungsergebnisse und Fortschritte im Jahre 1925. Pp. xviii + 365 (Stuttgart . Wissenschaftliche Verlagsgesellschaft m b H , 1926) 35 gold marks

Silbermann, Henri. Hilfsapparate fur den Farber und Koloristen : an Hand der deutschen Patentliteratur, 1913–1925. Pp. x + 173 (Leipzig : Max Janecke, 1926) 8 50 gold marks.

Society of Chemical Industry, Issued by the Reports of the Progress of Applied Chemistry Vol 10, 1925 Demy 8vo Pp 725 (London . Society of Chemical Industry, 1926) *

Speller, Frank N. Corrosion, Causes and Prevention : an Engineering Problem. Med 8vo Pp xii + 621. (New York : McGraw-Hill Book Co , Inc , London : McGraw-Hill Publishing Co , Ltd , 1926) 30*s* net *

Strohecker, Robert. Chemische Technologie der Nahrungs- und Genussmittel (Chemische Technologie in Einzeldarstellungen.) Pp xi + 252 (Leipzig . Otto Spamer, 1926) 22 gold marks

Underwood, Jr., H. W. Problems in Organic Chemistry (International Chemical Series) Ex Cr 8vo. Pp xii + 233 (New York : McGraw-Hill Book Co , Inc ; London · McGraw-Hill Publishing Co , Ltd , 1926) 10*s* net *

Webre, Alfred L., assisted by **Robinson, Clark S.** Evaporation Pp. 500 (New York The Chemical Catalog Co , Inc , 1926) 6 dollars.

Wiessmann, Hans. Agrikulturchemisches Praktikum : Quantitative Analyse. Pp. 329. (Berlin : Paul Parey, 1926) 18 gold marks

Zimmer, Emil. Bleiweiss und andere Bleifarben. (Fortschritte der chem. Technologie in Einzeldarstellungen, Band 9) Pp 132 (Dresden und Leipzig : Theodor Steinkopff, 1926) 6 gold marks.

Technology

Anderson, Robert J. The Metallurgy of Aluminium and Aluminium Alloys Med 8vo Pp 945 (London : Chapman and Hall, Ltd , 1926.) 45*s*. net

Barton, L. J. Refining Metals Electrically. 8vo. Pp. 414 (Cleveland, Ohio and London · Penton Publishing Co , 1926) 30*s*

Börjeson, J., et **Grabhorn, R.** Leçons de reliure pour amateurs Augmenté et dessiné par P -J Challot 8vo Pp 122. (Paris : Gauthier-Villars et Cie, 1926) 25 francs

Butter, Francis J. Locks and Lockmaking (Pitman's Common Commodities and Industries Series.) Cr. 8vo Pp. xi + 135. (London : Sir Isaac Pitman and Sons, Ltd , 1926) 3*s* net.*

Camp, J. M., and **Francis, C. B.** The Making, Shaping and Treating of Steel. Fourth edition 8vo Pp lxi + 1142. (Pittsburgh, Pa : Carnegie Steel Co., 1925) 7 dollars.

Derulle, G. Les progrès de la fonderie : moulage et fusion (Encyclopédie Léauté, 2e série) Cr. 8vo Pp 256 (Paris Gauthier-Villars et Cie, 1926) 22 francs

Giordano, Amerigo. Abrasivi-Affilatrici Rettificatrici (Milano Ulrico Hoepli, 1926) 18 50 lire

Giraldon, F. Le relieur pratique Cr. 8vo Pp. 124. (Paris . Hachette et Cie, 1926) 7 50 francs

Grenet, L. Trempe, recuit, cementation et conditions d'emploi des aciers Pp 656. (Paris et Liège : Ch. Béranger, 1926)

Hunter, J. A. Cloths and the Cloth Trade (Pitman's Common Commodities and Industries Series) Cr 8vo Pp 128. (London : Sir Isaac Pitman and Sons, Ltd , 1926) 3*s* net

Hurst, J. E. Metallurgy of Cast Iron : a Complete Treatise for Engineers, Foundrymen and Students (The Specialists' Series) Demy 8vo Pp xvi + 311 (London Sir Isaac Pitman and Sons, Ltd., 1926) 15*s* net *

Kneeland, Frank H., Compiled by Getting out the Coal Stripping, Underground Mining, Loading Machines, Roof Support (Practical Coal Production, Vol 2) Ex Cr. 8vo Pp vii + 403 (New York · McGraw-Hill Book Co , Inc , London : McGraw-Hill Publishing Co , Ltd , 1926) 15*s* net.*

Kremann, R. Elektrolyse geschmolzener Legierungen Pp 62 (Stuttgart : Ferdinand Enke, 1926) 3 gold marks.

Litz, V., Herausgegeben von Spanlose Formung Schmieden, Stanzen, Pressen, Pragen, Ziehen. (Berlin : Julius Springer, 1926) 12 60 gold marks.

Millis, C. T. Metal-Plate Work : its Patterns and their Geometry ; also Notes on Metals and Rules in Mensuration for the Use of Tin, Iron and Zinc Plate

Workers, Coppersmiths, Boilermakers and others Fifth edition, revised and enlarged Cr. 8vo. Pp 512. (London: E. and F N. Spon, Ltd., 1926.) 7*s* 6*d*. net

Renault, H., et **Langlois, G.** Manuel de poche sur la photographie simple et stéréoscopique en noir et en autochrome: les vues, les portraits. Cr. 8vo. Pp 44. (Paris: Gauthier-Villars et Cie, 1926.) 8 francs.

Silbermann, Henri. Maschinen zum Bedrucken von Textilstoffen Band 2: Garndruck, Zeugdruck, Tapetendruck; an Hand der deutschen Patentliteratur 1913–1925. Pp. xi + 198 (Leipzig: Max Janecke, 1926) 12.75 gold marks

Woodward, W. E. The Metallography of Steel and Cast Iron Demy 8vo. Pp. xii + 143. (London: Crosby Lockwood and Son, 1926.) 15*s* net *

Astronomy

Hamilton, George Hall. Mars at its Nearest. Demy 8vo Pp 93 (London: Simpkin, Marshall and Co., Ltd., 1926.) 6*s*. net.

Meteorology: Geophysics

Air Ministry: Meteorological Office, London. A Short Course in Elementary Meteorology. By W. H. Pick. (M O. 247.) (Published by the Authority of the Meteorological Committee.) Second edition, revised. Roy. 8vo Pp. 127 + 8 plates. (London: H M. Stationery Office, 1926.) 1*s*. 6*d*. net.*

Air Ministry: Meteorological Office. Particulars of Meteorological Reports issued by Wireless Telegraphy in Great Britain and the Countries of Europe and North Africa (M O. 252.) Fourth edition. Roy. 8vo. Pp. vi + 144. (London: H.M. Stationery Office, 1926.) 4*s*. net.*

Conrad, V., Herausgegeben von. Gerlands Beitrage zur Geophysik. Band 15, Heft 1. Med. 8vo. Pp. iii + 89 + 3 (Leipzig: Akademische Verlagsgesellschaft m b H, 1926.)*

Gutenberg, B., Herausgegeben von. Lehrbuch der Geophysik Lieferung 1. Sup Roy. 8vo Pp 176. (Berlin: Gebruder Borntraeger, 1926) 9 75 gold marks.*

Hann-Süring. Lehrbuch der Meteorologie. Vierte Auflage 8vo. Pp. xvi + 867. (Leipzig: Chr. H. Tauchnitz, 1926) 39 gold marks.

Hobbs, William Herbert. The Glacial Anticyclones: the Poles of the Atmospheric Circulation. (University of Michigan Studies, Scientific Series, Vol. 4) Med 8vo Pp xxiv + 198 + 3 plates. (New York: The Macmillan Co, 1926.) 2 75 dollars.*

McAdie, Alexander. Man and Weather. Cr. 8vo Pp vi + 99 + 18 plates (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1926) 8*s*. 6*d*. net.*

Pramanik, S. K. The Six-hourly Variations of Atmospheric Pressure and Temperature (Memoirs of the Royal Meteorological Society, Vol 1, No 3) Roy. 8vo. Pp. 35-47 (London: Edward Stanford, Ltd., 1926) 2*s*. 6*d* *

Richardson, Lewis F., and **Munday, Russell E.** The Single-layer Problem in the Atmosphere and the Height-Integral of Pressure. (Memoirs of the Royal Meteorological Society, Vol 1, No 2) Roy. 8vo. Pp. 17-34. (London: Edward Stanford, Ltd., 1926) 2*s* 6*d* *

Richardson, Lewis F., and **Proctor, Denis.** Diffusion over Distances ranging from 3 km. to 86 km. (Memoirs of the Royal Meteorological Society, Vol. 1, No. 1.) Roy 8vo. Pp. 16 (London: Edward Stanford, Ltd., 1926.) 2*s* 6*d* *

Weickmann, Ludwig, Herausgegeben von. Zum Klima der Turkei: Ergebnisse dreijahriger Beobachtungen 1915–1918 Zweites Heft: Die Temperaturverhaltnisse der Turkei; der Scirocco. Von Peregrin Zistler. Roy. 8vo Pp. 181 + 7 Tafeln. (Leipzig: Geophysikalisches Institut der Universitat, 1926)*

Geology: Mineralogy

Coleman, A. P. Ice Ages: Recent and Ancient. Demy 8vo. Pp. xliii + 296 (London: Macmillan and Co, Ltd., 1926.) 17*s*. net.*

Digby, Bassett. The Mammoth and Mammoth Hunting in North-East Siberia. Med. 8vo Pp. 224. (London: H. F. and G. Witherby, 1926.) 12*s*. 6*d*. net.

Geological Survey, England, Memoirs of the. Explanation of Special Oxford Sheet: The Geology of the Country around Oxford. By T. I. Pocock; with Contributions by H. B Woodward and G. W. Lamplugh. Second edition, by J. Pringle; with Contributions by K. S. Sandford and C. J Bayzand Roy 8vo Pp viii + 191 + 4 plates (London: H.M. Stationery Office; Southampton. Ordnance Survey Office, 1926) 4*s*. net *

Geological Survey, Scotland, Memoirs of the. The Economic Geology of the Central Coalfield of Scotland. Area 5: Glasgow East, Coatbridge and Airdrie; with Chryston, Glenboig, Greengairs, Slamannan, Caldercruix and Salsburgh By C T. Clough, L W Hinxman, W. B Wright, E M. Anderson and R G Carruthers, with Contributions from R Kidston and G W. Lee Second edition, with additions by M Macgregor. Roy. 8vo Pp x + 171 + 13 plates. (Edinburgh and London: H M Stationery Office; Southampton: Ordnance Survey Office, 1926) 5*s*. net.*

Henderson, Junius. Geology in its Relation to Landscape. Roy. 8vo Pp. 160 (London: Thomas Murby and Co, 1926) 12*s*. 6*d*. net.

Meunier, Stanislas. Dictionnaire de géologie. 8vo. Pp 716. (Paris. Libr. Dunod, 1926)

Pawlowski, A. Le minerai et les mines de fer en France (Pyrénées, Normandie, Anjou, Bretagne). Pp. 148. (Paris. Jules Charles et A Brunet, 1926)

Pia, Julius. Pflanzen als Gesteinsbildner Sup. Roy. 8vo. Pp viii + 355. (Berlin: Gebruder Borntraeger, 1926) 19 50 gold marks *

Geography: Travel

Ainslie, J. R. The Physiography of Southern Nigeria and its Effect on the Forest Flora of the Country. (Oxford Forestry Memoirs, No 5) Imp 8vo Pp. 36 (Oxford. Clarendon Press, London: Oxford University Press, 1926) 4*s*. net *

Baedeker, Karl. The Rhine from the Dutch to the Alsatian Frontier: a handbook for Travellers Eighteenth revised edition. Fcap. 8vo Pp xlii + 422. (London: T Fisher Unwin, Ltd., 1926) 15*s*. net

Banse, E. Abendland und Morgenland 8vo. Pp. 284. (Hamburg und Braunschweig: Georg Westermann, 1926) 25 gold marks.

Chancellor, John. How to be Happy in Paris without being Ruined! Cr. 8vo. Pp. 223. (London and Bristol J. W. Arrowsmith, Ltd, 1926.) 3*s* 6*d* net.

Cook's Guide to Paris New and revised edition. Cr. 8vo Pp 296 (London: Simpkin, Marshall and Co, Ltd., 1926.) 2*s*. 6*d*. net.

Cooper, Meriam C. Grass. Demy 8vo Pp. xx + 362 (New York and London: G. P Putnam's Sons, Ltd., 1926.) 10*s* 6*d* net

Coward, T. A. Picturesque Cheshire. Second edition, revised Cr. 8vo. Pp. xi + 370. (London: Methuen and Co, Ltd, 1926) 8*s*. 6*d*. net.*

Cunliffe-Owen, Betty. Thro' the Gates of Memory: from the Bosphorus to Baghdad. Med 8vo. Pp 283 (London: Hutchinson and Co., Ltd, 1926.) 21*s*. net.

Douglas, Major A. J. A., and **Johnson, P. H.** The South Seas of To-day: being an Account of the Cruise of the Yacht *St. George* to the South Pacific Roy 8vo. Pp. xiv + 296. (London: Cassell and Co, Ltd, 1926.) 21*s* net.

Featherstone, Capt. B. K. An Unexplored Pass: a Thousand Mile Journey to the Kara-Korem Himalayas Med 8vo. Pp 296 (London: Hutchinson and Co., Ltd., 1926) 18*s*. net.

Gompertz, M. L. A. ("Ganpat"). The Road to Lamaland: Impressions of a Journey to Western Thibet. Med. 8vo Pp x + 246. (London: Hodder and Stoughton, Ltd, 1926) 20*s*. net.

Gordon, Jan, and **Gordon, Cora.** Two Vagabonds in Sweden and Lapland. Roy. 8vo Pp. x + 323. (London: John Lane, The Bodley Head, Ltd, 1926.) 12*s*. 6*d*. net.

Green, Fitzhugh. Peary: the Man who Refused to Fail Roy. 8vo. Pp. viii + 404. (New York and London: G. P. Putnam's Sons, Ltd., 1926) 25*s* net.

Hedin, S. Gran Cañon. 8vo. Pp 245. (Leipzig: F. A. Brockhaus, 1926) 9 50 gold marks.

Kaiser, E. Die Diamantenwuste Sudwestafrikas 2 Bande 4to Band 1 Pp x+321. Band 2 Pp viii+535 (Berlin Dietrich Reimer, 1926) 120 gold marks.

Kermack, W. R. Historical Geography of Scotland Second edition, revised and enlarged Cr 8vo. Pp. 152 (Edinburgh and London. W & A. K Johnston, Ltd, 1926) 3*s* 6*d* net

Köhler, F. Brasilien heute und morgen 8vo. Pp 272 (Leipzig · F A Brockhaus, 1926) 9 50 gold marks

Mason, Arthur. Wide Seas and Many Lands (Travellers' Library) Gl. 8vo Pp 224. (London: Jonathan Cape, Ltd, 1926) 3*s* 6*d*. net

Mordaunt, Elinor. The Venture Book Med 8vo Pp xiv+272. (London: John Lane, The Bodley Head, Ltd, 1926) 15*s* net

Muirhead, Findlay, and **Monmarché, Marcel,** Edited by. The French Alps. (The Blue Guides) Second edition Fcap. 8vo Pp. xxxvi+255+25 maps and plans (London: Macmillan and Co., Ltd., Paris: Hachette et Cie, 1926) 10*s* net.

Muirhead, Findlay, and **Monmarché, Marcel,** Edited by. North-western France (The Blue Guides) Fcap 8vo Pp xliv+392+44 maps and plans (London: Macmillan and Co, Ltd.; Paris. Hachette et Cie, 1926.) 12*s* net

Nansen, F. Unter Robben und Eisbaren 8vo Pp x+371 (Leipzig: F A Brockhaus, 1926) 12 gold marks

Niles, Blair. Black Haiti: a Biography of Africa's Eldest Daughter. Fcap. 4to Pp viii+325. (New York and London · G P. Putnam's Sons, Ltd, 1926) 15*s*. net

O'Neil, O. Abenteuer in Swaziland 8vo. Pp 267 (Stuttgart: Union Deutsche Verlagsgesellschaft, 1926) 6 gold marks

Rider's California: a Guide Book for Travellers Compiled under the general editorship of Fremont Rider by Frederic Taber Cooper. Fcap 8vo Pp. lxii+667 (London: George Allen and Unwin, Ltd, 1926) 21*s* net.

Rossman, Earl. Black Sunlight a Log of the Arctic Cr 8vo Pp xi+231+16 plates (New York and London · Oxford University Press, 1926) 8*s*. 6*d* net *

Schott, G. Geographie des Atlantischen Ozeans Zweite Auflage 4to Pp xiv+368. (Hamburg · C. Boysen, 1926) 35 gold marks

Schott, Helena C. Czechoslovakia. (Peeps at Many Lands) Cr 8vo. Pp 72 (London: A and C Black, Ltd, 1926) 2*s* 6*d* net

Schulze-Maizier, F. Die Osterinsel 8vo Pp 238. (Leipzig: Insel-Verlag, 1926) 10 gold marks

Sheean, Vincent. Adventures among the Riffi. Demy 8vo. Pp. xxx+345. (London: George Allen and Unwin, Ltd, 1926) 12*s* 6*d* net

Speakman, Harold. Here's Ireland: New Travels with a Donkey Med. 8vo Pp xiii+353. (London and Bristol. J W. Arrowsmith, Ltd, 1926.) 15*s* net.

Stocks, Th. Das Flussgebiet der Pinnau 8vo Pp. 62 (Stuttgart: J Engelhorn, 1926) 6 50 gold marks

Taylor, E. G. R. The British Isles and the Neighbouring Lands. (Compassing the Vast Globe Series.) Gl 8vo Pp 204. (London: Constable and Co, Ltd, 1926) 2*s* 6*d* net

Terhorst, B. With the Riff Kabyles Demy 8vo Pp 237 (London and Bristol: J. W. Arrowsmith, Ltd., 1926) 12*s* 6*d*. net

Trautz, F. Ceylon 4to Pp. xv+133. (Munchen: Muller Verlag, 1926) 32 gold marks

White, Watson. The Paris that is Paris. Fcap 8vo. Pp xx+477 (New York and London: Charles Scribner's Sons, 1926.) 10*s* 6*d* net.

Woon, Basil. The Paris that's not in the Guide Books Cr 8vo Pp 279 (London and New York Brentano's, 1926) 8*s* 6*d* net.

General Biology: Natural History Botany: Zoology

Australasian Antarctic Expedition, 1911–14. Scientific Reports Series C: Zoology and Botany. Vol 7, Part 5 · Ecological Notes and Illustrations of the Flora of Macquarie Island. By H Hamilton Roy. 4to Pp 10+19 plates. (Sydney, N S.W: Alfred James Kent, 1926) 5*s* *

Birkeland, Knut B. The Whalers of Akutan · an Account of Modern Whaling in the Aleutian Islands. Med 8vo Pp vi+171+16 plates (New Haven, Conn.: Yale University Press; London · Oxford University Press, 1926) 14*s*. net *

British Museum (Natural History). Guide to the Exhibited Series of Insects in the Department of Entomology, British Museum (Natural History), Cromwell Road, London, S.W.7. Fourth edition. Demy 8vo Pp. iv+65+13 plates (London. British Museum (Natural History), 1926) 1*s* *

Calkins, Gary N. The Biology of the Protozoa. Med 8vo. Pp 623 (London: Baillière, Tindall and Cox, net *

Carr-Saunders, A. M. Eugenics. (Home University Library of Modern Knowledge.) Fcap. 8vo Pp. 256. (London: Williams and Norgate, Ltd, New York: Henry Holt and Co, 1926) 2*s* 6*d* net *

Coudenhove, Hans. My African Neighbours: Man, Bird and Beast in Nyasaland. Med. 8vo Pp xiv+245 (London · Jonathan Cape, Ltd., 1926.) 12*s*. 6*d* net.

Crile, George W. A Bipolar Theory of Living Processes. Edited by Amy F Rowland. Demy 8vo. Pp. xv+405 (New York: The Macmillan Co, 1926) 21*s*. net.*

Dahl, Friedrich. Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und nach ihrer Lebensweise Dritter Teil: Spinnentiere oder Arachnoidea. 1 Springspinnen (Salticidae) (Jena: Gustav Fischer, 1926) 3 gold marks.

Davy, Joseph Burtt. A Manual of the Flowering Plants and Ferns of the Transvaal, with Swaziland, South Africa. In 4 Parts. Cr 8vo. Part 1: Pteridophyta to Bombacaceæ Pp. 271 (London: Longmans, Green and Co, Ltd, 1926) 15*s*. net

Dennert, E. Die Intraindividuelle Fluktuierende Variabilitat: eine Untersuchung uber die Abanderung des Pflanzenindividuums und die Periodizitat der Lebenserscheinungen. (Botanische Abhandlungen, Heft 9.) Roy 8vo Pp 149. (Jena: Gustav Fischer, 1926) 7 gold marks *

Ellis, Arthur Erskine. British Snails · a Guide to the Non-Marine Gastropoda of Great Britain and Ireland, Pliocene to Recent. Cr 8vo. Pp. 275+14 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1926) 10*s*. net.*

Essex Field Club, and others, Members of the. Essex: an Outline Scientific Survey; including Geology, Botany and Zoology Prepared on the Occasion of the Congress of the South-Eastern Union of Scientific Societies at Colchester. Edited by G. E. Hutchings. Demy 8vo Pp 133+4 plates (Colchester: Benham and Co, Ltd, 1926.) 3*s* net.*

Fishery Board for Scotland. Salmon Fisheries, 1926, No. 1: The Sea Trout of the River Ewe and Loch Maree. By G Herbert Nall Imp. 8vo Pp. 42+4 plates. (Edinburgh and London: H M. Stationery Office, 1926) 4*s*. 6*d* net.*

France, R. H. Plants as Inventors (Cosmos Library) Cr. 8vo Pp. 64 (London: Simpkin, Marshall and Co, Ltd, 1926.) 1*s* net.

Gemeinhardt, Konrad. Die Gattung Synedra in systematischer, zytologischer und ökologischer Beziehung (Pflanzenforschung, Heft 6) Sup Roy 8vo Pp iv+88+4 Tafeln (Jena: Gustav Fischer, 1926.) 6 gold marks *

Goebel, K. von. Wilhelm Hofmeister · the Work and Life of a Nineteenth Century Botanist With Biographical Supplement by Frau Ganzenmuller. Translated into English by H M Bower and edited botanically by F. O. Bower. (Ray Society Volume (No 111) for 1925) Demy 8vo. Pp. xi+202 (London · Dulau and Co, Ltd, 1926) 12*s* 6*d*. net *

Gurwitsch, Alexander. Das Problem der Zellteilung physiologisch Betrachtet (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 11.) Demy 8vo Pp. vii+221. (Berlin: Julius Springer, 1926) 16 50 gold marks *

Hannig, E., and **Winkler, H.,** Herausgegeben von Die Pflanzenareale. Sammlung kartographischer Darstellungen von Verbreitungsbezirken der lebenden und fossilen Pflanzen-Familien, -Gattungen und -Arten Unter Mitwirkung von Ludwig Diels und G. Samuelsson 1 Reihe, Heft 1. Large 4to Pp iii+14+10 Karten (Jena: Gustav Fischer, 1926) 7 50 gold marks *

Hill, A. W., Ductu et consilio Index Kewensis Plantarum Phanerogamarum Supplementum Sextum Nomina et Synonyma Omnium Generum et Specierum ab initio anni MDCCCCXVI usque ad finem anni MDCCCCXX nonnulla etiam antea edita complectens Roy. 4to. Pp iii+222. (Oxford: Clarendon Press, London: Oxford University Press, 1926.) 70s. net.*

Hopkins, Isaac. Practical Beekeeping Being the Sixth Edition of the "Australasian Bee Manual" Cr 8vo. Pp. xvii+288 (Melbourne, Auckland and London: Whitcombe and Tombs, Ltd., 1926) 7s 6d net

Interdepartmental Committee on Crabs and Lobsters. Report on Lobsters: being an Interim Report of the Interdepartmental Committee appointed by the Minister of Agriculture and Fisheries and the Secretary for Scotland to enquire into the Crab and Lobster Fisheries. Roy. 8vo. Pp. 34. (London: H M. Stationery Office, 1926.) 2s 6d. net *

Jackson, Sir Frederick J. Notes on the Game Birds of Kenya and Uganda (including the Sand-Grouse, Pigeons, Snipe, Bustards, Geese and Ducks) Roy. 8vo Pp xv+258. (London: Williams and Norgate, Ltd., 1926) 25s net

Kirby, W. F. Butterflies and Moths: in Romance and Reality. Demy 8vo. Pp 178. (London. The Sheldon Press, 1926) 7s 6d. net

Krüger, Paul. Tierphysiologische Übungen. Sup Roy. 8vo. Pp. xxxv+518. (Berlin: Gebruder Borntraeger, 1926.) 30 gold marks.*

Kükenthal, Willy, Gegrundet von. Handbuch der Zoologie: eine Naturgeschichte der Stamme des Tierreiches Herausgegeben von Thilo Krumbach. Vierter Band. Progoneata, Chilopoda, Insecta Erste Lieferung Demy 4to. Pp 128 (Berlin und Leipzig: Walter de Gruyter und Co, 1926) 13 gold marks.*

Linsbauer, K., Herausgegeben von Handbuch der Pflanzenanatomie Lieferung 15. Abteilung 2, Teil 2. Pteridophyten und Anthophyten Band 9. Das abnorme Dickenwachstum. Von H. Pfeiffer. Sup. Roy 8vo. Pp. xii+273 (Berlin: Gebruder Borntraeger, 1926) 19 50 gold marks.*

Miehe, Hugo. Das Archiplasma: Betrachtungen uber die Organisation des Pflanzenkorpers Roy 8vo Pp vi+92 (Jena: Gustav Fischer, 1926) 4 gold marks *

Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol 9, No 1, 1926. The Plankton of a Herring Ground Imp 8vo Pp 35+2 plates. (London: H M Stationery Office, 1926) 5s. net.*

Morris, Morris. Man created during Descent. at the Beginning of the New Stone Age, that is, not more than about five or seven dozen Centuries ago Cr 8vo. Pp. 111 (London: Marshall Bros, Ltd., 1926) 3s 6d net.

Mosely, Martin E. Insect Life and the Management of a Trout Fishery Fcap 8vo. Pp 124 (London George Routledge and Sons, Ltd., 1926) 7s. 6d net

Pearse, A. S. Animal Ecology (McGraw-Hill Publications in the Zoological Sciences) Med 8vo Pp ix+417. (New York: McGraw-Hill Book Co, Inc; London: McGraw-Hill Publishing Co., Ltd, 1926.) 20s net *

Phillips, John C. A Natural History of the Ducks Volume 4: Fuligulinæ (concluded), Oxyurinæ, Mergemettinæ and Merginæ. Roy 4to Pp. xi+489+32 plates (London: Longmans, Green and Co, Ltd, 1926.) 210s. net.

Roule, L. L'histoire de la nature vivante d'après l'œuvre des grands naturalistes français Tome 3: Cuvier et la science de la nature. Pott 8vo. Pp. 248 (Paris: Ernest Flammarion, 1926.) 9 francs.

Sampson, Sir George F. Descriptions of new Genera and Species of Lepidoptera Phalænæ of the Subfamily Noctuinæ (Noctuidæ) in the British Museum (Natural History). Demy 8vo. Pp iv+641. (Londen. British Museum (Natural History), 1926) 20s.*

Schaxel, Julius, Herausgegeben von Abhandlungen zur theoretischen Biologie Heft 23 · Morphodynamik; ein Einblick in die Gesetze der organischen Gestaltung an Hand von experimentellen Ergebnissen. Von Paul Weiss Roy. 8vo. Pp. 43. (Berlin: Gebrüder Borntraeger, 1926.) 2.70 gold marks.*

Schiffner, Victor. Die Existenzgrunde der Vorgange der Zellbildung und Zellteilung. Gedanken aus dem Gebiete der exakten Biologie (Jena. Gustav Fischer, 1926) 5 gold marks.

Shipley, Sir Arthur E., Edited by; assisted by **Scott, Hugh.** The Fauna of British India, including Ceylon and Burma (Published under the Authority of the Secretary of State for India in Council) Coleoptera: Chrysomelidæ (Chrysomelinæ and Halticinæ). Med. 8vo. Pp. xiv+442 (London: Taylor and Francis, Calcutta: Thacker, Spink and Co.; Bombay: Thacker and Co, Ltd, 1926) 25s *

Stapf, O., Edited by Curtis's Botanical Magazine (Published for the Royal Horticultural Society, London.) Vol 151 (1925), Part 3 Roy. 8vo Pp 45+plates 9093-9104 (London: Bernard Quaritch, Ltd, 1926) 17s 6d net *

Theobald, Fred. V. The Plant Lice or Aphididæ of Great Britain. Vol 1 Demy 8vo Pp ix+372. (London Headley Bros, 1926.) 25s.*

Thomson, J. Arthur. Heredity Fifth edition, thoroughly revised. Med. 8vo Pp. xiv+542. (London: John Murray, 1926) 21s. net

Horticulture: Forestry: Agriculture

Adametz, Leopold. Lehrbuch der allgemeinen Tierzucht. Pp. 472. (Wien und Berlin: Julius Springer, 1926) 27 gold marks.

Department of Scientific and Industrial Research: Forest Products Research Technical Paper No 1: The Movement of Moisture, with reference to Timber Seasoning. By S. T. C. Stillwell. Cr. 4to. Pp. iv+29. (London: H M. Stationery Office, 1926.) 1s 6d. net.*

Forestry Commission. Bulletin No 7 · The Silver Fir Chermes By R. Neil Chrystal Roy 8vo Pp 27+9 plates. (London: H M Stationery Office, 1926) 1s. 6d net.*

Galt, A. S. The Principles and Practice of Horticulture. (Text-Books on Agriculture) Cr 8vo. Pp viii+240 (London: University Tutorial Press, Ltd, 1926) 3s 6d.*

Halsham, John. Every Man his own Gardener Fcap 8vo Pp xi+237+13 plates (London. Hodder and Stoughton, Ltd, 1926) 6s net *

International Institute of Agriculture, Rome. The Cotton Growing Countries, Present and Potential Production, Trade, Consumption Gl. 4to Pp. xxxvi+317. (London. P S King and Son, Ltd., 1926) 12s 6d. net *

Jones, David T.; Duncan, Joseph F.; Conacher, H. M., and **Scott, W. R.** Rural Scotland during the War. With an Appendix by J P. Day, and an Introduction by W R Scott (Publications of the Carnegie Endowment for International Peace, Division of Economics and History: Economic and Social History of the World War, British Series.) Roy 8vo. Pp xvi+311. (London Oxford University Press, New Haven, Conn. Yale University Press, 1926) 12s. 6d net.*

Rothamsted Conferences. 2: The Culture and Manuring of Fodder Crops; being the Report of a Conference held at Rothamsted on March 30th, 1926, under the Chairmanship of the Rt Hon Lord Bledisloe With Contributions by Sir John Russell, W. A. C. Carr, J C Brown, C Heigham, etc Demy 8vo Pp 40 (London · Ernest Benn, Ltd, 1926) 1s 6d net.*

Stoklasa, Julius. Handbuch der biophysikalischen und biochemischen Durchforschung des Bodens Unter Mitwirkung von Ernst Gustav Doerell. Roy 8vo. Pp 812. (Berlin: Paul Parey, 1926) 34 gold marks

Toovey, T. W. Commercial Poultry Farming a Description of the Evolutionary Progress of the King's Langley Poultry Farm and its Management Fourth edition, enlarged Large Cr 8vo. Pp viii+151 (London: Crosby Lockwood and Son, 1926.) 6s. net.

Weaver, John E. Root Development of Field Crops (McGraw-Hill Publications in the Agricultural and Botanical Sciences) Med. 8vo. Pp. xii+291 (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15s. net *

Philosophy: Psychology

Ament, W. The Mind of the Child: a Comparative History of Life. (Cosmos Library.) Cr. 8vo. Pp. 78 (London: Simpkin, Marshall and Co., Ltd, 1926.) 1*s.* net

Banch, B. Die Idee. 8vo. Pp. viii + 270. (Leipzig: Emmanuel Reinicke, 1926.) 9 gold marks.

Bourdon, B. L'intelligence. (Bibliothèque de Philosophie contemporaine.) 8vo Pp 388. (Paris: Félix Alcan, 1926) 30 francs.

Delacroix, Henri. L'analyse psychologique de la fonction linguistique: the Zaharoff Lecture, 1926. Demy 8vo. Pp. 28. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 2*s.* net.*

Driesch, Hans. The Possibility of Metaphysics: four lectures delivered before the University of London in March 1924 Cr. 8vo. Pp. 69 (London: The Faith Press, Ltd., 1926) 2*s.* 6*d* net.

Edgell, B. Mental Life: an Introduction to Psychology. Cr 8vo. Pp. xvi + 275. (London: Methuen and Co, Ltd, 1926) 7*s.* 6*d* net *

Enriquès, Federigo. L'évolution de la logique. (Bibliothèque de synthèse scientifique) Traduit de l'Italien par G.-E. Monod-Herzen. Demy 8vo. Pp 204. (Paris: Étienne Chiron, 1926.) 15 francs *

Hazlitt, Victoria. Ability: a Psychological Study Cr. 8vo Pp. ix + 147 + 2 plates. (London. Methuen and Co, Ltd, 1926) 6*s.* net.*

Howes, Frank. The Borderland of Music and Psychology. Cr. 8vo Pp. x + 244 (London: Kegan Paul and Co, Ltd; J Curwen and Sons, Ltd., 1926) 6*s.* net.*

Hulbert, H. H. Rhythm in Feeling, Emotion and Facial Expression: an Exposition of the Sixth Sense Gl. 8vo Pp. 96. (London: Erskine Macdonald, Ltd, 1926) 2*s* 6*d* net

Jones, W. Tudor. Nature, Thought and Personal Experience Demy 8vo Pp. xii + 182 (London: Williams and Norgate, Ltd., 1926) 7*s.* 6*d.* net.*

Leeming, Benjamin Christopher. Imagination—Mind's Dominant Power Ex Cr. 8vo Pp. xi + 288. (New York. M H Schroeder Co., 1926.)

McDougall, William. An Outline of Abnormal Psychology Demy 8vo. Pp xvi + 572. (London: Methuen and Co Ltd, 1926.) 15*s* net *

Montmorency, Hervey de. From Kant to Einstein Demy 8vo. Pp. iii + 39 (Cambridge: W. Heffer and Sons, Ltd; London: Simpkin, Marshall and Co, Ltd, 1926) 2*s* 6*d* net *

Sorley, W. R. Tradition: the Herbert Spencer Lecture delivered at Oxford, 19 May 1926 Demy 8vo. Pp 24 (Oxford: Clarendon Press; London: Oxford University Press, 1926) 2*s.* net *

Stoddard, Lothrop. Scientific Humanism. Cr. 8vo. Pp 189. (New York and London: Charles Scribner's Sons, 1926) 7*s* 6*d* net.

Stoops, John Dashiell. Ideals of Conduct: an Exposition of Moral Attitudes. Ex. Cr. 8vo Pp. xii + 373 (New York: The Macmillan Co, 1926.) 10*s* net.

Taylor, Edward Wyllys. Psychotherapy: Mental Elements in the Treatment of Disease (Harvard Health Talks) Gl. 8vo. Pp 53 (Cambridge, Mass: Harvard University Press, London: Oxford University Press, 1926) 4*s* 6*d* net

Williams, James M. Principles of Social Psychology Roy. 8vo. (New York and London. Alfred A Knopf, 1926) 21*s* net

Bacteriology: Hygiene

Adams, Henry. Sanitary Science: applied to Buildings and Public Works Med. 8vo. Pp. 200. (London. Chapman and Hall, Ltd., 1926.) 8*s* 6*d* net.

Craig, Charles F. A Manual of the Parasitic Protozoa of Man. Pp 569 (Philadelphia and London: J B. Lippincott and Co, Ltd, 1926) 35*s.* net

Frache. Les fouets et le mouvement des bactéries (Thèse) 8vo. Pp 188 + 3 planches. (Nancy, Paris et Strasbourg: Libr Berger-Levrault, 1926.)

Hackett, J. D. Health Maintenance in Industry. Demy 8vo Pp. 508. (London: A. W. Shaw and Co, Ltd, 1926) 25*s* net.

Hammerschmidt, Johann. Serologische Untersuchungstechnik Vollstandige Neubearbeitung von P Th. Mullers "Technik der serodiagnostischen Methoden" 8vo. Pp. vi + 195. (Jena: Gustav Fischer, 1926) 4 gold marks

d'Herelle, F. The Bacteriophage and its Behavior. Translated by George H. Smith Med 8vo Pp. xiv + 629 (Baltimore, Md.: Williams and Wilkins Co; London: Baillière, Tindall and Cox, 1926) 36*s* net.*

Hope, E. W., and Stallybrass, C. O. Text-book of Public Health Ninth edition, revised and enlarged. Demy 8vo Pp 350 (Edinburgh: E and S Livingstone, 1926) 15*s* net

Leonard, W. A. Organization and Administration of the Public Health Department (Pitman's Municipal Series) Demy 8vo. Pp vii + 148. (London. Sir Isaac Pitman and Sons, Ltd., 1926) 6*s.* net.

Norton, John F., and Falk, J. S. Laboratory Outlines in Bacteriology and Immunology. 8vo (Cambridge: At the University Press, 1926) 10*s.* net.

Welchardt, W. Unspezifische Immunitat. Roy. 8vo. Pp viii + 84 (Jena: Gustav Fischer, 1926) 4 gold marks

Medical Sciences

Achard, Ch. Troubles des échanges nutritifs: physiologie, pathologie, therapeutique. 2 vols Tome 1. Pp 696. Tome 2 Pp. 524 (Paris. Masson et Cie, 1926.) 110 francs.

Arvedson, J. Medical Gymnastics and Massage in General Practice. Translated and edited by Mina L. Dobbie Second edition, revised Cr. 8vo Pp 296 (London. J and A. Churchill, 1926.) 8*s* 6*d* net.

Blanton, W. B. A Manual of Normal Physical Signs. 8vo. (London: Henry Kimpton, 1926) 12*s.* net

Brundage, Albert H. A Manual of Toxicology: a Concise Presentation of the Principal Facts relating to Poisons, with detailed and descriptive Directions for the Treatment of Poisoning, a Table of Doses of the Principal and many new Remedies, and various Statistical Tables. Fifteenth edition, illustrated and enlarged. Ex Cr 8vo. Pp 443 (New York and London D. Appleton and Co, 1926) 18*s.* net

Buckley, J. P. Modern Dental Materia Medica, Pharmacology and Therapeutics Fifth edition, revised. Roy 8vo (London: William Heinemann, Ltd., 1926) 30*s* net.

Destouches, Louis. La quinine en thérapeutique. Fcap. 8vo. Pp 138. (Paris. Gaston Doin et Cie, 1926.) 5 francs

Duncan-Grant, Sir James. Points in the Diagnosis and Treatment of Tuberculosis and Cancer of the Larynx Roy. 8vo. (London: H. K. Lewis and Co, Ltd, 1926) 1*s.* 6*d.* net

Elwyn, Herman. Nephritis. 8vo. (London: H. K. Lewis and Co, Ltd., 1926) 21*s.* net.

Eppinger, H., und Walzel, P. Die Krankheiten der Leber mit Einschluss der heptolienalen Affektionen. (Diagnostiche und therapeutische Irrtumer und deren Verhutung Innere Medizin, Heft 16.) Roy. 8vo Pp. 134 (Leipzig: Georg Thieme, 1926.) 5.70 gold marks.

Friedemann, Martin. Krankenbeobachtung: eine Anleitung fur Schwestern Zweite, verbesserte Auflage. Roy. 8vo. Pp vi + 87 (Jena: Gustav Fischer, 1926.) 3 gold marks

Hall-Edwards, John F. Cancer: its Control and Prevention Gl 8vo. Pp. 98. (Birmingham: Cornish Bros, Ltd, 1926) 2*s* net

Hernaman-Johnson, Francis. Radiotherapy in Relation to General Medicine (Oxford Medical Publications) Gl 8vo. Pp 221. (London: Oxford University Press, 1926) 5*s.* net

Huntemüller, O., und Kliewe, H. Die Infektionskrankheiten Cr. 8vo. Pp 140. (Munchen: J. F. Lehmann, 1926) 3 50 gold marks.

Kilduffe, Robert A. A Manual of Clinical Laboratory Procedure for the Use of the General Practitioner. Roy. 8vo. Pp. 287. (London: Henry Kimpton, 1926.) 12*s* 6*d* net *

Kolle, W., Herausgegeben von. Arbeiten aus dem Staatsinstitut fur experimentelle Therapie und dem Georg Speyer-Hause zu Frankfurt a M. Begrundet von Paul Ehrlich. Heft 18 · Die staatliche Prufung der Salvarsanpraparate und ihre experimentellen Grundlagen. Von W. Kolle und F. Leupold. Roy. 8vo Pp. 46. (Jena: Gustav Fischer, 1926.) 3 gold marks

Lawrence, R. D. The Diabetic Life: its Control by Diet and Insulin Second revised edition. Demy 8vo. Pp. 175. (London: J. and A Churchill, 1926.) 7*s*. 6*d* net.

Leriche, R., et **Policard, A.** Les problèmes de la physiologie normale et pathologique de l'os. 8vo. Pp 229. (Paris: Masson et Cie, 1926) 28 francs.

Medizinalabteilung der Marineleitung, Herausgegeben von der. Marineärztliche Kriegserfahrungen. Heft 7: Die Erkrankungen der Kreislauforgane in der Marine wahrend des Krieges 1914–1918. Von Paul Wiens Roy. 8vo Pp. 21. (Jena: Gustav Fischer, 1926). 1 20 gold marks.

Meyer, Hans H., and **Gottlieb, R.** Experimental Pharmacology. Roy. 8vo. (Philadelphia and London: J. B. Lippincott and Co, Ltd., 1926) 35*s* net.

Monrad-Krohn, G. H. The Clinical Examination of the Nervous System Third edition, revised. Cr 8vo. Pp. 217. (London. H K. Lewis and Co., Ltd, 1926.) 7*s*. 6*d* net.

Nidergang, F. Les maladies de la bouche en clientèle. (Pathologie médicale et chirurgicale, thérapeutique) (Bibliothèque des Praticiens.) Cr. 8vo Pp 213 (Paris: A. Maloine et fils, 1926.) 12 francs.

Paracelsus' Samtliche Werke. Nach der 10 bandigen Huserschen Gesamtausgabe (1589–1591) zum erstenmal in neuzeitliches Deutsch ubersetzt Mit Einleitung, Biographie, Literaturangaben und erklarenden Anmerkungen versehen von Bernhard Aschner. Erster Band. Roy. 8vo. Pp xlviii + 1012. (Jena: Gustav Fischer, 1926) 40 gold marks.

Pascal, C., et **Davesne, Jean.** Traitement des maladies mentales par les chocs. (Collection Médecine et Chirurgie pratiques.) Cr 8vo. Pp. 184. (Paris: Masson et Cie, 1926) 15 francs.

Politzer's Text-Book of the Diseases of the Ear. Revised and largely rewritten by Milton J. Ballin Sixth edition. Roy. 8vo. Pp xiv + 776. (London: Baillière, Tindall and Cox, 1926) 31*s*. 6*d*. net.

Riddell, James R. Handbook of Medical Electricity and Radiology. Cr. 8vo. Pp. 256 (Edinburgh: E. and S Livingstone, 1926) 8*s*. 6*d*. net.

Rieux, J., et **Zoeller, C.** Traitement des maladies infectieuses en clientèle. (Bibliothèque des Praticiens) Cr. 8vo. Pp ii + 248. (Paris: A Maloine et fils, 1926) 18 francs

Rows, R. G., and **Bond, W. E.** Epilepsy, a Functional Mental Illness: its Treatment. Demy 8vo Pp. 146. (London: H K. Lewis and Co., Ltd., 1926) 8*s*. net.

Schriftleitung des Kongresszentralblattes, Herausgegeben von der. Jahresbericht uber die gesamte innere Medizin und ihre Grenzgebiete. Bibliographisches Jahresregister des Kongresszentralblattes fur die gesamte innere Medizin und ihre Grenzgebiete Sechster Band · Bericht über das Jahr 1923 8vo Pp 792. (Berlin: Julius Springer, 1926) 58 gold marks.

Smith, William Johnson. A Medical and Surgical Help: for Shipmasters and Officers in the Merchant Navy. Sixth edition, revised by Arnold Chaplin. Demy 8vo Pp. 355. (London: Charles Griffin and Co, Ltd, 1926) 6*s*. net.

Sorrel-Dejerine, Mme le Dr. Contribution à l'étude des paraplégies pottiques · essai sur l'évolution et le prognostic, basé sur quarante observations personnelles. Roy 8vo. Pp. x + 401. (Paris: Masson et Cie, 1926) 40 francs.

Stévenin, Henri. La coqueluche (Bibliothèque des connaissances médicales.) Cr 8vo. Pp. 213. (Paris: Ernest Flammarion, 1926) 7 50 francs.

Strümpell, Adolf. Lehrbuch der Speziellen Pathologie und Therapie der inneren Krankheiten: fur Studierende und Arzte Funfundzwanzigste vollig neu bearbeitete Auflage von Carly Seyfarth. Sup Roy. 8vo Band 1. Pp xi + 872 + 10 Tafeln. Band 2. Pp. ix + 955 + 6 Tafeln (Leipzig: F C W. Vogel, 1926) 50 gold marks

Thomson, Sir StClair. Diseases of the Nose and Throat, comprising Affections of the Trachea and Œsophagus. Third edition, enlarged. Med. 8vo. Pp 960 + 24 plates. (London: Cassell and Co., Ltd, 1926) 45*s*. net

Uteau, R. Causeries d'urologie. Imp. 16mo Pp. 312. (Paris: A. Maloine et fils, 1926.) 16 francs

Wallgren, Axel, Herausgegeben von Arbeiten aus dem Pathologischen Institut der Universitat Helsingfors (Finland). Begrundet von E. A. Homén Neue Folge. Vierter Band Drittes und viertes Heft Pp 227-458. (Jena: Gustav Fischer, 1926) 12 gold marks.

Wilkinson, W. Camac. The Principles of Immunity in Tuberculosis. Med. 8vo. Pp. viii + 141. (London: Nisbet and Co., Ltd, 1926.) 10*s* 6*d* net.

Miscellany

Brown, John. Teaching Science in Schools. Cr. 8vo Pp. 180 (London: University of London Press, Ltd, 1926.) 3*s*. 6*d*. net

Finn, Frank. The Masque of Birds, and other Poems. Cr. 8vo. Pp 62. (London: Selwyn and Blount, Ltd, 1926.) 3*s*. 6*d*. net *

Gamble, Sidney Gompertz. A Practical Treatise on Outbreaks of Fire: being a Systematic Study of their Causes and Means of Prevention. Med. 8vo. Pp. xii + 543. (London: Charles Griffin and Co., Ltd., 1926.) 30*s*. net *

Hall, Cyril. Triumphs of Invention Cr. 8vo Pp. 276 (London, Glasgow and Bombay: Blackie and Son, Ltd, 1926.) 3*s* 6*d*. net

Harris, D. Fraser. Life and Science. Popular edition. Cr. 8vo. Pp 212. (London: Andrew Melrose, Ltd, 1926) 3*s*. 6*d*. net

Holmyard, E. J. Science: an Introductory Textbook. Cr. 8vo. Pp. x + 230. (London and Toronto: J. M. Dent and Sons, Ltd., 1926) 4*s*.*

Inge, Very Rev. W. R. Science and Ultimate Truth: Fison Memorial Lecture, 1926, delivered at Guy's Hospital Medical School, March 25, 1926 Demy 8vo. Pp. 32 (London: Longmans, Green and Co., Ltd., 1926) Paper, 1*s* net; cloth, 2*s* net *

Krebs, Erich. Technisches Worterbuch enthaltend die Wichtigsten Ausdrucke des Maschinen und Schiffbaues Band 2: English-Deutsch. (Berlin und Leipzig: Walter de Gruyter und Co., 1926) 1.50 gold marks

Kürschners Deutscher Gelehrten-Kalender auf das Jahr 1926. Unter redaktioneller Leitung von Hans Jaeger, herausgegeben von Gerhard Ludtke. Jahrgang 2 Pp. 2515. (Berlin und Leipzig: Walter de Gruyter und Co, 1926) 40 gold marks.

Meredith, Capt. G. W. L. Training Horses for Races a Handbook for Amateur Beginners Cr 8vo Pp xiv + 64. (London: Constable and Co., Ltd, 1926.) 4*s*. 6*d*. net.*

Montessus de Ballore, R. de, Issued under the Direction of. Index Generalis. the Year-Book of the Universities, Libraries, Astronomical Observatories, Museums, Scientific Institutes, Academies, Learned Societies, 1925–1926 Cr. 8vo Pp vi + 1708 (Paris: "Editions Spes," 1926) 35*s*.

Oppenheim, Paul. Die naturliche Ordnung der Wissenschaften: Grundgesetze der vergleichenden Wissenschaftslehre. Roy. 8vo. Pp. viii + 288 (Jena: Gustav Fischer, 1926) 12 gold marks

Riegel, Robert Edgar. The Story of the Western Railroads. Ex Cr 8vo. Pp xvi + 345 (New York. The Macmillan Co, 1926) 10*s* 6*d* net *

Smith, J. Russell. Industry and Commerce New edition Ex. Cr 8vo. Pp. x + 769. (London · Constable and Co, Ltd, 1926) 12*s* net *

Trevelyan, George Macaulay. History of England Demy 8vo. Pp. xx + 723. (London: Longmans, Green and Co, Ltd, 1926.) 12*s*. 6*d* net.*

Washburne, C. W. Common Science Cr 8vo Pp xiii + 235. (London. G. Bell and Sons, Ltd, 1926) 3*s*

Woodruff, Douglas, Done out of the Original by Plato's American Republic. (To-day and To-morrow Series.) Pott 8vo Pp 122. (London Kegan Paul and Co, Ltd.; New York: E P. Dutton and Co, 1926) 2*s*. 6*d*. net.*

H. K.
LEWIS
& CO. LTD.
BOOKSELLERS & PUBLISHERS,
136 GOWER ST.,
AND
24 & 28 Gower Place,
LONDON, W.C. 1.
District Railway Euston Square Station
All Tube Railways Warren Street
Telephone Museum 1072

SCIENTIFIC BOOKS

Complete Stock of Works and Text-books in all branches of General, Technical, and Medical Science.

Classified List of Scientific, Technical and Industrial Books, post free. All books in General Literature also supplied. Periodicals at subscription rates.

SPECIAL FACILITIES FOR EXECUTION OF ORDERS FROM ABROAD, which can be forwarded under the V.P.P. (C.O.D.) system when desired.

Effectually protective packing used without charge.

LARGE STOCK OF SECOND-HAND BOOKS, 140 GOWER STREET
'Phone. Museum 4031

Dr. A. HUTCHINSON'S
UNIVERSAL GONIOMETER

For the Examination of Small Crystals and Mineral Grains.

This instrument can be used for any of the following purposes :—
As an Ordinary Goniometer for the Measurement of Angles
As an Axial-angle Apparatus.
As a Kohlrausch Total-reflectometer.
For Determining Refractive Indices by the Prism Method.
For Experimental Work in Mineralogy.

Descriptive Pamphlet on application to the Makers:

JAMES SWIFT & SON Ltd.,
UNIVERSITY OPTICAL WORKS,
81 Tottenham Court Rd., London, W. 1.

MAN An illustrated monthly record of Anthropological Science, 2s. net per part, 20s. a year, post free anywhere.

CONTENTS OF AUGUST ISSUE.

Original Articles :- Pygmy Implements from North-East Africa. (*Illustrated*)—Chagga Time-Reckoning.—Copper Rod "Currency" from Palabora. (*Illustrated*)—The Sacred Litter (Mahmal) of Kharga Oasis.—Megaliths and Metals in Brittany. (*Illustrated*)—Two Bronze Hoards from Hajdusámson, near Debreczen (*With Plate I-J.*)—The Origin of Mankind.—Reviews.

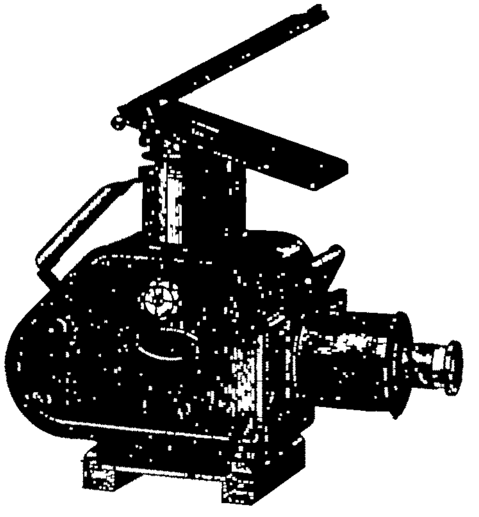
THE ROYAL ANTHROPOLOGICAL INSTITUTE,
52 Upper Bedford Place, Russell Square, London, W.C. 1

CHEMICAL AND TECHNICAL BOOKS
We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms,
Write for Catalogue—
WILLIAM BRYCE, Scientific Bookseller,
54-54a Lothian Street, EDINBURGH.

RHEINBERG MICROMETERS and other GRATICULES by the processes of Grainless and of Filmless Photography. Stock list of standard articles on request. Rheinberg & Co., 57-60 Holborn Viaduct, London, E.C. 1.

BRITISH INDIA

Ica



HAND EPISCOPES AND EPIDIASCOPES

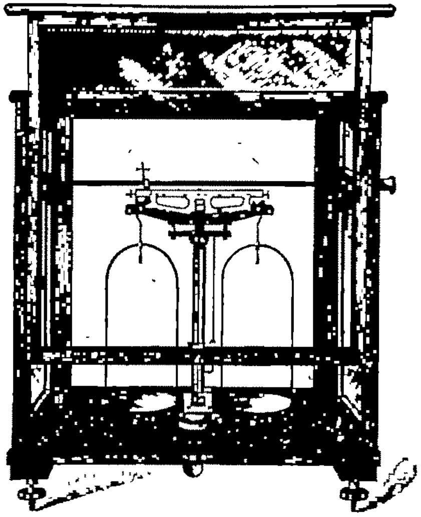
No. 1438/11. For the projection of prints, drawings, books, etc.
No. 1438/7. For the projection of lantern slides in addition to opaque objects (see illustration).
Source of illumination : 500 W. (1250 c.p.) lamp with reflector.

Full particulars and Rupee prices of these and other projection apparatus from the SOLE DISTRIBUTORS for BRITISH INDIA :

ADAIR, DUTT & CO. LTD.
(Incorporated in England)
Stephen House, Dalhousie Square East,
CALCUTTA
and 174 Hornby Road, Fort,
BOMBAY

Head Office : 47 Victoria Street, London, S.W. 1, where Government indents may be sent.

A
NEW
OERTLING
BALANCE



No. 43

PRICE £16:16:0

This Balance has been carefully constructed, and has all the essentials contained in higher priced instruments. Capacity 200 grm. Sensitivity 0·0001 grm.

Write for our 1926 Catalogue (post free) giving particulars of the above and all our other Models.

L. OERTLING LTD.
88-90 Turnmill Street
LONDON, E.C.1

Phone: CLERKENWELL 1959. Est. 1849

HOPKIN & WILLIAMS, Ltd.
16 & 17 Cross St., Hatton Garden, London, E.C.1
Works: Ilford, Essex. Telegrams: "Cerium, Smith, London." Telephone: Holborn [illegible] and [illegible].

The Leading British House for
CHEMICAL REAGENTS
PURE, FINE, AND RARE CHEMICALS

Manufacturers of Guaranteed
Chemical Reagents for Analysis and Research.

Made and supplied to standards and specifications described in the publication
"Analytical Reagents: Standards and Tests."
Compiled by
EDMUND WHITE, B.Sc. (Lond.), F.I.C.
Published by
HOPKIN & WILLIAMS, LTD.
NEW EDITION, 1925.
CLOTH BOUND INTERLEAVED.
Price 1/6 post free from the Publishers.

MICROSCOPES, MICROTOMES AND ACCESSORY APPARATUS

PHYSIOLOGICAL, PSYCHOLOGICAL
and
ANTHROPOMETRICAL APPARATUS

Catalogues free

REPAIRS
to any make of Microscope or Objective and other Scientific Apparatus a Speciality.

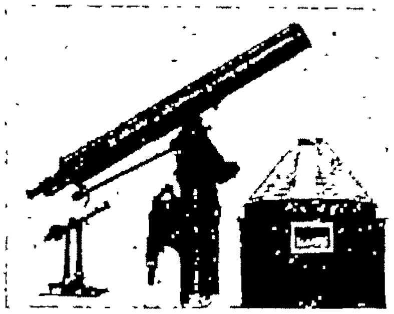
Estimates submitted

HAWKSLEY & SONS, LTD.
83 WIGMORE STREET, LONDON, W.1
Phone: *Mayfair* 3859

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

COOKE EQUATORIAL 4½″

1¼″ finder electric illumination for cross wires, sliding balance weight latitude adjustment and azimuth, 2 spirit levels on equatorial head, hour circle 5″ diameter,



graduated on gun-metal, 2 verniers and reading by microscopes illuminated, cast iron pillar, 5 oculars, 50/360, 2 terrestrial 45 and 75, solar diagonal; Dawes solar eyepiece, small camera attachment, rotating dome observatory. £175:0:0

NEGRETTI & ZAMBRA

38 HOLBORN VIADUCT, LONDON, E.C.1

THE RESEARCH FOUNTAIN PEN (Patented).

Price 20s. free by post.

A hardy and most durable self-filling and safety pen which is ***entirely cleanly*** and ***entirely reliable.***

Warranted not to blot or flood. ***Warranted*** to start to write without shaking the pen. No other fountain pen can give such warranties, and several other warranties even more valuable than these are given regarding the writing qualities of the pen. In particular the greater EASE and SPEED of writing is a most valuable asset to all writers.

It is necessary to understand that the Research Pen contains ***two*** new physical properties which are not present in the dip pen and are not present in ***any*** other fountain pen. In the first place, the pen automatically declines to blot or flood; it ***therefore*** also automatically declines to leak or spill ink in the pocket. Used like the ordinary fountain pen and always ready to write, yet the Research Pen may safely be carried ***point downwards*** in the pocket, although it is NOT sealed up. The absence of leaking—although extremely useful and important—is comparatively a small matter when regard is had to the far-reaching results due to the absence of blotting and flooding. No writing pen of this new character had formerly existed, and it is necessary to use a Research Pen before writers can form any adequate idea of the greater value of such a pen.

The second new physical property harnessed into the Research Pen is that it maintains a ***uniform*** and unvarying quantity of ink upon the gold nib. It is like a cistern, always four-fifths full, and which can neither overflow nor lessen. How unlike the dip pen on which the ink was ever running down, and how unlike all other fountain pens on which the ink alternately went up and down! The great fault of dip pens was that for the greater part of the time there was too little ink on the nib, and which made it necessary to press the nib hard on the paper. The same fault attached to all former fountain pens, but varied at times with too much ink!

The greater ease and speed of writing of the Research Pen is certainly due to the ink on the nib never descending below its best level.

A professor writes: "The Astronomer Royal recommends me to get one of your Research Pens."

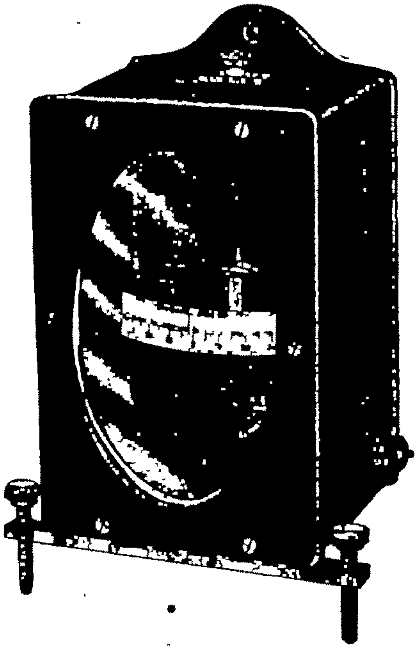
On the vital points of complete absence of blotting and the complete continuity and ability of the Research Pen to write, it may be pointed out that the pen is now used in various observatories all over the world on their chronographs, and that various Government Astronomers have reported their great satisfaction with the pen's behaviour in overcoming difficulties formerly insurmountable Testimony to the same effect may be seen on page 249 of the "Journal of Scientific Instruments" for May 1924.

A. MUNRO, Fountain Pen Manufacturer,

248 Corporation Street, BIRMINGHAM.

GAMBRELL BROS. LTD.

Established 1898.



Wall or Table Galvanometer Moving Coil.

The following are some of our standard lines:

Please send for Lists in which you are interested.

LIST	
"G"	Galvanometers, moving coil, pointer and reflecting.
"OG"	Galvanometers, "Onwood" pattern.
"GA"	Galvanometer Accessories, including Lamps, Scales, Universal Shunts, etc.
"K.S"	Keys and Switches.
"IR"	Gambrell's "Independent" Plug Contact Resistance Boxes and Wheatstone Bridges.
"HR"	Megohms and High Resistances.
"SR"	Switch pattern Resistance Boxes and Wheatstone Bridges, all grades, including Direct Reading.
"P.K"	Potentiometers, Kelvin Low Resistance Bridges, Kelvin Double Ratio Boxes, Volt Ratio Boxes, Standard Cells, Low Resistance Shunts.
"RR"	Rheostats and Single Resistances.
"C"	Condensers, Standard and Secondary.
"V.A"	Voltmeters, Ammeters, Milliameters.
"T.A"	Apparatus for Electro-Titration.

MERTON ROAD, SOUTHFIELDS,

London, S.W.18.

Phones: PUTNEY 3641-2 (Instrument). VICTORIA 9938 (Wireless).

Radio Sales Dept. for Wireless Apparatus 76 VICTORIA ST., LONDON, S.W.1.

UNIVERSITY OF LONDON.
KING'S COLLEGE.
FACULTY OF ENGINEERING.

Complete courses of study, extending over either three or four years, are arranged in Civil, Mechanical and Electrical Engineering for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.

The four years' course provides, in addition to the academic training, opportunity for practical training in works.

Heads of Departments.

MECHANICAL ENGINEERING·
  Professor · G. Cook, D.Sc , M I Mech.E., A M.Inst C.E.
  Senior Lecturer: C. A Gentve, B Sc., A.M.I.Mech E.
CIVIL ENGINEERING.
  Professor: A. H. Jameson, M.Sc , M.Inst C E. (Dean).
  Senior Lecturer. C H Lobban, D Sc., A M.Inst.C E.
ELECTRICAL ENGINEERING·
  Professor: E. Wilson, M.Inst C E., M.I.E E.
  Lecturer: F. S Robertson, M I E.E.
MATHEMATICS.
  Professors: S. A. F. White, M.A., and A. E Jolliffe, M.A.

Considerable extensions have been made in the Engineering Department. These include a large additional drawing office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the Secretary, King's College, Strand, W C.2

BATTERSEA POLYTECHNIC,
LONDON, S.W.11.

Principal—Robert H. Pickard, D.Sc., F.R.S.

Day Technical College in preparation for Polytechnic Diplomas in Mechanical, Civil and Constructional, and Electrical Engineering, Chemistry, Mathematics and Physics, and for B.Sc. and B.Sc.(Eng.) Pass and Honours Degrees of the University of London.

Training College of Domestic Science in preparation for Teachers' Diplomas in Cookery, Laundrywork, Housewifery, Science Applied to Housecraft, Needlework, Dressmaking, Ladies' Tailoring, and Millinery

Department of Hygiene and Public Health for the training of Health Visitors, Sanitary Inspectors, Infant Welfare Workers, Teachers of Hygiene, Nurses, Sister Tutors, etc.

School of Art and Crafts for training in Drawing and Design, Fashion Plate Drawing, Applied Art, etc

Hostels for Women Students.

Evening Courses in preparation for University of London Degrees in Science, Engineering, and Music, and Non-degree Courses in Mechanical and Electrical Engineering, Mathematics, Physics, Chemistry, Art and Crafts, Civil Service subjects, Domestic Science, Music, and Physical Training.

Large Athletic Ground at Merton Abbey, and numerous Athletic Clubs

Next session begins on September 21.

Full particulars of all classes on application to the Principal. Telephone BATTERSEA 0673

Manchester Municipal

COLLEGE OF TECHNOLOGY.

Principal:
B. MOUAT JONES, D.S.O., M A.(Oxon)

UNIVERSITY OF MANCHESTER.
(Faculty of Technology.)

DEGREE COURSES IN TECHNOLOGY.

The Prospectus gives particulars of the courses leading to the Manchester University degrees (B Sc Tech, M.Sc Tech., and Ph.D.) in the Faculty of Technology, in the following Departments·

MECHANICAL ENGINEERING (Prof. Dempster Smith, M B.E., M.Sc.Tech)
ELECTRICAL ENGINEERING (Prof. Miles Walker, M.A., D.Sc).
MUNICIPAL AND SANITARY ENGINEERING (G. S. Coleman, D.Sc.).
CHEMICAL TECHNOLOGY, including General Chemical Technology, Chemistry of Textiles (Bleaching, Dyeing, Printing, and Finishing), Paper Manufacture, Metallurgy and Assaying, Chemical Technology of Brewing, Electro-Chemistry, Photography, Colouring Matters, Foodstuffs, and Fuels (Prof. F. L. Pyman, D.Sc., F.R S.).
TEXTILE TECHNOLOGY (Prof. W. E. Morton, M.Sc.Tech.).

The session 1926–27 will begin on Thursday, October 7.

Prospectus will be forwarded free on application to the Registrar, College of Technology, Manchester.

EVENING INSTRUCTION in Bacteriology, Microscopy, and practical clinical and analytical Chemistry, in West End laboratory. Write "Z.S.Z," c/o Deacons, Fenchurch Avenue, E C.3.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

JUNIOR ASSISTANTS are wanted at the National Physical Laboratory.

Candidates should have a good Honours Degree, and preferably some research or technical experience in one of the following subjects. Physics, Engineering, Electrical Engineering.

Scale of salary £175-£15-£235 per annum plus Civil Service Bonus: initial pay approximately £267 Superannuation provision will be made under the Federated Superannuation System for Universities.

Preference will be given, other things being equal, to ex-Service men

Application must be made on a form to be obtained from the Laboratory, and must be received by the Director, National Physical Laboratory, Teddington, Middlesex, not later than September 4

UNIVERSITY OF ABERDEEN.
LECTURESHIP IN PLANT PHYSIOLOGY.

Applications are invited for the post of LECTURER IN PLANT PHYSIOLOGY in the Department of Botany. The salary proposed is from £400 to £450, according to qualifications

Applications, together with full statement of qualifications, age, and 16 copies of not more than three testimonials, to be lodged before September 15, 1926, with the Secretary to the University.

The University,
Aberdeen

H. J. BUTCHART,
Secretary.

UNIVERSITY COLLEGE, NOTTINGHAM.
DEPARTMENT OF MATHEMATICS.

The Council invites applications for the position of LECTURER IN MATHEMATICS, candidates to have an Honours Degree Further particulars and form of application, which must be returned not later than Tuesday, September 14, may be obtained from J. E. Shimeld, Registrar

---

BIRKBECK COLLEGE
(UNIVERSITY OF LONDON).

The Governors invite applications for a PART-TIME LECTURESHIP in the Department of Mathematics. Salary £300 per annum. Further particulars and forms of application, which must be returned not later than the first post on Friday, September 17, 1926, may be obtained from the Secretary, Birkbeck College, Breams Buildings, Fetter Lane, E.C.4

Standard Exhibition Naturkundliches Heimatmuseum Leipzig, Lortzingst. 3. Evolution of paleolithic flint implements from many countries. For sale. Apply to Dr. O. Hauser, Weimar, Elisabethstr 11

WANTED.—Microscope, $\frac{1}{12}$" oil immersion object glass. Also general apparatus for Lab. Send details to The Fiona Company, Ipswich.

KING'S PATENT AGENCY LTD., 146a Queen Victoria Street, E.C.4. Advice handbook free. 40 years' refs.

CHEMICAL AND TECHNICAL BOOKS

We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms

Write for Catalogue—

WILLIAM BRYCE, Scientific Bookseller,
54-54a Lothian Street, EDINBURGH.

Just Issued

from the Natural History Department of

DULAU & COMPANY LTD.

54-56 Margaret St., Cavendish Square, London, W.1

CATALOGUE No. 143:
PHYTO-PATHOLOGY AND HORTICULTURE.

Post free on request.

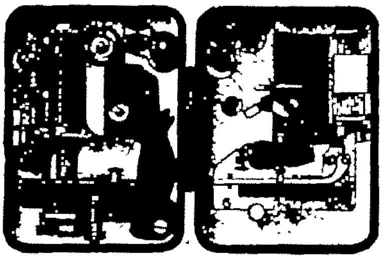
SCIENTIFIC BOOKS
AND PERIODICALS

Including the Publications of the Learned Societies,
ON SALE BY

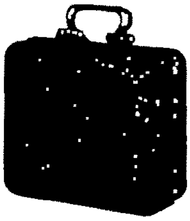
WHELDON & WESLEY Ltd

2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

Spencer Portable Microscope



The case takes the instrument and complete equipment, including a mechanical stage and camera lucida.



The closed case

All metal case. Total weight, with lenses, etc., 9½ lbs.

MICROTOMES
MICROSCOPE LAMPS
PHYSIOLOGICAL
APPARATUS
ETC.

Catalogues free

HAWKSLEY & SONS LTD.
83 Wigmore Street, London, W.1.
Phone · Langham 3859

B.D.H. CHEMICALS
FOR RESEARCH AND ANALYSIS

BRITISH MANUFACTURE

Over 3500 Substances for use in Research and Analysis are kept in stock, and we are continually adding to the list of our manufactures. The reliable quality of the B.D.H. Organic Chemicals and Analytical Reagents has led to their adoption by those who place the highest value on scientific accuracy.

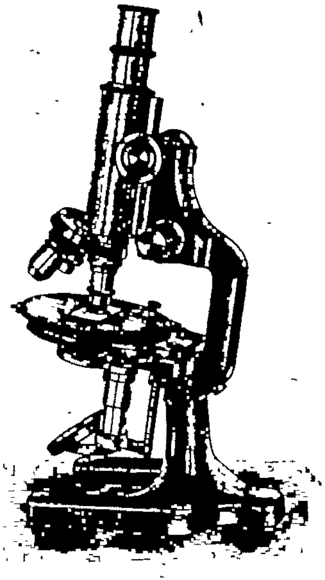
A copy of our latest Catalogue will be supplied on application.

THE BRITISH DRUG HOUSES, LTD.
Makers of Fine Chemicals,
Graham St., City Road, London, N.1.
Chemical Works: Wharf Road, London, N.1.

BRITISH INDIA **WINKEL-ZEISS** BRITISH INDIA

MICROSCOPES

FOR CLINICAL, LABORATORY AND STUDENT PURPOSES.

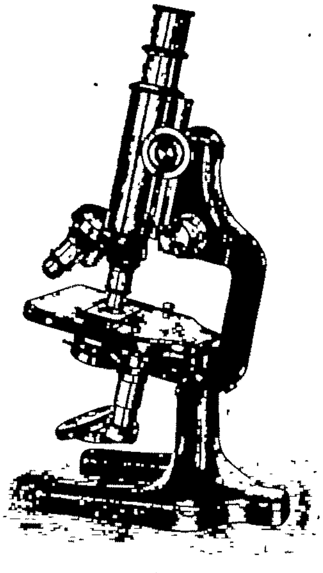


Stand LSA

Full descriptive lists and Rupee prices from the SOLE DISTRIBUTORS FOR BRITISH INDIA:

ADAIR, DUTT & CO. LTD.
(Incorporated in England)
Stephen House,
Dalhousie Square East,
CALCUTTA

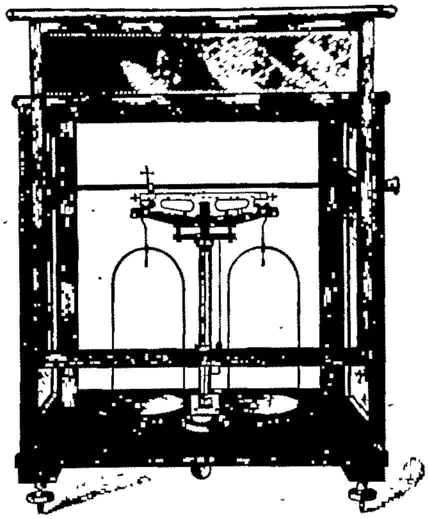
WINKEL-ZEISS
GOTTINGEN



Stand LSC

Head Office: 47 Victoria Street, London, S.W.1, where Government indents may be sent.

A
NEW
OERTLING
BALANCE



No. 43

PRICE £16:16:0

This Balance has been carefully constructed, and has all the essentials contained in higher priced instruments. Capacity 200 grm. Sensitivity 0·0001 grm.

Write for our 1926 Catalogue (post free) giving particulars of the above and all our other Models.

L. OERTLING LTD.
88-90 Turnmill Street
LONDON, E.C.1

Phone: CLERKENWELL 1959. Est. 1849.

HOPKIN & WILLIAMS, Ltd.
16 & 17 Cross St., Hatton Garden, London, E.C.1
Works: Ilford, Essex. Telegrams: "Cerium, Smith, London" Telephone: Holborn 6084 and 6085

The Leading British House for
CHEMICAL REAGENTS
PURE, FINE, AND RARE CHEMICALS

Manufacturers of Guaranteed
Chemical Reagents for Analysis and Research.

Made and supplied to standards and specifications described in the publication

"Analytical Reagents: Standards and Tests."

Compiled by
EDMUND WHITE, B.Sc. (Lond.), F.I.C.

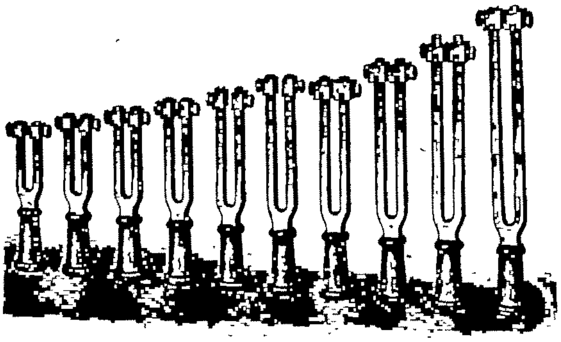
Published by
HOPKIN & WILLIAMS, LTD.

NEW EDITION, 1925.
CLOTH BOUND. INTERLEAVED.

Price 1/6 post free from the Publishers.

Max Kohl A.G.
Chemnitz A1 (Germany)

Manufacturers of
Physical Apparatus
Laboratory Furniture
Induction Coils · Oil Air Pumps
Experimental Switchboards
Projection Apparatus



Tuning Forks with Sliding Weights

Special Lists on request

Recent Scientific and Technical Books.

Volumes marked with an asterisk have been received at "NATURE" *Office.*

Mathematics: Mechanics: Physics

Bagchi, Haridas. A Course of Geometrical Analysis. Roy. 8vo. Pp. xi + 562. (Calcutta: Chuckervertty, Chatterji and Co, Ltd, 1926.) 20 rupees.*

Ballard, P. B. Fundamental Arithmetic. Cr. 8vo. Pupil's Book 2. Pp 64. Paper, 10*d*; limp cloth, 1*s* Teacher's Book 2, with Notes and Answers Pp 48. 2*s*. Pupil's Book 3 1*s* 2*d*. (London: University of London Press, Ltd, 1926.)

Bardet, Jacques. Atlas de spectres d'arc: tableaux d'analyse pour les recherches spectrochimiques. Gl. 4to. Pp 55 + 54 planches. (Paris. Gaston Doin et Cie, 1926) 240 francs *

Born, Max. Probleme der Atomdynamik. Erster Teil: Die Struktur des Atoms; Zweiter Teil: Die Gittertheorie des festen Zustandes. Dreissig Vorlesungen, gehalten im Wintersemester 1925–26, am Massachusetts Institute of Technology. Demy 8vo. Pp viii + 183. (Berlin: Julius Springer, 1926.) 10.50 gold marks.*

Buhl, A. Formules Stokiennes. (Mémorial des sciences mathématiques, Fascicule 16.) Roy. 8vo. Pp. iv + 60 (Paris: Gauthier-Villars et Cie, 1926) 12 francs.*

Department of Scientific and Industrial Research: Building Research. Technical Paper No 3: The Permeability of Portland Cement Concrete By W H. Glanville. Roy. 8vo Pp. vi + 50. (London: H M. Stationery Office, 1926) 1*s*. 6*d*. net.*

Durell, Clement V., and Fawdry, R. C. Arithmetic. Parts 3 and 4. Cr. 8vo. Pp. ix + 157-369 + xxi-xl (London: G. Bell and Sons, Ltd., 1926.) With or without Answers, 2*s* 6*d*.*

Durell, Clement V., and Wright, R. M. An Introduction to the Calculus. (Cambridge Mathematical Series.) Cr. 8vo Pp. vii+91+xi. (London: G. Bell and Sons, Ltd, 1926) 2*s*. 6*d*.*

Franck, J., und Jordan, P. Anregung von Quantensprüngen durch Stösse (Struktur der Materie in Einzeldarstellungen, Band 3.) Demy 8vo. Pp. viii + 312. (Berlin: Julius Springer, 1926) 19 50 gold marks.*

Geiger, H., und Scheel, Karl, Herausgegeben von. Handbuch der Physik Band 11. Anwendung der Thermodynamik. Redigiert von F. Thirring. Sup. Roy. 8vo. Pp. vii + 454. 34 50 gold marks. Band 22: Elektronen, Atome, Molekule. Redigiert von H. Geiger. Sup. Roy. 8vo Pp vii + 568. 42 gold marks. Band 23: Quanten. Redigiert von H Geiger. Sup. Roy. 8vo. Pp. ix + 782. 57 gold marks. (Berlin: Julius Springer, 1926)*

Gianfranceschi, G. La fisica dei corpuscoli. Terza edizione. Demy 8vo. Pp. viii + 267. (Roma: Università Gregoriana, 1926.) 18 lire.*

Hills, W. D. Mechanics and Applied Mathematics: Statics-Dynamics-Hydrostatics. Part 2: Applied Mathematics. Cr 8vo. Pp. xi + 248. (London: University of London Press, Ltd., 1926) 5*s*.*

Howard, H. E. Introductory Course in General Mathematics. Cr. 8vo. Book 1. Pp viii + 135 1*s*. 4*d*. Book 2. Pp. viii + 144. 1*s*. 6*d* Book 3. Pp. viii + 176. 1*s* 9*d*. Teacher's Book 1. Pp. x + 79. 2*s*. 6*d* net. Teacher's Book 2. Pp x + 89. 2*s* 6*d*. net Teacher's Book 3. Pp. x + 96. 2*s*. 6*d*. net. (London: Oxford University Press, 1926.)

Kaye, G. W. C., and Laby, T. H. Tables of Physical and Chemical Constants: and some Mathematical Functions. Fifth edition. Roy 8vo. Pp. vii + 161. (London: Longmans, Green and Co, Ltd., 1926) 14*s*. net.*

Kayser, H. Tabelle der Hauptlinien der Linienspektra aller Elemente nach Wellenlange geordnet. Cr. 4to Pp. vii + 198. (Berlin: Julius Springer, 1926.) 24 gold marks *

Littlewood, J. E. The Elements of the Theory of Real Functions: being Notes of Lectures delivered in the University of Cambridge, 1925. Second (revised) edition. Demy 8vo. Pp vii + 60. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1926.) 4*s*. 6*d*. net *

Loney, S. L. Solutions of the Examples in a Treatise on Dynamics of a Particle and of Rigid Bodies. Demy 8vo. Pp vi + 240. (Cambridge: At the University Press, 1926.) 17*s*. 6*d*. net.*

Lorenz, Hans. Lehrbuch der technischen Physik. Erster Band: Technische Mechanik starrer Gebilde. Zweiter Teil: Mechanik räumlicher Gebilde. Zweite, vollständig neubearbeitete Auflage. 8vo. Pp. 302. (Berlin: Julius Springer, 1926) 21 gold marks

McKay, Herbert. Progressive Arithmetic Tests. Cr. 8vo. Third Year. Pp. 32 + 8. Fourth Year Pp. 32 + 8. Fifth Year. Pp. 32 + 8. Sixth Year. Pp 32 + 8. Seventh Year. Pp 32 + 8. (London: Oxford University Press, 1926.) Without Answers, paper, 3*d* each; limp cloth, 5*d*. each; with Answers, paper, 4½*d*. each; limp cloth, 6½*d*. each.

Mair, David Beveridge. Fourfold Geometry: being the Elementary Geometry of the Four-Dimensional World. Demy 8vo Pp. viii + 183. (London: Methuen and Co, Ltd., 1926) 8*s*. 6*d*. net *

Mines Department: Safety in Mines Research Board. Paper No 22: A Method for the Determination of the Velocity of Detonation over Short Lengths of Explosive. By E. Jones. Roy 8vo. Pp 21. (London: H M. Stationery Office, 1926.) 9*d* net.*

Research Department, Woolwich. R.D Report No 63: Part 1, Description and Discussion of the Air Disturbance round Bullets in Free Flight. Roy. 8vo Pp. 24 + 9 plates (London: H M. Stationery Office, 1925.) 4*s* net.*

Roberts, Maria M., and Colpitts, Julia T. Analytic Geometry Second edition. Cr. 8vo. Pp xii + 261 (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd, 1926.) 9*s*. net.*

Roe, F. Percy. Practical Mathematics: Guide to First-Class and Special Certificates. (Army Educational Series.) Cr. 8vo Pp. xvii + 201. (London: Gale and Polden, Ltd., 1926) 6*s* 6*d*. net

Schorling, R., and others Modern Mathematics: an Elementary Course. Cr. 8vo (London, Calcutta and Sydney: George G. Harrap and Co, Ltd., 1926) 3*s* 6*d*.; with Answers, 4*s*. 6*d*.

Seitz, A. Joseph Fraunhofer und sein Optisches Institut Demy 8vo. Pp iv + 118 + 6 Tafeln. (Berlin: Julius Springer, 1926) 4 80 gold marks *

Siddons, A. W., and Hughes, R. T. Practical Geometry: based on the various Geometry Books by Godfrey and Siddons. Large Cr. 8vo. Pp x + 264 (Cambridge: At the University Press, 1926) 4*s*.*

Siddons, A. W., and Hughes, R. T. Theoretical Geometry: based on the various Geometry Books by Godfrey and Siddons. Large Cr 8vo. Pp. xvi + 173. (Cambridge: At the University Press, 1926) 3*s* *

Valiron, G. Théorie générale des séries de Dirichlet. (Mémorial des sciences mathématiques, Fascicule 17.) Roy. 8vo. Pp iv + 56. (Paris: Gauthier-Villars et Cie, 1926) 12 francs.*

Walsh, John W. T. Photometry. Roy 8vo Pp. xxvii + 505. (London: Constable and Co., Ltd., 1926) 40*s* net *

Washburn, Edward W., Editor-in-Chief. International Critical Tables of Numerical Data, Physics, Chemistry and Technology. Prepared under the Auspices of the International Research Council and the National Academy of Sciences, by the National Research Council of the United States of America. (Published for the National Research Council.) In 5 vols Demy 4to. Vol. 1. Pp xx + 415. (New York: McGraw-Hill Book Co, Inc.; London: McGraw-Hill Publishing Co, Ltd, 1926.) Sold in sets only, 12 dollars per vol.*

Wien, W., und Harms, G., Herausgegeben von. Handbuch der Experimentalphysik. Band 1: Mess-Methoden und Mess-Technik, von Ludwig Holborn; Technik des Experiments, von Ernst von Angerer Sup. Roy 8vo. Pp. xx + 484. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 42 gold marks.*

Woods, Frederick S. Advanced Calculus: a Course arranged with Special Reference to the Needs of Students of Applied Mathematics. Med. 8vo. Pp. ix + 397 (Boston, New York and London. Ginn and Co., 1926) 21*s*. net.*

Zaremba, Stanislas. La logique des mathématiques. (Mémorial des sciences mathématiques, Fascicule 15) Roy. 8vo. Pp iv + 52. (Paris: Gauthier-Villars et Cie, 1926.) 12 francs.*

Engineering

Bacon, Admiral Sir Reginald. A Simple Guide to Wireless: for all those whose Knowledge of Electricity is Child-like. Cr. 8vo. Pp. 132. (London: Mills and Boon, Ltd., 1926.) 3s 6d. net.*

Black, Archibald. Transport Aviation (New York and London: The Simmons-Boardman Publishing Co., 1926.) 12s 6d. net.

David, P. Les filtres électriques. Pp. 130. (Paris: Gauthier-Villars et Cie, 1926.) 25 francs

Fleming, J. A. Fifty Years of Electricity: the Memories of an Electrical Engineer. Cr. 4to. Pp. 383. (London: Iliffe and Sons, Ltd., 1926.) 15s net.

Goldreich, A. H. Die Bodenbewegungen im Kohlenrevier und deren Einfluss auf die Tagesoberflache. Pp 315. (Berlin: Julius Springer, 1926.) 22 50 gold marks

Hardy, A. C. From Slip to Sea: a Chronological Account of the Construction of Merchant Ships from the Laying of the Keel Plate to the Trial Trip. Demy 8vo Pp. 268. (Glasgow: J. Brown and Son, Ltd., 1926.) 10s. 6d. net.

Jones, Bernard E., Edited by. The Practical Wireless Data Book: containing in Simple Form the Essential Facts, Figures and Formulæ relating to the Design and Construction of Wireless Receiving Apparatus (*Amateur Wireless* Half-Crown Series) Cr. 8vo Pp 144. (London: Cassell and Co., Ltd., 1926) 2s. 6d. net.

Kaula, R. J., and **Robinson, I. V.** Condensing Plant: a Complete Treatise on the Principles and Details of Construction of Modern Steam Condensing Apparatus; for Designers, Users and Students. (The Specialists' Series) Demy 8vo Pp. xii + 400 (London: Sir Isaac Pitman and Sons, Ltd., 1926) 30s. net *

Kelen, N. Die Staumauern, Theorie und wirtschaftlichste Bemessung: mit besonderer Berucksichtigung der Eisenbetontalsperren und Beschreibung ausgefuhrter Bauwerke. 4to Pp. viii + 294. (Berlin: Julius Springer, 1926) 37 50 gold marks

Klopstock, Hans. Berichte des Versuchsfeldes fur Werkzeugmaschinen an der Technischen Hochschule, Berlin. No. 8: Die Untersuchung der Dreharbeit (Berlin: Julius Springer, 1926) 12 gold marks.

Krause, Hugo. Maschinenkunde fur Chemiker. Pp. viii + 436. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1926) 19 gold marks.

Lacoin, M. Cours de moteurs à combustion interne Livre 1: Puissance fournie par le combustible. Sixième édition. Pp. 338. (Paris: Léon Eyrolles, 1926.) 25 francs.

Linley, C. M. Recent Progress in Engineering Production Cheap edition. Roy. 8vo. Pp. 340. (London: Ernest Benn, Ltd., 1926.) 18s. net.

Maurer, P. Appareillage électrique (École d'électricité et de mécanique industrielles.) Med. 8vo. Pp. vi + 317. (Paris: Gauthier-Villars et Cie, 1926)

Meyer, C. W. Erich, Herausgegeben von. Deutsche Kraftfahrzeug-Typenschau. Teil 2: Omnibusse, Nutzkraftwagen, Zugmaschinen. (Dresden: Verlag Deutsche Motor Zeitschrift G m.b H., 1926) 2 gold marks.

Mines Department: Safety in Mines Research Board Paper No. 23: A Method of Trapping the Dust produced by Pneumatic Rock Drills By P S. Hay. Roy. 8vo. Pp. 18 + 2 plates (London: H.M Stationery Office, 1926.) 6d net.*

Mollier, Richard. Neue Tabellen und Diagramme fur Wasserdampf. Vierte, durchgesehene und erganzte Auflage. 4to. Pp. 25. (Berlin: Julius Springer, 1926) 2 70 gold marks.

Monkhouse, Allan. Electrical Insulating Materials: a Complete Treatise on the Preparation, Properties and Characteristics of the Materials used for Electrical Insulation, with a Full Description of the Methods of Testing. (The Specialists' Series) Demy 8vo Pp. xvi + 392. (London: Sir Isaac Pitman and Sons, Ltd., 1926) 21s net.*

Motor Cycles and How to Manage Them Twenty-fourth edition. Cr. 8vo Pp 320. (London: Iliffe and Sons, Ltd., 1926.) 2s. 6d. net.

Ott, L. A. Wassermessungen bei Wasserkraftanlagen. (München: Richard Pflaum Verlag A.G., 1926.)

Rankine, William J. M. A Manual of Civic Engineering. With corrections and additions by W J. Millar. Cr. 8vo. Pp. 839. (London: Charles Griffin and Co, Ltd., 1926.) 16s. net.

Robinson, Ernest H. Perfect Broadcast Reception. (*Amateur Wireless* Half-Crown Series.) Cr. 8vo. Pp. 142. (London: Cassell and Co, Ltd, 1926) 2s. 6d. net.

Seufert, Franz. Bau und Berechnung der Verbrennungskraftmaschinen: eine Einfuhrung. Vierte, verbesserte Auflage. Pp. 128 + 3 Tafeln. (Berlin: Julius Springer, 1926) 3 60 gold marks.

Simmons, J. J. The Efficient Boiler House: a Practical Treatise for the Guidance of Boiler House Operators. Cr. 8vo. Pp. 143. (London: Crosby Lockwood and Son, 1926.) 5s. net.

Veaux, M. Cours élémentaire de télégraphie et téléphonie sans fil. Livre 1. Pp. 390. (Paris: Léon Eyrolles, 1926.) 30 francs.

Chemistry: Chemical Industry

Alexander, Jerome, Collected and edited by. Colloid Chemistry: Theoretical and Applied By Selected Contributors. Vol. 1: Theory and Methods. Med 8vo. Pp. 974. (New York: The Chemical Catalog Co, Inc., 1926) 14.50 dollars.*

Bentley, Arthur Owen. A Text-book of Pharmacy: for Pharmaceutical Students and Apprentices. With a section on some Biological Aspects of Pharmacy, by H S. Holden. Demy 8vo Pp. 550 (London. Baillière, Tindall and Cox, 1926.) 15s. net.

Binz, Arthur. Chemisches Praktikum fur Anfanger: mit Berucksichtigung der Technologie. Zweite vollig umgearbeitete Auflage. Pp. 94. (Berlin und Leipzig. Walter de Gruyter und Co, 1926) 5 gold marks.

Braun, Karl. Die Fette und Öle. (Sammlung Goschen, Band 335.) Dritte neubearbeitete Auflage Pp. 128. (Berlin und Leipzig: Walter de Gruyter und Co, 1926) 1 50 gold marks

Claude, Georges. Air liquide, oxygène, azote, gaz rares Deuxième édition, revisée et mise à jour Roy. 8vo Pp. 424. (Paris: Libr. Dunod, 1926.) 38 40 francs.

Clerc, L.-P., et **Labussière, G.**, Publiés par. VIe Congrès International de Photographie, Paris, 29 juin-4 juillet 1925. Décisions, procès-verbaux, rapports et mémoires. Roy. 8vo. Pp. vii + 287 + 10 planches (Paris: Société française de Photographie, 1926) *

Collins, S. Hoare, and **Redington, George.** Plant Products. (Industrial Chemistry Series) Demy 8vo Pp xiii + 262. (London: Baillière, Tindall and Cox, 1926) 10s 6d. net *

Department of Scientific and Industrial Research: Fuel Research. Technical Paper No. 15: Carbonisation of Coal in Continuous Vertical Retorts. "Holmside" (Durham) Coal with Experiments on the Production of Coal Gas of High Calorific Value. Roy 8vo. Pp. iv + 45. (London: H.M. Stationery Office, 1926.) 1s 3d net.*

Dixon, Doris. Chemistry Revision Notes for a First Examination. Cr. 8vo. Pp. 138 (London: Edward Arnold and Co, 1926) 3s. 6d *

Elsdon, G. D. The Chemistry and Examination of Edible Fats and Oils, their Substitutes and Adulterants. Roy. 8vo. Pp xx + 521. (London: Ernest Benn, Ltd., 1926.) 45s. net *

Gardner, William. Chemical Synonyms and Trade Names: a Dictionary and Commercial Handbook. Third edition, revised and much enlarged. Roy. 8vo. Pp. vi + 355 (London: Crosby-Lockwood and Son, 1926.) 30s. net.*

Gnamm, Hellmut. Die Fettstoffe in der Lederindustrie (Monographien aus dem Gebiete der Fett-Chemie, Teil 6.) Pp. xxx + 597. (Stuttgart: Wissenschaftliche Verlagsgesellschaft m.b.H., 1926.) 45 gold marks

Goldberg, E. La formation de l'image photographique: considérations photométriques et sensitométriques Traduit sur la deuxième édition allemande par L. Lobel et L.-P Clerc Gl 8vo. Pp. 196. (Paris: Paul Montel, 1926.) 6 francs

Holmyard, E. J. Simple Qualitative Analysis. Being Part 3 of "Practical Chemistry." (Bell's Natural Science Series) Cr. 8vo. Pp. viii + 257-295. (London: G. Bell and Sons, Ltd., 1926.) 1s.*

Ineson, W. I. Gas Works Laboratory Handbook. Demy 8vo. Pp 183. (London: J. and A. Churchill, 1926.) 9*s*. 6*d* net

Jaquet, Emanuel. Theorie der Adsorption von Gasen (Fortschritte der Chemie, Physik und physikalischen Chemie, Band 18, Heft 7, Serie B) Pp. 56. (Berlin: Gebruder Borntraeger, 1926.) 5 gold marks.

Jenaer akademische Reden. Herausgegeben von dem jeweiligen Rektor der Universitat. Heft 2: Goethe, Grossherzog Carl August und die Chemie in Jena. Rede, gehalten zur Feier der akademischen Preisverteilung am 19 Juni 1926 von Alexander Gutbier. Mit einem neu aufgefundenen Brief Doberemers an Goethe. Roy. 8vo. Pp. vi + 66 + 3 Tafeln (Jena: Gustav Fischer, 1926) 2.80 gold marks.

Lehner, Sigmund. Ink Manufacture, including Writing, Copying, Lithographic, Marking, Stamping, Typewriter and Laundry Inks. Third revised and enlarged English edition. Revised and compared with the seventh German edition by C. Ainsworth Mitchell. Cr 8vo. Pp. viii + 212 (London: Scott, Greenwood and Son, 1926.) 7*s*. 6*d*. net.

Lowy, Alexander, and **Baldwin, Wilmur E.** A Laboratory Book of Elementary Organic Chemistry. 4to (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd, 1926) 15*s*. net.

Lüdecke, Carl. Die Wachse und Wachskorper (Monographien aus dem Gebiete der Fett-Chemie, Teil 7) Pp 161 (Stuttgart: Wissenschaftliche Verlagsgesellschaft m b.H., 1926) 12 gold marks

Martin, Geoffrey. The Modern Soap and Detergent Industry, including Glycerol Manufacture: a Complete Practical Treatise on the Manufacture of Laundry, Toilet, Pharmaceutical, Textile, Abrasive, Scouring and Powdered Soaps; also Detergent Compositions and Soap Substitutes of all kinds, including Analyses of Raw Materials, Modern Patents and Literature, Recent Machinery and Processes, together with numerous Practical Recipes, and Lay-out of Modern Soap Factories In 3 vols Vol 3: The Manufacture of Glycerol. (Containing the Index to the Complete Work) Roy 8vo Pp xi + 78 + 36 + 13 + 20 + 8 + 41 + 57. (London: Crosby Lockwood and Son, 1926) 30*s*. net *

Mines Department: Safety in Mines Research Board. Paper No. 24: The Ignition of Firedamp by Momentary Flames. Part 1, by N. S. Walls and R. V. Wheeler; Part 2, by W. Rintoul and A. G. White Roy. 8vo Pp 18. (London: H M. Stationery Office, 1926.) 9*d*. net.*

Ministry of Agriculture and Fisheries. Power Alcohol Production: being a Report to the Minister of Agriculture and Fisheries of the Departmental Committee appointed by him in connection with the Manufacture of Alcohol for Power Purposes from Sugar Beet. Roy. 8vo. Pp. ii + 14. (London: H.M. Stationery Office, 1926.) 6*d* net.*

Molinari, Ettore. Chimie générale et industrielle Quatrième édition revue et augmentée. Traduit de l'italien par B de Viviès et Marcel Amic. Tome 5: Chimie organique, série forménique (suite), série cyclique. Roy. 8vo Pp 793. (Paris: Libr. Dunod, 1926.)

Noyes, William Albert. Organic Chemistry. Demy 8vo Pp xix + 677. (New York: Henry Holt and Co, 1926.) 3 50 dollars.*

Noyes, William Albert. Organic Chemistry for the Laboratory. Fifth edition, revised and enlarged. Pp. xiv + 329 (Easton, Pa.: The Chemical Publishing Co, 1926.) 4 dollars.

Oppenheimer, Carl. Die Fermente und ihre Wirkungen Nebst einem Sonderkapitel: Physikalische Chemie und Kinetik, von Richard Kuhn Funfte vollig neu bearbeitete Auflage. Sup Roy. 8vo. Lieferung 11. Pp. 1569-1744 17.10 gold marks. Lieferung 12 Pp 1745-1871. 17 45 gold marks. (Leipzig: Georg Thieme, 1926).*

Rideal, Eric Keightley. An Introduction to Surface Chemistry. Demy 8vo. Pp. viii + 336 (Cambridge: At the University Press, 1926) 18*s*. net.*

Rideal, Samuel. Glue and Glue Testing. Third edition, revised and enlarged by H. B. Stocks. Demy 8vo. Pp. viii + 264. (London: Scott, Greenwood and Son, 1926.) 12*s*. 6*d*. net.

Rosenmund, K. W. Hilfsbuch zur Ausfuhrung der qualitativen Analyse. Pp. 86. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 4 20 gold marks.

Schiebl, K. Warmewirtschaft in der Zuckerindustrie. (Warmelehre und Warmewirtschaft in Einzeldarstellungen, Band 2.) Pp. xvi + 174. (Dresden und Leipzig: Theodor Steinkopff, 1926) 10 gold marks

Searle, Alfred B. Cement, Concrete and Bricks (Outlines of Industrial Chemistry.) Second edition. Demy 8vo Pp. xi + 441. (London: Constable and Co., Ltd, 1926) 24*s*. net.*

Serger, H. Nahrungsmittelchemisches Taschenbuch: Kurze Anleitung zur Untersuchung und Begutachtung von Nahrungs-, Genussmitteln und Gebrauchsgegenstanden. Zweite verbesserte Auflage. Pp. 144. (Leipzig: Curt Kabitzsch, 1926) 5 gold marks.

Trenkler, R. Les gazogènes: guide de la gazéification avec ou sans récupération de sous-produits. Traduit de l'allemand par H. Besson. (Bibliothèque technique.) 8vo. Pp xvi + 400. (Paris: Payot et Cie, 1926.) 50 francs.

Ulich, Hermann. Über die Beweglichkeit der elektrolytischen Ionen. (Fortschritte der Chemie, Physik und physikalischen Chemie, Band 18, Heft 10, Serie A und B.) Pp. 56 (Berlin: Gebrüder Borntraeger, 1926.) 4.80 gold marks.

Vernon, C. G. An Introduction to Chemistry. Cr. 8vo. Pp 276. (London, Calcutta and Sydney: George G Harrap and Co, Ltd, 1926) 4*s*. 6*d*.

Villavecchia, G. V. Dizionario di merceologia e di chimica applicata Quarta edizione. Vol. 4: Senapa-Zucchero. Pp. 1803. (Milano: Ulrico Hoepli, 1926.)

Wagner, Alfred. Die Herstellung von Essigsaure, Garungsessig, Buttersaure, Citronensaure und Milchsaure In 2 Banden (Chem.-Techn. Bibliothek, Bande 382 und 383) Band 1. 6 gold marks. Band 2. 3 gold marks. (Wien und Leipzig: A. Hartlebens Verlag, 1926)

Waite, Arthur Edward. The Secret Tradition in Alchemy: its Development and Records. Roy 8vo. Pp. xxii + 415. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926) 15*s*. net.*

Wentzel, Friedrich. Die photographisch-chemische Industrie. (Fortschritte der chemischen Technologie, Band 10.) Pp. 363. (Dresden und Leipzig: Theodor Steinkopff, 1926) 18 50 gold marks.

Winderlich, Rudolf. Lehrbuch der Chemie fur hohere Lehranstalten. Teil 2: Oberstufe. Zweite durchgesehene Auflage. Pp 300. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1926.) 7.20 gold marks.

Technology

Bennetts, J. H. Builders' Standard Administration and Practice. Cr 8vo Pp. 139. (London: Crosby Lockwood and Son, 1926) 4*s*. 6*d* net.

Firth and Sons, Ltd., Thos. The Development of Stainless Steel: its Properties and Uses. Being a Text-book of Data collected from Investigations in the Research Laboratories and in the Works of Thos Firth and Sons, Ltd. Pp xi + 82. (Sheffield: Thos Firth and Sons, Ltd., 1926.) 10*s*. 6*d* net

Gates, Philip. The Brass Founders' and Finishers' Manual Cr. 8vo. Pp. 181. (London: Crosby Lockwood and Son, 1926.) 5*s*. net.

Heermann, Paul. Technologie der Textilveredelung. Zweite, verbesserte Auflage. 8vo. Pp. xi + 655. (Berlin: Julius Springer, 1926) 33 gold marks.

Meade, R. K. Portland Cement: its Composition, Raw Materials, Manufacture, Testing and Analysis Third edition. Pp. xii + 707. (Easton, Pa.: The Chemical Publishing Co, 1926.) 10 dollars.

Naske, Carl. Zerkleinerungsvorrichtungen und Mahlanlagen. (Chem. Technologie in Einzeldarstellungen.) Vierte erweiterte Auflage. Pp. 375. (Leipzig: Otto Spamer, 1926) 33 gold marks.

Schimpke, P., und **Horn, Hans A.** Praktisches Handbuch der gesamten Schweisstechnik. Zweiter Band: Elektrische Schweisstechnik. Pp. 208 + 20 Tafeln. (Berlin: Julius Springer, 1926.) 13.50 gold marks.

Schuchardt, Gustav. Beitrage zur Kenntnis der Fabrikation und Untersuchung von Kohlenelektroden. Pp. 17 + 2 Tafeln. (Halle a S.: Wilhelm Knapp, 1926) 1.50 gold marks.

Weber, Andreas. Die naturliche und kunstliche Alterung des geharteten Stahles: Physikalische und metallographische Untersuchungen 8vo. Pp. 81 + 12 Tafeln. (Berlin: Julius Springer, 1926.) 7.50 gold marks.

Astronomy

Boodin, John Elof. Cosmic Evolution: Outlines of Cosmic Idealism. Ex. Cr. 8vo Pp. 484. (New York: The Macmillan Co., 1925.) 15*s* net

Forbes, George. The Wonder and the Glory of the Stars. Demy 8vo Pp. 221 + 16 plates. (London: Ernest Benn, Ltd., 1926.) 8*s* 6*d* net *

Parvulesco, Const. Les amas globulaires d'étoiles et leurs relations dans l'espace. 8vo Pp. 142. (Paris: Gauthier-Villars et Cie, 1926.)

Proctor, Mary. Legends of the Sun and Moon. Cr. 8vo Pp. 159 (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1926.) 1*s* 3*d* *

Meteorology: Geophysics

Air Ministry: Meteorological Office. Professional Notes, No 44: The Velocity Equivalents of the Beaufort Scale By G C Simpson. (M O. 273d) Roy 8vo. Pp. 24. (London: H M Stationery Office, 1926) 9*d*. net.*

Ambronn, Richard. Methoden der angewandten Geophysik. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, Band 15) Med. 8vo. Pp. xii + 258. (Dresden und Leipzig: Theodor Steinkopff, 1926.) 15 gold marks.*

Hess, Victor F. Die elektrische Leitfahigkeit der Atmosphare und ihre Ursachen. (Sammlung Vieweg, Hefte 84-85) Demy 8vo. Pp. viii + 174. (Braunschweig: Friedr. Vieweg und Sohn A.-G, 1926) 8 50 gold marks.*

Geology: Mineralogy

Davison, E. H. Handbook of Cornish Geology. Demy 8vo. Pp. 106. (Penzance: Royal Geological Society of Cornwall, 1926.) *

Garrod, D. A. E. The Upper Palaeolithic Age in Britain. Demy 8vo Pp. 211 + 3 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1926) 10*s*. 6*d* net.*

Haddock, M. H. The Location of Mineral Fields: Modern Procedure in the Investigation of Mineral Areas and the Subsequent Verification of their Extent, etc. (Lockwood's Manuals) Cr. 8vo Pp vii + 295. (London: Crosby Lockwood and Son, 1926) 9*s* 6*d*. net.*

Krüger, Karl, und **Poschardt, G. R.** Die Erdolwirtschaft der Welt. Teile 1 und 2. Pp. 494. (Stuttgart: E. Schweizerbartsche Verlagsbuchhandlung (Erwin Nagell) G m.b.H., 1926.) 30 gold marks.

Lecointre, Georges. Recherches géologiques dans la Meseta marocaine 8vo. Pp 155 + 18 planches (Paris: Émile Larose, 1926.) 35 francs.

Pompeckj, J. F., und Huene, Fr. Freiherr von, Herausgegeben von Geologische und palaontologische Abhandlungen Neue Folge, Band 15 (der ganzen Reihe Band 19), Heft 2: Vollstandige Osteologie eines Plateosauriden aus dem schwabischen Keuper Von Fr v Huene (Jena: Gustav Fischer, 1926) 30 gold marks.

Thüringischen Geologischen Landesuntersuchung und vom **Thüringischen Geologischen Verein,** Herausgegeben von der Beitrage zur Geologie von Thuringen. Drittes Heft. (Jena: Gustav Fischer, 1926) 3 gold marks.

Geography: Travel

Baughan, B. E. Arthur's Pass and the Otira Gorge Ex. Cr. 8vo. Pp. 67. (Auckland, Melbourne and London: Whitcombe and Tombs, Ltd, 1926.) 2*s*. net.

Bournemouth. A Pictorial and Descriptive Guide to Bournemouth, Poole, Christchurch, the Avon Valley, Salisbury and the New Forest. Fifteenth edition revised. Gl. 8vo Pp. 176. (London: Ward, Lock and Co., Ltd., 1926.) 2*s* net.

Clyde, Constance, and **Mulgan, Alan E.** New Zealand: Country and People, with an Historical Outline. Demy 4to. Pp. 58. (Auckland, Melbourne and London: Whitcombe and Tombs, Ltd., 1926.) 7*s* 6*d*. net.

Darlington, Ralph, Edited by. Darlington's Handbooks: Switzerland. Part 1: Lausanne, Montreux and Lake of Geneva. Part 2: Zurich and the Engadine. Part 3: St. Moritz, Davos and Pontresina. Fcap. 8vo. (London: Simpkin, Marshall and Co, Ltd., 1926.) 2*s*. net each.

Debraye, Henry. Touraine and its Chateaux (Picture Guides) Pott 4to Pp 156 (London: The Medici Society, 1926) 7*s*. 6*d*. net

Dugmore, Major A. Radclyffe. The Vast Sudan Reprint. Demy 8vo. Pp. 312. (London and Bristol: J. W. Arrowsmith, Ltd, 1926.) 7*s*. 6*d* net

Farrar, Rev. C. F. Old Bedford: the Town of Sir William Harper, John Bunyan and John Howard the Philanthropist. Post 4to Pp. xvi + 289 (Bedford: F. R. Hockliffe; London: Simpkin, Marshall and Co, Ltd., 1926) 21*s*. net

Ferriman, Z. Duckett. East and West of Hellespont: Memories of Fifty Years. Med. 8vo. Pp 320 (London. Jonathan Cape, Ltd, 1926.) 15*s* net

Fletcher, C. R. L. A Handy Guide to Oxford. Revised edition. Cr 8vo (London: Oxford University Press, 1926) 1*s*. net

Fletcher, J. Brunsdon. The Murray Valley: a Three Thousand Mile Run. Cr. 8vo. (Sydney: Angus and Robertson, Ltd; London: Australian Book Co., 1926) 3*s*. 6*d*. net

Freeston, Charles L. The Alps for the Motorist. Post 8vo. Pp. 188 + 8 maps (London: Cassell and Co, Ltd., 1926) 7*s* 6*d*. net.

Fry, G. Cecil. A Text-book of Geography Sixth edition. Cr 8vo Pp xxiv + 527 + 16 maps. (London: University Tutorial Press, Ltd, 1926) 6*s* 6*d*.

Godlee, Sir Rickman J. A Village on the Thames: Whitchurch, Yesterday and To-day. Ex Cr. 8vo. Pp. 283. (London: George Allen and Unwin, Ltd, 1926.) 7*s* 6*d*. net.

Goldring, Douglas. Northern Lights and Southern Shade. Med. 8vo. Pp 220. (London: Chapman and Hall, Ltd., 1926) 12*s* 6*d*. net.

Gudgin, F. Wheaton's Junior Suggestive Geography of the British Isles. Second edition. Roy. 8vo Pp. 72. (Exeter: A. Wheaton and Co, Ltd, 1926.) 1*s*. 3*d*

Hannan, Thomas. The Beautiful Isle of Mull: with Iona and the Isle of Saints. Cr. 8vo. Pp 212. (Edinburgh: Robert Grant and Son, 1926.) 7*s*. 6*d* net

Letts, Malcolm, Edited by Francis Mortoft, his Book: being his Travels through France and Italy, 1658–1659. Med. 8vo Pp. xxxiv + 216. (London: The Hakluyt Society, 1926.) 25*s*. net.

Lucas, E. V. A Wanderer in London. Twenty-sixth edition, revised Cr. 8vo. Pp. 296. (London: Methuen and Co., Ltd., 1926.) 10*s*. 6*d*. net.

MacGregor, Alasdair Alpin. Over the Sea to Skye: or, Ramblings in an Elfin Isle Cr. 8vo Pp xxiv + 353. (London and Edinburgh. W. and R Chambers, Ltd., 1926.) 7*s*. 6*d*. net.

Macmillan's Mapping Exercise Book. Book A1. Cr. 4to. Pp. 32. (London: Macmillan and Co., Ltd, 1926) 4*d* *

Metcalfe-Shaw, Gertrude E. English Caravanners in the Wild West: the Old Pioneers' Trail Med. 8vo. Pp. viii + 400. (Edinburgh and London: W. Blackwood and Sons, Ltd, 1926) 21*s*. net.

Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol. 9, No. 3, 1926: The Water Movements in the Southern North Sea. Part 2: The Bottom Currents. By J. N. Carruthers Imp. 8vo. Pp 114. (London: H M Stationery Office, 1926) 14*s*. net.*

Morley, F. V. River Thames from Source to Mouth. Med. 8vo. Pp xi + 255 + 16 plates. (London. Methuen and Co, Ltd., 1926.) 16*s*. net.

Morton, H. V. London. (The Little Guides.) Pott 8vo Pp. ix + 239. (London: Methuen and Co., Ltd., 1926) 5*s*. net

Mothersole, Jessie. Czechoslovakia, the Land of an Unconquerable Ideal. Roy. 8vo. Pp xxi + 296. (London: John Lane, The Bodley Head, Ltd., 1926) 18*s*. net.

Rawnsley, Willingham Franklin. Highways and Byways in Lincolnshire. (Highways and Byways Series) Pocket edition. Fcap. 8vo. Pp. xviii + 511. (London: Macmillan and Co, Ltd, 1926.) Cloth, 6*s* net; leather, 7*s* 6*d* net.

Roberts, Kenneth L. Florida. Demy 8vo Pp. 340. (New York and London: Harper and Bros., 1926) 8*s*. 6*d*. net.

Robson, E. I. A Wayfarer on the Loire. Cr. 8vo Pp xi+220. (London: Methuen and Co, Ltd, 1926) 7s 6d net

Salis, Rachel de. Hillingdon through Eleven Centuries. Ex. Cr. 4to. (Uxbridge: Lucy and Birch, 1926) 8s. net.

General Biology: Natural History Botany: Zoology

Barclay, D., Bolus, H. M. L., and **Steer, E. J.** A Book of South African Flowers Cr 4to Pp. xviii+174 (57 plates) (Cape Town and Johannesburg. The Specialty Press of South Africa, Ltd; London. L. Reeve and Co, Ltd, 1925) 21s*

Berg, Leo S. Nomogenesis: or Evolution determined by Law Translated from the Russian by J. N. Rostovtsow. Demy 8vo Pp. xviii+477. (London: Constable and Co, Ltd, 1926.) 28s net*

Byng, Lady Rachel. How to make Money by Angora Rabbit Breeding and Wool Farming. Demy 8vo. Pp 36 (Hexham, Northumberland: The Author, High Sandhoe, 1926.) 1s 3d. net

Chemin, E. Les mollusques d'eau douce. (Encyclopédie pratique du naturaliste, Tome 24.) Cr. 8vo Pp. viii+186+15 planches. (Paris: Paul Lechevalier, 1926.) 25 francs*

Chun, Carl, Herausgegeben von. Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia* 1898–1899. Band 23, Hefte 4 und 5: Copepoda; Cephalophanes G. O. Sars 1907 der Deutschen Tiefsee-Expedition, Systematik und Verbreitung der Gattung. Von Adolf Steuer Amphipoda 3: Die Gammariden der Deutschen Tiefsee-Expedition. Von A. Schellenberg. (Jena: Gustav Fischer, 1926.) 8 gold marks.

Cock, Reginald. Genesis v. Evolution. Cr. 8vo Pp. 77 (London: Elliot Stock, 1926.) 2s. net.

Danish *Dana* Expeditions, 1920–22, in the North Atlantic and the Gulf of Panama, The. Oceanographical Reports edited by the *Dana* Committee. No. 2: The Pediculate Fishes of the Suborder Ceratioidea. By C. Tate Regan. (Published at the cost of the Rask-Orsted Fund.) Sup. Roy 4to. Pp. 45+13 plates. (Copenhagen: Gyldendalske Boghandel; London: Wheldon and Wesley, Ltd., 1926.) 15s.*

Elliston-Wright, F. R. Braunton: a Few Nature Notes, with Lists of Flora, Macro-Lepidoptera, and Birds known to Occur in the District. Cr. 8vo. Pp. 106. (Barnstaple: Arthur Ernest Barnes, 1926.)

Fishery Board for Scotland. Salmon Fisheries, 1926. No. 2: Salmon Passes (A Second Paper). By W. L. Calderwood. Imp 8vo. Pp. 18+7 plates. 4s 6d. net. No. 3: Sea Trout of the River Ailort and Loch Eilt. By G Herbert Nall Imp. 8vo. Pp. 24+4 plates. 3s. net. (Edinburgh and London: H M. Stationery Office, 1926)*

Fishery Board for Scotland. General Index to the Reports and Papers issued by the Fishery Board for Scotland on the Subject of Salmon Fisheries from 1882 to 1924 inclusive Prepared by W. J. M. Menzies. Roy. 8vo. Pp. 50. (Edinburgh and London: H.M. Stationery Office, 1926.) 3s 6d. net.*

Fitting, Hans. Die okologische Morphologie der Pflanzen im Lichte neuerer physiologischer und pflanzengeographischer Forschungen. Roy. 8vo. Pp. 35. (Jena: Gustav Fischer, 1926.) 1 80 gold marks.

Frisch, K. von, Goldschmidt, R., Ruhland, W., und **Winterstein, H.,** Herausgegeben von. Ergebnisse der Biologie. Erster Band. Pp. 678. (Berlin: Julius Springer, 1926.) 36 gold marks.

Gilbert White Fellowship, The. Pamphlet No 4: The Literature of the Countryside in the School; Paper read at a Meeting of the Fellowship on November 1, 1924, by the President, Sir A. Daniel Hall, at No. 6 Queen Square, W.C.1. Demy 8vo. Pp. 16. (London: The Gilbert White Fellowship, 1926.)*

Goebel, K., Herausgegeben von. Botanische Abhandlungen. Heft 10: Untersuchungen über Marchantiaceen. Von E. Bergdolt. (Jena: Gustav Fischer, 1926.) 5 gold marks

Grimpe, G., und **Wagler, E.,** Herausgegeben von Die Tierwelt der Nord- und Ostsee. Lieferung 4. Teil 7, c1: *Bryozoa,* von Ernst Marcus; Teil 12, c: *Pisces,* Allgemeiner Teil, von H. M Kyle und E. Ehrenbaum, Teil 12, g1 *Teleostei Physoclisti* 1-5, von Georg Duncker und Erna W. Mohr. Med 8vo. Pp 100+104+44. (Leipzig: Akademische Verlagsgesellschaft m.b H, 1926) 18 gold marks*

Haberland, H. F. O. Die operative Technik des Tierexperimentes Pp 346. (Berlin: Julius Springer, 1926) 28 50 gold marks.

Harms, Jürgen W. Korper und Keimzellen. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 9.) Teil 1. Demy 8vo. Pp. x+516 Teil 2. Demy 8vo Pp. iii+517-1023. (Berlin: Julius Springer, 1926) 66 gold marks.*

Hinton, Martin A. C. Monograph of the Voles and Lemmings (Microtinæ), Living and Extinct. Vol 1. Demy 8vo. Pp. xvi+488+15 plates. (London: British Museum (Natural History), 1926). 30s.*

Hutchinson, J. Key to the Families of the Dicotyledons. Reprinted from "The Families of Flowering Plants, Vol 1: Dicotyledons" Med 8vo. Pp. 54. (London: Macmillan and Co, Ltd., 1926.) 2s. net.

Johannsen, W. Elemente der exakten Erblichkeitslehre. Dritte, erweiterte und umgearbeitete Auflage. (Jena: Gustav Fischer, 1926) 35 gold marks.

Kepner, William Allison. Animals looking into the Future. Large Post 8vo. Pp. xi+197. (New York: The Macmillan Co, 1925.) 7s. 6d. net*

Kükenthal, Willy, Gegrundet von Handbuch der Zoologie: eine Naturgeschichte der Stamme des Tierreiches. Herausgegeben von Thilo Krumbach. Funfter Band: Solenogastres, Mollusca, Echinodermata, Tunicata. Dritte Lieferung. Med. 4to. Pp. 177-256. (Berlin und Leipzig: Walter de Gruyter und Co., 1926.) 8 gold marks.*

Latter, O. H. Biology. (Science for All Series) Cr. 8vo Pp. vii+197 (London: John Murray, 1926) 3s. 6d.*

Loomis, Frederic Brewster. The Evolution of the Horse. (The Amherst Books: Second Series.) Cr. 8vo Pp. xvi+233+26 plates. (Boston, Mass.: Marshall Jones Co., 1926.) 3 dollars.*

Meyer, Adolf. Logik der Morphologie: im Rahmen einer Logik der gesamten Biologie. Sup. Roy. 8vo. Pp. vii+290. (Berlin: Julius Springer, 1926) 18 gold marks*

Phelps, Edith M., Compiled by. Selected Articles on Evolution. (The Handbook Series) Post 8vo Pp. liii+283. (New York: The H W. Wilson Co.; London: Sir Isaac Pitman and Sons, Ltd., 1926.) 2.40 dollars.*

Shelford, V. E., Edited by. Naturalist's Guide to the Americas. Roy. 8vo. (London: Baillière, Tindall and Cox, 1926) 45s. net.

Stoppel, Rose. Pflanzenphysiologische Studien. Roy. 8vo Pp. v+164. (Jena: Gustav Fischer, 1926.) 7.50 gold marks.

Ungerer, E. Die Regulationen der Pflanzen: ein System der ganzheitbezogenen Vorgange bei den Pflanzen. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 10.) Zweite erweiterte Auflage. Demy 8vo Pp. xxiv+363. (Berlin: Julius Springer, 1926.) 22.80 gold marks.*

Walker, Comdr. James J., Contributions edited by. The Natural History of the Oxford District. Presented to the Members of the British Association for the Advancement of Science, Oxford Meeting 1926. Cr. 8vo. Pp. viii+336. (London: Oxford University Press, 1926). 10s. net.*

Wenyon, C. M. Protozoology: a Manual for Medical Men, Veterinarians and Zoologists. In 2 vols. Roy. 8vo. Vol. 1. Pp. xvi+778+5 plates. Vol. 2. Pp. x+779-1563+plates 6-20. (London: Baillière, Tindall and Cox, 1926.) 84s. net.*

Horticulture: Forestry: Agriculture

Allwood, Montagu C. Carnations: for every Garden and Greenhouse. Fcap. 4to. Pp. xvi+139+plates. (London: *Country Life,* Ltd, 1926.) 12s. 6d net.

Amess, A. H. R., and **Johnson, H. C.** Manual of Dairy Science. Cr. 8vo Pp. 208. (Auckland, Melbourne and London: Whitcombe and Tombs, Ltd., 1926.) 4s. 6d. net.

Crumley, J. J. Constructive Forestry for the Private Owner Ex. Cr. 8vo. Pp xviii + 322 (New York: The Macmillan Co, 1926) 15*s* net.

Davis, R. A. Citrus Growing in South Africa. Roy. 8vo. Pp 309. (Cape Town and Johannesburg: The Specialty Press of South Africa, Ltd.; London: L. Reeve and Co., Ltd., 1924) 25*s*. net.*

Henslow, T. Geoffrey W. Garden Renovation. Demy 8vo. Pp. xxi + 416. (London: Dean and Son, Ltd, 1926) 15*s*. net.

Rümpler, A. Die käuflichen Düngestoffe: ihre Gewinnung, Zusammensetzung, Wirkung und Anwendung. Sechste vollstandig neubearbeitete Auflage, von D Meyer. Pp. 199. (Berlin: Paul Parey, 1926.) 5 50 gold marks.

Russell, E. J. Plant Nutrition and Crop Production 8vo. (Cambridge: At the University Press, 1926.) 12*s*. 6*d*. net.

Stebbing, E. P. The Forests of India. In 3 vols Vol. 3: The Progress of Conservancy and the Development of Research in Forestry, 1901–1925; including Brief Reviews of the Progress of Conservancy in the several Presidencies and Provinces between 1871–1900. Demy 8vo. Pp. xix + 705 + 122 plates. (London: John Lane, The Bodley Head, Ltd, 1926) 42*s*. net.*

Swaine, Agnes K. A Flower Garland and Alphabet. Fcap. 8vo. Pp 60 + 26 plates. (London: Selwyn and Blount, Ltd., 1926) 2*s* 6*d*. net.

Anatomy: Physiology

Aubertin, Émile. L'insuline Roy. 8vo. Pp. 490. (Paris: Gaston Doin et Cie, 1926.) 45 francs.

Bainbridge, J. S. Diet for the Million With a chapter on Diet and Disease by S. Henning Belfrage. Cr. 8vo Pp. xiii + 241. (London: Williams and Norgate, Ltd, 1926) 6*s* net

Berblinger, W., Dietrich, A., Herxheimer, G., Kraus, E. J., Schmincke, A., Siegmund, H., und **Wegelin, C.,** Bearbeitet von. Die pathologische Anatomie und Histologie der Drüsen mit innerer Sekretion. (Handbuches der speziellen pathologischen Anatomie und Histologie, Band 8.) Pp. 1159. (Berlin: Julius Springer, 1926.) 165 gold marks.

Coste, F. Équilibre acido-basique des milieux biologiques. 8vo. Pp. 101. (Paris: Masson et Cie, 1926.) 9 francs.

Cushny, Arthur R. Die Absonderung des Harns. Nach der zweiten englischen Auflage ins Deutsche übersetzt von Alfred Noll und Johanna Puschel. (Jena: Gustav Fischer, 1926) 16 gold marks.

De Lint, J. G. Atlas of the History of Medicine. 1: Anatomy. Folio. (London: H. K Lewis and Co., Ltd., 1926) 15*s*. net.

Gardiner, Harold. Physiology and Anatomy. With chapters on common Diseases and Accidents, and a List of common Medical Terms. Demy 8vo. Pp. xiii + 414. (London: Sir Isaac Pitman and Sons, Ltd, 1926) 10*s* 6*d*. net.

Harris, D. T. Practical Histology for Medical Students. 4to (London: H. K. Lewis and Co., Ltd., 1926.) 7*s*. 6*d* net.

Macleod, John James Rickard. Carbohydrate Metabolism and Insulin. (Monographs on Physiology.) Med. 8vo. Pp xii + 357 + 4 plates. (London: Longmans, Green and Co, Ltd., 1926) 18*s*. net *

Maurer, Friedrich. Carl Gegenbaur: Rede zum Gedachtnis seines hundertsten Geburtsjahres, gehalten im Horsaal der Anatomischen Anstalt in Heidelberg am 19 April 1926. (Sonderabdruck aus Jenaische Zeitschrift fur Naturwissenschaft, Band 62.) Roy. 8vo. Pp. ii + 18 + 3 Tafeln (Jena. Gustav Fischer, 1926) 1 20 gold marks.*

Medical Research Council: Industrial Fatigue Research Board. Report No. 35: A Physiological Study of the Ventilation and Heating in certain Factories. By H M. Vernon and T. Bedford; assisted by C. G. Warner. Roy 8vo. Pp. iv + 82 (London: H.M. Stationery Office, 1926) 3*s*. net.*

Rost, E. Beziehungen zwischen chemischer Konstitution und physiologischer Wirkung. Pp. 24. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 1.20 gold marks.

Ryle, John. Gastric Function in Health and Disease. Pp. 152. (London: Oxford University Press, 1926.) 8*s*. 6*d*. net

Taylor, D. D. Cottington. Food Wisdom. Pp. ix + 136. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 2*s*. 6*d*. net.

Thorlakson. Le fondement physiologique des instincts des systèmes nutritifs neuromusculaire et génital. 8vo Pp. 390. (Paris: Les Presses universitaires de France, 1926.) 20 francs.

Tissot, J. Constitution des organismes animaux et végétaux: causes des maladies qui les atteignent. Roy. 8vo. Tome 1. Pp. viii + 679. Tome 2. Pp. iii + 42 + 329 planches. (Paris: Laboratoire de physiologie générale du Muséum d'Histoire naturelle, 1926.) *

Winterstein, Hans. Die Narkose in ihrer Bedeutung fur die allgemeine Physiologie. Zweiter Band. Zweite, umgearbeitete Auflage. Pp. 228. (Berlin: Julius Springer, 1926.) 28.50 gold marks.

Anthropology: Archæology

Bolk, L. Das Problem der Menschwerdung. Vortrag, gehalten am 15 April 1926 auf der 25 Versammlung der Anatomischen Gesellschaft zu Freiburg. Roy. 8vo. Pp. iii + 44. (Jena: Gustav Fischer, 1926.) 2.10 gold marks.*

Bowhay, T. A. Life and Man. Demy 8vo. Pp. 320. (London: Jonathan Cape, Ltd., 1926.) 9*s*. net.

Budge, Sir E. A. Wallis. The Dwellers on the Nile. Chapters on the Life, History, Religion and Literature of the Ancient Egyptians. Demy 8vo. Pp. xxxii + 326 + 11 plates. (London: Religious Tract Society, 1926.) 10*s*. 6*d*. net.

Churchward, Colonel James. The Lost Continent of Mu: the Motherhood of Man. Roy. 8vo. Pp. x + 316. (New York: William Edwin Rudge, Inc, 1926.)

Collingwood, R. G. A Guide to the Roman Wall Cr 8vo. Pp. 31. (Newcastle-on-Tyne: Andrew Reid and Co, 1926) 6*d*. net.

Coulton, H. G. The Medieval Village. (Cambridge Studies in Medieval Life and Thought.) Med. 8vo. Pp. 634. (Cambridge: At the University Press, 1926.) 25*s*. net.

Daunt, H. D. The Centre of Ancient Civilization: Discoveries in Ancient Geography and Mythologies. Med. 8vo. Pp. vii + 280 (London: John Lane, The Bodley Head, Ltd., 1926.) 10*s*. net.

Davison, Dorothy. Our Prehistoric Ancestors: the Story of Man's Evolution to the End of the Old Stone Age. Cr. 8vo. Pp. xiv + 208. (London: Methuen and Co., Ltd., 1926.) 7*s*. 6*d*. net.

East, Edward M. Die Menschheit am Scheidewege. Deutsch von Helene Schmid. Pp 369. (Basel: Benno Schwabe und Co., 1926.) 9.60 gold marks.

Edwardes, S. M., Edited by. Folk Tales from Northern India. From the Collection made by the late Dr. William Crooke. 4to. Pp. 56. (London: Luzac and Co., 1926) 5*s*.

Ellis, T. P. Welsh Tribal Law and Custom in the Middle Ages. 2 vols 8vo. (London: Oxford University Press, 1926.) 80*s* net.

Friend, J. Newton. Iron in Antiquity. Cr. 8vo. Pp. viii + 221. (London: Charles Griffin and Co., Ltd., 1926.) 10*s*. 6*d*. net.*

Gardiner, Alan H. The Tomb of Huy, Viceroy of Nubia in the Reign of Tutʿankhamun. Copied in Line and Colour by Nina de Garis Davies, and with Explanatory Text. (The Theban Tombs Series, Fourth Memoir.) (No. 40.) Roy. 4to Pp 42 + 60 plates. (London: Egypt Exploration Society, 1926.) 50*s*.

Grierson, Sir George A. Bihar Peasant Life. being a Discursive Catalogue of the Surroundings of the People of that Province. (Prepared (in 1885) under Orders of the Government of Bengal.) Second and revised edition. Roy. 8vo. Pp. iv + 4 + 443 + xvii + cly + 40 plates. (Patna Government Printing Office, 1926) 10 rupees.*

Haile, Fr. Berard, Arranged by. A Manual of Navaho Grammar. Med. 8vo. Pp. xi + 324. (Arizona: Franciscan Fathers, St. Michaels, 1926) 6 dollars.*

Hauschild, M. W. Grundriss der Anthropologie. Roy. 8vo. Pp. viii + 235. (Berlin: Gebruder Borntraeger, 1926.) 10.50 gold marks.*

Holl, Joseph. The Arab Civilisation. Translated from the German by S. Khuda Bukhsh Demy 8vo. Pp. 166. (Cambridge: W Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co, Ltd., 1926.) 8*s*. 6*d*. net.

Howey, M. Oldfield. The Encircled Serpent: Serpent Symbolism in all Countries and Ages. Roy 8vo. Pp. 423 (London: W. Rider and Son, Ltd., 1926.) 25*s*. net.

Humphreys, C. B. The Southern New Hebrides: an Ethnological Record. Demy 8vo. Pp. xvi+214. (Cambridge: At the University Press, 1926.) 12*s*. 6*d*. net.*

Kummer, Frederic Arnold. The First Days of Man: as narrated quite simply for young readers. (The Earth's Story, Vol. 1.) Demy 8vo. Pp. 293. (London: Hodder and Stoughton, Ltd., 1926.) 7*s*. 6*d*. net.

Ledroit, Johannes. Fruhschein der Kultur: Bilder aus Vorgeschichte und Urzeit. Ex. Cr 8vo Pp. ix+257 (Freiburg im Breisgau: Herder und Co. G.m.b.H, 1926.) 4.80 gold marks.*

Luquet, G.-H. L'art et la religion des hommes fossiles. Pp. 234. (Paris: Masson et Cie, 1926.) 26 francs.

Malinowski, Bronislaw. Crime and Custom in Savage Society (International Library of Psychology, Philosophy and Scientific Method.) Demy 8vo. Pp. xii+132+6 plates. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1926.) 5*s*. net.*

Meyerhof, Max. Le monde islamique (Bibliothèque générale illustrée, No. 3.) Pott 4to. Pp. 80+59 planches. (Paris: F. Rieder et Cie, 1926.) 15 francs.*

Moret, A., and **Davy, G.** From Tribe to Empire: Social Organization among Primitives and in the Ancient East. (The History of Civilization Series.) Translated by V. Gordon Childe. Med. 8vo. Pp xxx+371. (London: Kegan Paul and Co., Ltd.; New York: Alfred A Knopf, 1926) 16*s*. net.*

Pfizenmayer, E. Mammutleichen und Urwaldmenschen in Nordost-Sibirien. 8vo. Pp. 341. (Leipzig: F. A Brockhaus, 1926)

Prorok, Byron Khun de. Digging for Lost African Gods: Five Years' Archæological Excavation in North Africa. With notes and translation by Edgar F. Allen. Roy. 8vo. Pp 385 (New York and London: G. P. Putnam's Sons, Ltd., 1926.) 25*s*. net.

Sampson, John. The Dialect of the Gypsies of Wales. being the Older Form of British Romani preserved in the Speech of the Clan of Abram Wood. Cr. 4to. Pp. xxiii+419. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 84*s*. net.*

Sedgwick, Mrs. William T. Acoma, the Sky City: a Study in Pueblo-Indian History and Civilization. Demy 8vo. Pp xiii+314+33 plates (Cambridge, Mass.: Harvard University Press, London: Oxford University Press, 1926.) 18*s* 6*d*. net.*

Shetelig, Haakon. Préhistoire de la Norvège. (Instituttet for Sammenlignende Kulturforskning, Serie A, Forelesninger, 5.) Cr. 8vo Pp vi+280+10 planches (Oslo: H. Aschehoug and Co.; London: Williams and Norgate, Ltd.; Leipzig: Otto Harrassowitz; Paris: Honoré Champion, Cambridge, Mass.: Harvard University Press, 1926.) 7*s*. 6*d*.*

Smith, Edwin W. The Golden Stool: some Aspects of the Conflict of Cultures in Modern Africa. Ex. Cr. 8vo. Pp. 328. (London: Holborn Publishing House, 1926.) 5*s* net

Sydenham, Edward A. Aes Grave: a Study of the Cast Coinages of Rome and Central Italy. Cr. 4to. Pp. 145+28 plates. (London: Spink and Son, Ltd., 1926.) 21*s* net.

Talbot, P. Amaury. The Peoples of Southern Nigeria: a Sketch of their History, Ethnology and Languages; with an Abstract of the 1921 Census. In 4 vols. Med. 8vo. Vol. 1: Historical Notes. Pp. xii+365. Vol. 2: Ethnology. Pp. xx+423. Vol. 3: Ethnology Pp. x+426-976. Vol. 4: Linguistics and Statistics. Pp. 234. (London: Oxford University Press, 1926.) 70*s*. net.

Vulliamy, C. E. Immortal Man: a Study of Funeral Customs and of Beliefs in regard to the Nature and Fate of the Soul. Ex. Cr. 8vo. Pp. 215. (London: Methuen and Co, Ltd., 1926.) 6*s*. net.

Wells, H. G. The Outline of History: a Plain History of Life and Mankind. New edition, fully revised. Demy 4to. Part 19. Pp. 577-608. Part 20. Pp. 609-640. Part 21 Pp. 641-672 Part 22 Pp. 673-704 (London: Cassell and Co., Ltd., 1926.) 1*s* 3*d*. net each part.*

Weule, K. The Culture of the Barbarians: a Glimpse in the Beginnings of the Human Mind (Cosmos Library) Cr. 8vo. Pp 80. (London: Simpkin, Marshall and Co, Ltd., 1926.) 1*s*. net.

Weule, K. Cultural Element in Mankind: Commencements and Primitive Forms of Material Culture. (Cosmos Library.) Cr. 8vo. Pp. 88. (London: Simpkin, Marshall and Co, Ltd., 1926) 1*s*. net.

Bacteriology: Hygiene

Kirk, J. Balfour. Hints on Equipment and Health for Intending Residents in the Tropics Cr. 8vo. Pp. 128 (London: Baillière, Tindall and Cox, 1926) 3*s* 6*d*. net.

Wood, Thomas D., and **Brownell, Clifford L.** Source Book in Health and Physical Education. Ex Cr. 8vo. Pp xi+590 (New York: The Macmillan Co., 1925) 10*s* 6*d*. net.

Medical Sciences

Bailey, Percival, and **Cushing, Harvey.** A Classification of the Tumors of the Glioma Group on a Histogenetic Basis; with a Correlated Study of Prognosis. Roy. 8vo (Philadelphia and London: J. B Lippincott and Co., Ltd, 1926) 21*s* net

Bergmann, G. v., und **Staehelin, R.,** Herausgegeben von. Handbuch der inneren Medizin. Band 4. Blut, Bewegungsapparat, Konstitution, Stoffwechsel, Blutdrusen, Erkrankungen aus physikalischen Ursachen, Vergiftungen. Zweite Auflage Teil 1: Blut, Bewegungsapparat, Konstitution, Stoffwechsel, Bearbeitet von W. Alwens, M. Cloetta, G. Denecke, R. Doerr, W Falta, E. St Faust, E. Hubener, M. Klotz, L Lichtwitz, F. Lommel, M Ludin, Erich Meyer, P Morawitz, R. Staehelin, E. Steinitz, R. von den Velden und H. Zangger Pp. 1045. (Berlin: Julius Springer, 1926) 69 gold marks.

Blümel, Karl Heinz, Herausgegeben von Handbuch der Tuberkulose-Fursorge. Erster Band. Roy. 8vo. Pp viii+457. (München: J F. Lehmann, 1926.) 24 gold marks

Braeuning, H., und **Lorentz, Friedrich.** Die Tuberkulose und ihre Bekampfung durch die Schule. eine Anweisung fur die Lehrerschaft. Dritte, verbesserte Auflage. Pp. 136. (Berlin: Julius Springer, 1926.) 2.50 gold marks

Cope, Zachary. The Treatment of the Acute Abdomen. (Oxford Medical Publications) 8vo Pp. 254. (London: Oxford University Press, 1926) 10*s* 6*d*. net

Curschmann, Fritz; Curschmann, Hans; Hirsch, Carl, und **Wolff, Felix.** Erinnerungen an Heinrich Curschmann 8vo Pp. iv+88+6 Tafeln. (Berlin: Julius Springer, 1926.) 4 gold marks.

Denker, A., und **Kahler, O.,** Herausgegeben von Handbuch der Hals-Nasen-Ohren-Heilkunde Zweiter Band: Die Krankheiten der Luftwege und der Mundhohle. Sup Roy. 8vo. Pp xiv+1068 84 gold marks. Sechster Band: Die Krankheiten der Gehororgans. Erster Teil. Pp xv+1274. 96 gold marks. (Berlin: Julius Springer; Munchen: J F. Bergmann, 1926.)

Fitzgibbon, Elliot. Marvels of Modern Medicine. Cr. 8vo. Pp. 74. (London: The C. W. Daniel Co, 1926) 2*s* net.

Franck, R. Moderne Therapie in innerer Medizin und Allgemeinpraxis: ein Handbuch der medikamentosen, physikalischen und diätetischen Behandlungsweisen der letzten Jahre. Teil 1: Arzneimittelbesprechung, Teil 2: Therapie der inneren Krankheiten Pp. 580. (Leipzig: F. C. W. Vogel, 1926.) 15 gold marks

Gould and **Pyle's** Pocket Cyclopaedia of Medicine and Surgery. Third edition, revised, enlarged and edited by R J. E. Scott. 18mo. Pp 924. (London: H. K. Lewis and Co., Ltd, 1926.) 12*s* net

Graham, George. The Pathology and Treatment of Diabetes Mellitus. (Oxford Medical Publications.) Second edition Cr 8vo. Pp. xv+230. (London: Oxford University Press, 1926.) 8*s*. 6*d*. net.

Greene, Charles L. Medical Diagnosis: for the Student and Practitioners Sixth edition, revised and enlarged. 4to (London: William Heinemann, Ltd., 1926.) 63*s*. net

Guleke, N., Penzoldt, F., und Stintzing, R., Herausgegeben von. Handbuch der gesamten Therapie In sieben Banden. Band 1. Infektionskrankheiten, Vergiftungen, Erkrankungen des Stoffwechsels, des Blutes, des Lymphsystems und der endokrinen Drusen. Roy. 8vo. Pp. viii + 1085. (Jena: Gustav Fischer, 1926.) 41 gold marks

Gunther, R. T. Early Medical and Biological Science. Extracted from "Early Science in Oxford." Demy 8vo Pp iv + 246. (London: Oxford University Press, 1926.) 7*s*. 6*d* net.*

Hadwen, Walter R. The Difficulties of Dr Deguerre. Pott 4to. Pp. 596. (London: The C W. Daniel Co., 1926.) 22*s* 6*d*. net.

Hajek, M. Pathologie und Therapie der entzundlichen Erkrankungen der Nebebhohlen der Nase Funfte, ganzlich umgearbeitete und vermehrte Auflage Sup Roy 8vo. Pp. xxiv + 600 + 7 Tafeln. (Leipzig und Wien: Franz Deuticke, 1926.) 26 gold marks.

Hampshire, Charles H., Edited by. Pharmacopoeia of the University College Hospital, 1926 (Published by authority of the Medical Committee) New edition. 18mo. Pp. 99 (London: John Bale, Sons, and Danielsson, Ltd., 1926.) 4*s*. net.

Jones, J. Henry. Healing by Manipulation (Bone-Setting). Cr. 8vo. Pp 80. (London: Watts and Co., 1926) 2*s*. 6*d*. net

Jordan, Alfred C. Chronic Intestinal Stasis (Arbuthnot Lane's Disease): a Radiological Study. (Oxford Medical Publications) Second edition, revised Roy. 8vo. Pp. 246. (London: Oxford University Press, 1926.) 21*s*. net.

Jores, Leonhard. Anatomische Grundlagen wichtiger Krankheiten: ein Lehrbuch fur Ärzte und Studierende. Zweite Auflage. 8vo Pp vi + 525 (Berlin: Julius Springer, 1926) 42 gold marks.

Jötten, K. W. Die Auskunfts- und Fursorgestelle fur Lungenkranke wie sie ist und wie sie sein soll. Zweite, erweiterte Auflage. Pp. 134. (Berlin: Julius Springer, 1926) 6 60 gold marks.

Labbé, Marcel. Le traitement du diabète. (Collection médecine et chirurgie pratiques.) Deuxième édition. 8vo. Pp. 152. (Paris: Masson et Cie, 1926) 8 francs

Lake, Richard. Contributions to the Art and Science of Otology: Lectures and Papers, 1892–1925 Demy 8vo Pp. vi + 255. (London: Macmillan and Co, Ltd, 1926) 15*s*. net.*

Lotmar, F. Die Stammganglien und die extrapyramidal-motorischen Syndrome. (Monographien aus dem Gesamtgebiete der Neurologie und Psychiatrie, Band 48) Pp. 176. (Berlin: Julius Springer, 1926) 13 50 gold marks.

McKissack, Henry Lawrence. Aids to Case-Taking: a Practical Guide to the Examination and Recording of Medical Cases. Second edition, revised. Fcap 8vo. Pp. 176. (London: Baillière, Tindall and Cox, 1926) 4*s*. 6*d* net.

Medical Research Council. Special Report Series No. 106: Small-pox and Climate in India: Forecasting of Epidemics. By Sir Leonard Rogers. Roy 8vo. Pp 22. (London: H M. Stationery Office, 1926) 2*s*. net

Pinch, A. E. Hayward. A Manual of Technique in Radium-Therapy. Demy 8vo. Pp. 41 + 40 plates (London: The Radium Institute, 1926) Gratis to medical practitioners.

Porritt, Norman. The Abdomen in Labour: being a General Practitioner's Clinical Study of the Parturient Abdomen. (Oxford Medical Publications) Pp. xiv + 76. (London: Oxford University Press, 1926) 5*s*. net.

Rost, Georg Alexander. Hautkrankheiten. (Fachbucher für Ärzte, Band 12.) Pp 416. (Berlin: Julius Springer, 1926.) 30 gold marks

Schiff, Fritz. Die Technik der Blutgruppenuntersuchung: fur Kliniker und Gerichtsarzte Nebst Berucksichtigung ihrer Anwendung in der Anthropologie und der Vererbungs- und Konstitutionsforschung. Pp. 72. (Berlin: Julius Springer, 1926.) 6 gold marks.

Thomson, F. G., and Gordon, R. G. Chronic Rheumatic Diseases: their Diagnosis and Treatment (Oxford Medical Publications) Demy 8vo. Pp viii + 202. (London: Oxford University Press, 1926) 8*s*. 6*d* net

Tod, Hunter. Diseases of the Ear. Revised and largely rewritten by George C Cathcart. (Oxford Medical Publications.) New (second) edition. Cr. 8vo Pp. xiv + 333. (London: Oxford University Press, 1926) 10*s* 6*d*. net.

Vlasto, Michael. The Nursing of Diseases of the Nose, Ear and Throat. Cr. 8vo Pp. xiv + 229 (London Faber and Gwyer, Ltd., 1926.) 6*s*. net

Williams, L. Les petites maladies et leur traitement Traduit sur la sixième édition anglaise par F Françon. 8vo Pp. 380. (Paris: Félix Alcan, 1926) 25 francs.

Miscellany

Albanesi, E. Maria. The White in the Black Cr. 8vo. Pp v + 314. (London, Glasgow, Sydney and Auckland: W Collins, Sons and Co., Ltd, 1926.) 7*s*. 6*d* net.*

Bach, C. v. Mein Lebensweg und meine Tätigkeit eine Skizze. 8vo. Pp. vi + 108. (Berlin: Julius Springer, 1926) 5 gold marks.

Bootham School, 1823–1923. Demy 8vo Pp. xix + 207 + 32 plates. (London and Toronto: J. M Dent and Sons, Ltd., 1926.) 7*s* 6*d*. net.

Bouglé, C., et Raffault, J. Éléments de sociologie: textes choisis et ordonnés (Publications du Centre de Documentation sociale.) Med 8vo Pp. viii + 506 (Paris: Félix Alcan, 1926) 30 francs.*

Darmstaedter, Ludwig. Naturforscher und Erfinder: Biographische Miniaturen. Gl. 4to. Pp. vii + 182 + 16 Tafeln. (Bielefeld und Leipzig. Velhagen und Klasing, 1926.)*

Dudeney, Mrs. Henry. Fly Leaves. Cr. 8vo. Pp v + 262 (London, Glasgow, Sydney and Auckland: W. Collins, Sons and Co., Ltd, 1926) 7*s*. 6*d*. net *

Duncanson, David B. Experimental Science for Schools. Parts 1-3. Cr. 8vo. Pp. 263. (London, Calcutta and Sydney: George G. Harrap and Co, Ltd., 1926.) 4*s* 6*d*; Part 1 only, 2*s*.

Helle, Paul, Herausgegeben von. Nachschlagebuch der Nachschlagewerk fur die Wirtschaftspraxis Nebst Anlagen: (i) Verzeichnis wichtiger Wirtschaftszeitschriften aller Lander; (ii) Denkschrift: Das Hamburgische Welt-Wirtschafts-Archiv. Jahrgang 1, 1925 Med. 4to Pp. xii + 98 + 54 + 41 (Hamburg: Verlag Wirtschaftsdienst G m.b.H., 1925) 5 gold marks.*

Industry. The Facts of Industry: the Case for Publicity Demy 8vo Pp. 62. (London: Macmillan and Co., Ltd, 1926.) 1*s*. net.*

Leplay House, Members of Coal; Ways to Reconstruction. Being a Sequel to "The Coal Crisis and the Future." Roy. 8vo Pp. vi + 58. (London: Leplay House Press, 1926.) 2*s*.*

Rawnsley, W. F. Edward Thring, Maker of Uppingham School, Headmaster 1853 to 1887. Cr. 8vo. Pp iv + 103. (London: Kegan Paul and Co., Ltd., 1926.) 3*s*. 6*d* net.*

Spaight, J. M. Aircraft and Commerce in War. Demy 8vo. Pp viii + 111. (London: Longmans, Green and Co., Ltd., 1926.) 6*s* net.*

Stumpf, Carl. Die Sprachlaute: experimentell-phonetische Untersuchungen Nebst einem Anhang über Instrumentalklange. Roy 8vo. Pp. xii + 419. (Berlin Julius Springer, 1926.) 28.50 gold marks *

Thwing, Charles Franklin. The College President. Ex. Cr. 8vo. Pp. x + 345. (New York: The Macmillan Co., 1926.) 10*s*. 6*d*. net.

Tolly, Colin. Knowledge and Dream: and other Poems. Cr. 8vo. Pp. 63. (London: Hodder and Stoughton, Ltd, 1926.) 3*s*. 6*d*. net *

Tuite, Hugh. Mr Dovercourt's Decoy. Cr 8vo. Pp ix + 272. (London, Glasgow, Sydney and Auckland: W. Collins, Sons and Co, Ltd, 1926.) 3*s*. 6*d*. net *

Watson, John M. Science as Revelation. Cr 8vo. Pp. 303 + 7 plates. (New York: The Macmillan Co, 1925.) 10*s*. net *

LEWIS'S
CIRCULATING LIBRARY
of Scientific, Technical, and Medical Books
covering the widest range of subjects, pure and applied.

NEW BOOKS and EDITIONS are added in UNLIMITED SUPPLIES, as long as the demand requires, delay or disappointment thus being prevented.

ANNUAL SUBSCRIPTION (Town or Country) FROM ONE GUINEA according to the number of books required at one time.

Subscriptions may commence from any date.
Books may be retained as long or exchanged as frequently as desired.

The READING AND WRITING ROOM (first floor) is open daily.

Prospectus, with Monthly List of Additions, post free.

H. K. LEWIS & CO. Ltd.,
136 Gower Street, and Gower Place, London, W.C.1.
District Railway: Euston Square Station. All Tube Railways: Warren Street

J. POOLE & CO.
ESTABLISHED 1854
NEW & SECOND-HAND
SCIENTIFIC AND EDUCATIONAL
BOOKSELLERS

ENQUIRIES BY LETTER RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

That Book you want!

Foyles can supply any Scientific Book that is in print and most of those that are out of print. They have a Special Department for this class of literature under a Manager who has experience and knowledge of the Natural Sciences. Call and consult him, or write and you will get an intelligent reply. Books sent on approval. Over a million volumes Second-hand and New on every conceivable subject in stock. Twenty-one Departmental Catalogues issued, any of which will be sent gratis and post free on mentioning interests.

That Book you do not want!

Foyles will buy it.—A single volume to a library.
Expert valuers sent any distance.

FOYLES, 121 Charing Cross Road, London.

CARNEGIE INSTITUTION OF WASHINGTON.

BIOLOGY AND GENETICS.

114. **Castle, W. E. et al.** Studies of Inheritance in Rabbits. Octavo, 70 pp., 3 figs. (1909) $0.75

116. **Reichert, E. T., and A. P. Brown.** The Differentiation and Specificity of Corresponding Proteins and other Vital Substances in Relation to Biological Classification and Organic Evolution: The Crystallography of Hemoglobins. Quarto, 357 pp., 100 pls., 411 figs. (1909) $9.00

121. **Davenport, C. B.** Inheritance of Characteristics in Domestic Fowls. Quarto, 100 pp., 12 pls., 2 figs. (1909) $4.50

122. **Johnson, R. H.** Determinate Evolution in the Color Pattern of the Lady Beetles. Octavo, 110 pp., 92 figs. (1910) $1.50

143. **Lutz, F. E.** Experiments with Drosophila ampelophila, concerning Evolution. Octavo, 43 pp., 53 figs. (1911) $0.50

195. **Castle, W. E., and J. C. Phillips.** Piebald Rats and Selection: An Experimental Test of the Effectiveness of Selection and of the Theory of Gametic Purity in Mendelian Crosses. Octavo, 53 pp., 3 pls. (1914) . $0.75

228. Studies on the Variation, Distribution, and Evolution of the Genus Partula. The Species of the Mariana Islands (Guam and Saipan). Quarto. (1925) . . . $3.75

241. **Castle, W. E. and S. Wright.** Studies in Inheritance in Guinea-Pigs and Rats. Octavo, 198 pp., 7 pls., 7 figs. (1916) $2.50

259. **Davenport, C. B., and Mary F. Scudder.** Naval Officers: Their Heredity and Development. Octavo, 240 pp, 60 charts. (1919) $3.00

278. **Morgan, T. H., C. B. Bridges, and A. H. Sturtevant.** Contributions to the Genetics of Drosophila melanogaster. Octavo, 393 pp, 12 pls., 105 figs. (1919) $7.00

282. **Bartsch, Paul.** Experiments in the Breeding of Cerions. Octavo, 56 pp., 59 pls. (1920) $3.00

295. **Mohr, O. L., and Chr. Wriedt.** A New Type of Hereditary Brachyphalangy in Man. Octavo, 64 pp., 7 pls., 4 figs. (1919) $1.00

320. **Castle, W. E.** Genetic Studies of Rabbits and Rats. Octavo, 55 pp., 2 pls., 7 figs. $1.00

326. **Hall, H. M., and F. E. Clements.** The Phylogenetic Method in Taxonomy: A Monograph of the North American Species of Artemisia, Chrysothamnus and Atriplex. Quarto, 359 pp., 58 pls., 47 figs. (1923) $6.75

327. **Bridges, C. B., and T. H. Morgan.** The Third Chromosome Group of Mutant Characters of Drosophila melanogaster. Octavo, 261 pp., 3 pls., 37 figs. (1923) $3.00

328. **Metz, C. W., M. S. Moses, and E. D. Mason.** Genetic Studies of Drosophila virilis, with considerations of the Genetics of other Species of Drosophila. Octavo, 94 pp., 5 pls., 17 figs. (1923) $1.75

329. **Davenport.** Body-Build and its Inheritance. Octavo, 182 pp., 9 pls., 53 figs. (1924) $2.75

337. **Castle, W. E., H. W. Feldman, and W. H. Gates.** Contributions to a Knowledge of Inheritance in Mammals. Octavo. (1926) . . . . . . Price later.

This book contains the following papers:

Castle, W. E.—Studies of Color Inheritance and of Linkage in Rabbits.

Feldman, H. W.—Fertility and Sterility in the Norway Rat—*Mus norvegicus.*

Gates, W. H.—The Japanese Waltzing Mouse: Its Origin, Heredity, and Relation to the Genetic Characters of other Varieties

CARNEGIE INSTITUTION OF WASHINGTON,
WASHINGTON, D.C.

A SELECTION FROM

MACMILLAN'S BOOKS ON ANTHROPOLOGY.

THE WORSHIP OF NATURE. By SIR JAMES GEORGE FRAZER, O.M., F.R.S., F.B.A. 2 vols. 8vo.

Vol. I. THE WORSHIP OF THE SKY, THE EARTH, AND THE SUN. 25s. net.

THE GOLDEN BOUGH: A STUDY IN MAGIC AND RELIGION. By SIR J. G. FRAZER, O.M., D.C.L., LL.D., &c. Third Edition. 8vo.

PART 1. **The Magic Art and the Evolution of Kings.** Fourth Impression. 2 Vols. 25s. net.

PART 2. **Taboo and the Perils of the Soul.** Third Impression. 1 Vol. 12s. 6d. net.

PART 3. **The Dying God.** 1 Vol. Third Impression. 12s. 6d. net.

PART 4. **Adonis, Attis, Osiris.** Studies in the History of Oriental Religion. 2 Vols. Third Edition. 25s. net.

PART 5. **Spirits of the Corn and of the Wild.** Second Impression. 2 Vols. 25s. net.

PART 6. **The Scapegoat.** 1 Vol. 12s. 6d. net.

PART 7. **Balder the Beautiful: The Fire-Festivals of Europe and the Doctrine of the External Soul.** Second Impression. 2 Vols. 25s. net.

VOL. XII. **Bibliography and General Index.** 25s. net.

ABRIDGED EDITION IN ONE VOLUME. 8vo. 18s. net.

PSYCHE'S TASK. A Discourse concerning the Influence of Superstition on the Growth of Institutions. By SIR J. G. FRAZER, O.M., D.C.L., LL.D., &c. Second Edition, Revised and enlarged, to which is added "The Scope of Social Anthropology." 8vo. 6s. 6d. net.

TOTEMISM AND EXOGAMY. A Treatise on Certain Early Forms of Superstition and Society. By SIR J. G. FRAZER, O.M., D.C.L., LL.D., &c. With Maps. In 4 Vols. 8vo. 50s. net.

FOLK-LORE IN THE OLD TESTAMENT: STUDIES IN COMPARATIVE RELIGION, LEGEND AND LAW. By SIR J. G. FRAZER, O.M., D.C.L., LL.D., &c. 3 Vols. 8vo. 37s. 6d. net.

ABRIDGED EDITION IN ONE VOLUME. 8vo. 18s. net.

THE BELIEF IN IMMORTALITY AND THE WORSHIP OF THE DEAD. By SIR J. G. FRAZER, O.M., D.C.L., LL.D., etc. 8vo.

VOL. I. The Belief among the Aborigines of Australia, the Torres Straits Islands, New Guinea, and Melanesia. 18s. net. VOL. II. The Belief among the Polynesians. 18s. net. VOL. III. The Belief among the Micronesians. 18s. net.

ANCIENT HUNTERS AND THEIR MODERN REPRESENTATIVES. By W. J. SOLLAS, Sc.D., F.R.S., Professor of Geology and Palæontology in the University of Oxford. Third Edition. With 370 Illustrations. 8vo. 25s. net.

BIG GAME AND PYGMIES: EXPERIENCES OF A NATURALIST IN CENTRAL AFRICAN FORESTS IN QUEST OF THE OKAPI. By CUTHBERT CHRISTY, M.B., C.M., F.R.G.S., F.Z.S., etc. With an Introductory Chapter by SIR HARRY H. JOHNSTON, G.C.M.G., K.C.B., and with 120 Illustrations and a Map. 8vo. 21s. net.

SAVAGE LIFE IN CENTRAL AUSTRALIA. By G. HORNE, V.D., M.D., and G. AISTON, Mounted Police of South Australia. Illustrated. 8vo. 18s. net.

NATIVE TRIBES OF THE NORTHERN TERRITORY OF AUSTRALIA. By SIR W. BALDWIN SPENCER, K.C.M.G., F.R.S. Illustrated. 8vo. 25s. net.

LIFE IN SOUTHERN NIGERIA: THE MAGIC, BELIEFS, AND CUSTOMS OF THE IBIBIO TRIBE. By P. AMAURY TALBOT. Illustrated. 8vo. 21s. net.

THE AO NAGA TRIBE OF ASSAM: A STUDY IN ETHNOLOGY AND SOCIOLOGY. By WILLIAM CARLSON SMITH, A.M., Ph.D. With an Introduction by J. H. HUTTON, C.I.E., D.Sc., Honorary Director of Ethnography, Assam. Illustrated. 8vo. 21s. net.

PAGAN RACES OF THE MALAY PENINSULA. By W. W. SKEAT, M.A., and C. O. BLAGDEN, M.A. With numerous Illustrations. 2 Vols. 8vo. 50s. net.

THE HISTORY OF HUMAN MARRIAGE. By EDWARD WESTERMARCK, Ph.D. Fifth Edition, entirely re-written. New and cheaper Impression. 3 vols. 8vo. £3 3s. net.

THE ORIGIN AND DEVELOPMENT OF THE MORAL IDEAS. By EDWARD WESTERMARCK, Ph.D. In 2 Vols. 8vo. 14s. net each.

⁂ ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

ZENITH

REGULATING RESISTANCES

WILL BE FOUND
IN MOST LABORATORIES

COMPETITIVE PRICES—PROMPT DELIVERIES

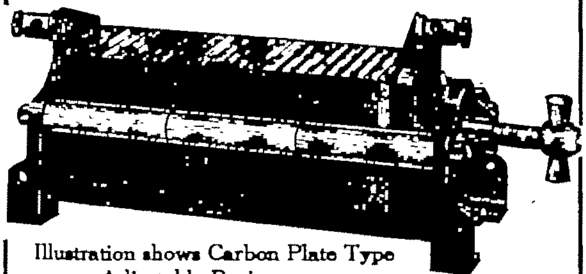


Illustration shows Carbon Plate Type
Adjustable Resistance.

MANY OTHER PATTERNS AVAILABLE.

THE ZENITH MANUFACTURING CO.
(Sole Makers of the "ZENITH" Patterns)
Contractors to the Admiralty, War Office, Air Ministry, Post Office, L.C.C., &c.
ZENITH WORKS, VILLIERS ROAD, WILLESDEN GREEN, LONDON, N.W.2.

THE PRECIOUS METALS
GOLD, PLATINUM, SILVER.

SPINK & SON, LIMITED
(By Appointment)
17-18 PICCADILLY, LONDON, W.1.
Established 158 years.
VALUE, PURCHASE or ASSAY the above in any form.
Parcels can be safely sent by registered post.

"Coolidge"

The tube which gives greatest certainty in X-ray practice

Wherever consistently perfect technique is being achieved in X-ray practice, wherever knowledge is taking the place of guess-work, wherever there is a satisfying certainty of procedure, there you will find the "Coolidge" tube.

The "Coolidge" tube makes success a matter of facts and figures. It gives the operator complete control over his results. It yields a measured quantity of rays of measured intensity.

Moreover, it functions steadily and consistently for hours on end, unfailingly duplicating results whenever a given set of conditions is repeated.

In physical and industrial X-ray work, where accuracy is of the utmost importance, the Coolidge tube is indispensable for the greatest measure of success.

Send for full particulars.
All types in stock.

WATSON & SONS
(ELECTRO-MEDICAL) LTD.
SUNIC HOUSE, PARKER ST.,
KINGSWAY, LONDON, W.C.2.

Telephone: Regent 1227. *Telegrams: "Skiagram, Westcent, London."*

Estab.] STEVENS'S AUCTION ROOMS, LTD. [1760

A SALE by AUCTION is held EVERY FRIDAY, at 12.30, which affords first-class opportunities for the disposal or purchase of SCIENTIFIC, OPTICAL, ELECTRICAL, and WIRELESS APPARATUS, Microscopes and Accessories, Telescopes, Surveying Instruments, Photographic Cameras and Lenses, Cinematographs and Films, Lanterns and Slides, Lathes and Tools, Books and Miscellaneous Property.

Frequent Sales of Natural History and Ethnological Specimens, Curiosities, etc., are also held.

Catalogues and terms for selling will be forwarded on application to 38 King Street, Covent Garden, London, W.C.2.

SCIENTIFIC WORTHIES.

THE FOLLOWING IS A LIST OF THE STEEL AND PHOTOGRAVURE PORTRAITS THAT HAVE APPEARED IN THE ABOVE SERIES:—

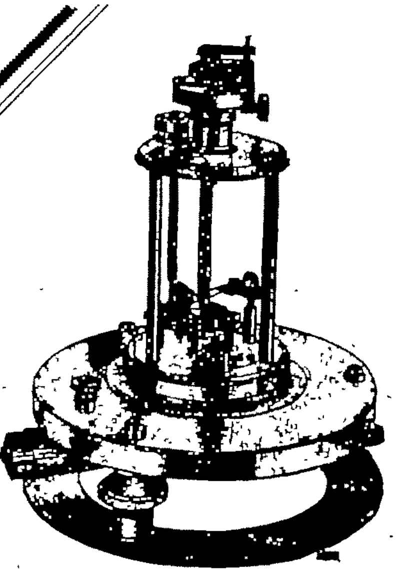
Michael Faraday
Thomas Henry Huxley
Charles Darwin
John Tyndall
Sir George Gabriel Stokes
Sir Charles Lyell
Sir Charles Wheatstone
Sir Wyville Thomson
Robert Wilhelm Bunsen
Lord Kelvin
Baron A. E. Nordenskjöld
Hermann L. F. Helmholtz
Sir Joseph Dalton Hooker
William Harvey
Sir George B. Airy
J. Louis R. Agassiz
Jean Baptiste André Dumas
Sir Richard Owen
James Clerk Maxwell
James Prescott Joule
William Spottiswoode
Arthur Cayley
Sir C. W. Siemens
John Couch Adams
James Joseph Sylvester
Dmitri Ivanowitsh Mendeléeff
Louis Pasteur
Sir Archibald Geikie
Lord Lister
Stanislao Cannizzaro
Von Kölliker
Simon Newcomb
Sir William Huggins
Lord Rayleigh
Eduard Suess
Sir William Crookes
Sir William Ramsay
Dr. A. Russel Wallace
Prof. H. Poincaré
Sir J. J. Thomson
Sir Norman Lockyer
Prof. H. A. Lorentz
Prof. I. P. Pavlov
Prof. A. A. Michelson

Proof Impressions of any of the above, printed on India Paper, may be had from the Publishers, at 5s. each.

Cheques and Money Orders should be made payable to MACMILLAN & CO., Ltd.

OFFICE OF "NATURE," ST. MARTIN'S STREET, LONDON, W.C.2.

COMPTON ELECTROMETER



18 × 18 × 22 cm

This highly sensitive electrometer is based upon the design of Professors A. H. and K. T. Compton. It is of the quadrant form, and is suitable for the quick and accurate measurement of small electric charges and small potential differences. The minimum sensitivity is approx. 3000 mm. per volt per metre when the potential of the needle relative to the quadrants is 45 volts. This can be easily increased to 10,000 mm. per volt, while with careful adjustment considerably higher sensitivities can be obtained. The capacity is about 10 cm.

Further particulars sent on request.

CAMBRIDGE
INSTRUMENT CO LTD
Works:- London & Cambridge
Head Office & Showrooms:- 45, GROSVENOR PLACE LONDON, S.W.1
AMERICAN COMPANY.
Cambridge Instrument Co, Inc, Grand Central Terminal, New York

42

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals. General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connection with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

¶ W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE, will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ CATALOGUE 269. Scientific Books and Publications of learned Societies.

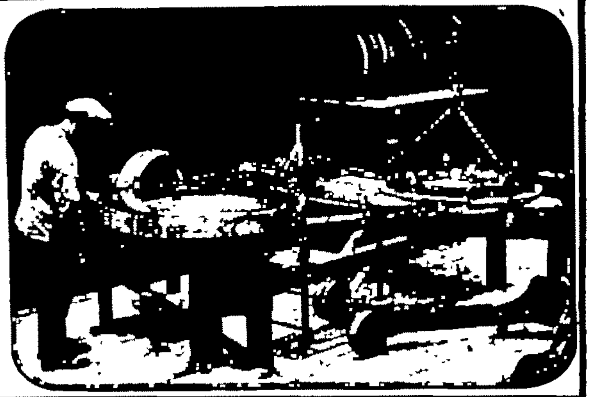
Licensed Valuers for Probate.

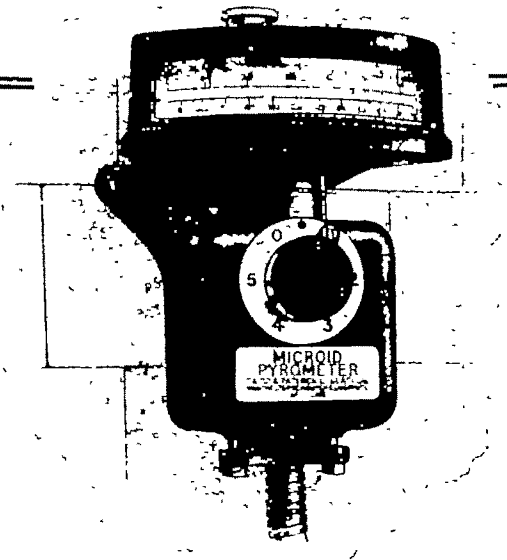
Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone: [illegible] (2 lines).

SIR HOWARD GRUBB, PARSONS
AND COMPANY
ENGINEERS & ASTRONOMICAL
INSTRUMENT MAKERS.

OPTICAL WORKS
WALKER GATE
NEWCASTLE
ON-TYNE

The Illustration shows the Flint Glass Disc of a 41" OBJECT GLASS being edged





PYROMETERS

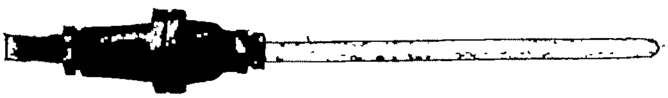
FOR ALL PURPOSES

¶ Microid Pyrometers have recently been completely re-designed. The new models incorporate many improvements arising from long experience of the application of these instruments to industrial and laboratory conditions.

¶ Microid Pyrometers are accurate and robust. Their component parts are standardised and are electrically interchangeable.

Catalogues will be supplied on application. If full particulars of the conditions are stated, expert information as to the most suitable type of outfit will gladly be provided.

BAIRD & TATLOCK, LTD.
(in association with John J. Griffin & Sons, Ltd.)
Kemble Street, Kingsway,
LONDON



MANSFIELD OIL-GAS APPARATUS FOR LABORATORIES.

This plant is designed to provide a gas supply for laboratories which are out of reach of the ordinary town's gas supply.

The gas is made in a simple manner from any heavy oil, such as paraffin, and gives perfect oxidising and reducing flames.

MANSFIELD & SONS, LTD.,
23 HAMILTON SQUARE,
BIRKENHEAD.

ULTRA VIOLET RAYS

WHICH ARE STOPPED BY GLASS PASS THROUGH

WINDOLITE,

The Practical Glass Substitute

for windows in **FACTORIES, SCHOOLS,** and **HOSPITALS;**
for **POULTRY HOUSES, BROODERS,** and **CATTLE SHEDS;**
for all **GARDEN USES.**

Light. Flexible. Unbreakable.
Easy to cut and fix.

Particulars post free, or Sample 3 ft. by 1 ft. for 4/6.

WINDOLITE (Dept. M), 179/185 Great Portland St.,
LONDON, W. 1.

MICROSCOPES—MICROTOMES—DARK GROUND CONDENSERS—PHOTO-MICROGRAPHIC APPARATUS—HÆMATOLOGICAL APPLIANCES—DISSECTING STANDS AND LENSES—MICROSCOPICAL, MEDICAL AND DENTAL ILLUMINATING APPARATUS—MICRO-PROJECTION APPARATUS—EPIDIASCOPES—COLORIMETERS—PRISMATIC FIELD GLASSES—CAMERAS, ETC.

WORKSHOPS

This section of our business has been enlarged and additional machinery installed for the production of new instruments and for optical and mechanical repairs of all kinds. Our men are highly skilled mechanics of long experience and, under expert supervision, producing results of the highest possible quality.

OGILVY & CO.
Optical Engineers
20 Mortimer Street, London, W.1

THE UNIVERSITY OF LIVERPOOL.

DEPARTMENT OF INDUSTRIAL CHEMISTRY.

(Oils, Fats and Waxes.)

Campbell Brown Professor—T. P. HILDITCH, D.Sc.

This newly-established Department provides facilities for post-graduation students to undertake, and to receive training in, research in the field of oils, fats and waxes and subjects connected therewith.

The NEXT SESSION COMMENCES on OCTOBER 7, 1926, and Prospectuses and details as to fees may be obtained on application to the REGISTRAR, The University of Liverpool.

EDWARD CAREY, Registrar.

UNIVERSITY OF MANCHESTER.

PHYSICS DEPARTMENT.

Full particulars of the Lectures and Laboratory Courses in Physics, preparing for both the Ordinary and the Honours Degrees, will be forwarded on application to the REGISTRAR.

APPOINTMENTS BOARD OF THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY,

SOUTH KENSINGTON, S.W.7.

EMPLOYERS requiring men who have received training in Science and Technology, and who are Diplomates or Associates of the College, are asked to make use of the services of the Board. Applications should be addressed to the SECRETARY No fees are charged.

The Imperial College includes the Royal College of Science, the Royal School of Mines, and the City and Guilds (Engineering) College. Members and Associates are trained in the following: viz: Aeronautics, Applied Optics and Optical Engineering, Biology, Chemical Technology, Chemistry (all branches), Engineering (all branches, including Metallurgy, Mining, Mining Geology, and Oil Technology), Geology, Mathematics and Mechanics, and Physics.

MINISTRY OF AGRICULTURE AND FISHERIES.

Applications are invited for an appointment as ASSISTANT (Museums) at the Royal Botanic Gardens, Kew. Salary: Male Assistant £250 per annum, rising to a maximum of £600 per annum; Female Assistant £200 per annum, rising to a maximum of £450 per annum, plus Civil Service Bonus in each case. The bonus as from September 1, 1926, on £250 is £111 : 3s. per annum, and on £200, £99 per annum.

Candidates should be Honours graduates of British Universities and have had, since graduating, at least two years' experience especially of work in Economic Botany or of research work in one or more of the following botanical subjects.—Morphology, Ecology, Genetics, Systematic Botany. Candidates must also produce evidence of ability to translate from French and German

Candidates must be between the ages of 25 and 32 on October 4, 1926, except that they may deduct from their actual age any time during which they served in His Majesty's Forces during the late war. Preference will be given to ex-Service applicants.

No application will be considered unless it has been received by the Ministry of Agriculture and Fisheries on the prescribed form on or before October 4, 1926. Forms of application and copies of the Regulations can be obtained from the SECRETARY, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

A EUROPEAN SCIENCE MASTER is required for the Agricultural School at Moor Plantation, Ibadan, Nigeria. Candidates should be of good health, between 25 and 35 years of age, and should possess the Teaching Certificate of the Board of Education or the Scottish Education Department. They should be able to teach Mathematics, Chemistry, Physics and Botany to about Junior Local standard. Ability to teach elementary Surveying would be an additional qualification. Further information and forms of application are obtainable from the SECRETARY, C.A. (N.), Board of Education, Whitehall, London, S.W.1. Scottish candidates should apply to the SECRETARY, Scottish Education Department, S E.D. (N), Whitehall, London, S.W.1. List of applications closes September 27.

UNIVERSITY COLLEGE, NOTTINGHAM.

DEPARTMENT OF MATHEMATICS.

The Council invites applications for the position of LECTURER IN MATHEMATICS; candidates to have an Honours Degree. Further particulars and form of application, which must be returned not later than Tuesday, September 14, may be obtained from J. E. SHIMELD, Registrar.

UNION OF SOUTH AFRICA.

WITWATERSRAND TECHNICAL INSTITUTE.

Applications are invited for the vacancy for the HEAD OF THE DEPARTMENT OF CHEMISTRY.

SALARY.—Salary £450-£25-£650, plus Local Allowance, which, in the case of married officers, brings the total emoluments from £516 to £726 The initial salary will be fixed according to the existing salary, qualifications and experience of the successful applicant.

ENGAGEMENT.—The appointment will be made subject to the conditions of service laid down in the Union Higher Education Act, 1923, which may be inspected in this office.

QUALIFICATIONS.—Applicants must be qualified chemists, and the possession of qualifications of the Pharmaceutical Society of Great Britain and knowledge of Metallurgy would be a recommendation. The possession of degrees or equivalent professional qualifications and/or teaching and practical experience will be considered in making the appointment

DUTIES.—The post is a full-time one and includes both day and evening work, and the successful applicant will be required to take charge of the School of Pharmacy in addition to undertaking lectures in various branches of Chemistry.

Applications and copies of testimonials containing information as to the particulars of training, experience and present salary should be lodged with the SECRETARY, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C.2, from whom the prescribed forms of application may be obtained, not later than September 30.

UNIVERSITY OF DURHAM

(ARMSTRONG COLLEGE),

NEWCASTLE-UPON-TYNE.

ADVISER IN AGRICULTURAL CHEMISTRY.

The Council of Armstrong College invites applications for the above post, under Grade III. of the advisory scheme of the Ministry of Agriculture and Fisheries. Salary £300 per annum plus Bonus. Appointment to date from January 1, 1927.

Ten copies of applications and of not more than three testimonials should be lodged, not later than October 1, 1926, with the undersigned, from whom further particulars may be obtained.

J. Y. T. GREIG, Registrar,
Armstrong College.

BIRKBECK COLLEGE

(UNIVERSITY OF LONDON).

The Governors invite applications for a PART-TIME LECTURESHIP in the Department of Mathematics. Salary £300 per annum. Further particulars and forms of application, which must be returned not later than the first post on Friday, September 17, 1926, may be obtained from the SECRETARY, Birkbeck College, Breams Buildings, Fetter Lane, E.C 4.

THE NATIONAL INSTITUTE OF POULTRY HUSBANDRY.

APPOINTMENT OF DIRECTOR.

Applications are invited for the above post. Scientific training and practical experience essential.

Particulars on application to the PRINCIPAL, Harper Adams Agricultural College, Newport, Shropshire.

August 28, 1926.

PARTNERSHIP.—Wanted, Analytical Chemist with capital, as active working partner in established London laboratory Another practice could be amalgamated therewith. Write "Z.T.589," c/o DEACONS, Fenchurch Avenue, E.C.3.

TRANSLATIONS of Scientific Subjects, from German, French, Russian and Polish, also Science literature research, at moderate prices. Box 4, c/o NATURE Office.

B.Sc., 1st class honours Botany (Mycology), subsidiary Chemistry, a years' research experience, desires post. Will accept a small salary. Box 151, c/o NATURE Office.

A. P. THURSTON, D^r.Sc., F.R.Ae.S.,

Patent Agent, 329 HIGH HOLBORN, W.C.1.

Phone: Holborn 2542. Patents, Trade Marks and Designs.

KING'S PATENT AGENCY LTD., 146a Queen Victoria Street, E.C.4. Advice handbook free. 40 years' refs.

SPECIAL RESEARCH CHEMICALS 1926

An enlarged List of BOOTS' RESEARCH CHEMICALS has been prepared because of the rapid expansion of this important side of our activities.

More than 1000 Chemicals are included, and over 80% of them are made in our own laboratories.

Letters of appreciation received, and the extension of our business, indicate that the guaranteed purity of our products has become widely known.

FOR NEW LIST WRITE TO WHOLESALE SALES DEPARTMENT

BOOTS PURE DRUG COMPANY LIMITED

Manufacturing Chemists and
Makers of Fine Chemicals

NOTTINGHAM

Telephone : 7000 Nottingham.
Telegrams : "Drug," Nottingham.

POCKET CALCULATOR

"accuracy is about four times that of the ordinary ten-inch slide rule . . ."

writes a B.Sc., from Canada. This unsolicited letter goes on to state : "My estimate is that I have made about fifty thousand calculations with your product. About twenty-two thousand hydraulic calculations have been made in the last month with a probable error of any one calculation not greater than 5/100 of 1%."

Otis King Model K for multiplication, division, proportion, percentages. Model L gives, in addition, all powers and roots—fractional or otherwise—of all numbers without limit.

Price, packed in leather case, 21/- (special Black Cursor 1/6 extra), post free within U.K.

Write for illustrated and fully descriptive folder.

CARBIC LIMITED

(Dept. N), 61 Holborn Viaduct, London, E.C.1.

Agents in most Dominions and Foreign Countries.

"POSTLIP"
(No. 633 Mill)
ENGLISH FILTER PAPERS

Manufactured in
ANNUALLY INCREASING QUANTITIES
for upwards of 50 years.

White and Grey Plain, Antique, Crinkled, and Embossed.

All sizes in Squares, Circles, and Folded Filters. Rolls made to order.

Pure Filterings for Laboratory Work and in quantities for all industrial purposes.

See Report of TESTS made by The National Physical Laboratory, a copy of which will be sent on application, together with free samples if required.

EVANS, ADLARD & CO., LTD.
POSTLIP MILLS,
WINCHCOMBE, CHELTENHAM, ENGLAND.

Now ready. **Third Edition.**

A TEXT-BOOK OF

EXPERIMENTAL PSYCHOLOGY

By CHARLES S. MYERS, M.A., M.D., Sc D., F.R.S.,
and F. C. BARTLETT, M.A.

In two parts. **Price 16s net.**

The two parts are also sold seperately:—Part I, Text-book, **10s 6d** net; Part II, Laboratory Exercises With 40 Figures and Diagrams, **7s** net.

"The edition just issued is probably the most complete text-book of experimental psychology in this or any other language. Every page is loaded with trustworthy statements of verified fact, yet the argumentation is so well ordered, and the style so concise and clear, that the book can be read with ease and pleasure"

Nature on the Second Edition.

Prospectus on application.

CAMBRIDGE UNIVERSITY PRESS
Fetter Lane, London, E.C.4

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals, General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."

NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

MAN **An illustrated monthly record of Anthropological Science, 2s. net per part, 20s. a year, post free anywhere.**

CONTENTS OF SEPTEMBER ISSUE.

ORIGINAL ARTICLES: Some Factors in Racial Immunity and Susceptibility to Disease. (*Illustrated*)—Analyses of Bronze Implements and Foundry Metal.—Traces of the Aryans on the Middle Danube. (*With Plate K.*)—Remarks on a South-East European Ceramic Type. (*Illustrated.*)—Father, Mother, Child.—Variations and Mutations in Invention.—REVIEWS.

THE ROYAL ANTHROPOLOGICAL INSTITUTE,
52 Upper Bedford Place, Russell Square, London, W.C.1

THE PRECIOUS METALS
GOLD, PLATINUM, SILVER.

SPINK & SON, LIMITED
(By Appointment)
17-18 PICCADILLY, LONDON, W.1.
Established 153 years.

VALUE, PURCHASE or ASSAY the above in any form.

Parcels can be safely sent by registered post.

OXYGEN

And other Gases.

The British Oxygen Co. have works for the production of Oxygen, Nitrogen, Carbonic Acid, Nitrous Oxide, Hydrogen, and Argon in all chief industrial centres. The Company's Plants are capable of an aggregate output of **about four million cubic feet per day.**

Special Terms quoted to the Trade.

Catalogue and full particulars on application to the Head Offices of the Company—

THE BRITISH OXYGEN CO., Ltd.,
ANGEL ROAD, UPPER EDMONTON,
LONDON, N.18.

ADLARD & SON
& WEST NEWMAN
LIMITED

IT 66
A & S

SCIENCE PRINTERS.

Home and Export.

23 Bartholomew Close, London, E.C.1.

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

GERMAN BOOKS
AND PERIODICALS
supplied by
W. MULLER, Foreign Bookseller,
26 Hart Street, Bloomsbury, London, W.C.1
References in all countries.

NATURAL SCIENCE
BOOKS AND PERIODICALS
INCLUDING THE PUBLICATIONS
OF THE LEARNED SOCIETIES
CATALOGUES GRATIS **LIBRARIES PURCHASED**
BERNARD QUARITCH LTD.
11 Grafton Street, New Bond Street, London, W.1

GENERAL DISCUSSIONS OF THE FARADAY SOCIETY.

A list of REPRINTS available can be obtained from Messrs. GURNEY & JACKSON, 33 Paternoster Row, London, E.C.4, Official Publishers to the Society. Information relating to the Society may be obtained from the SECRETARY, 90 Great Russell Street, London, W.C.1.

W. OTTWAY & Co. Ltd.
(Established 1640)

Actual Makers of Astronomical and Terrestrial Telescopes

STAINLESS STEEL MIRRORS AND FLATS

for Reflector Telescopes; no silvering required. A permanent highly polished surface guaranteed.

Surplus stock of 1¼" and 2", 90 degree **REFLECTING PRISMS** made from the best Optical glass flat surfaces; guaranteed highest quality. 1¼", **£1 5 0.** 2", **£1 15 0.**

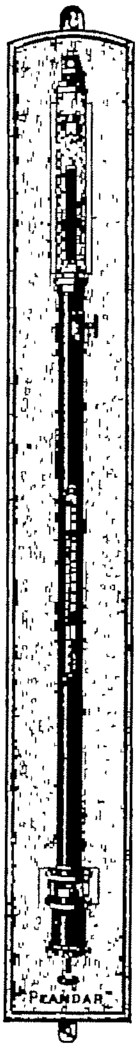
All types of **Astronomical Telescopes, Eyepieces, Equatorial Mountings, etc.** Pamphlets post free on application.

Orion Works, Ealing, London, W.5.

The Subscription and Advertisement Rates of NATURE are to be found on p. lxxix of the present issue.

THE IMPROVED "PEANDAR FORTINETTE" STANDARD BAROMETER

This Barometer has been designed to meet the requirements of **Chemical Laboratories, Gas Works, Private Observers, Colleges, etc.**, for an instrument giving **exact readings** at a moderate cost. The Frame, which is made of solid drawn brass tube, is enamelled black and finished in the very best manner, and is mounted on a polished oak board, with brackets for adjustment, and opal glass reflectors behind the scales and glass cistern. Each instrument is engraved **The Improved "Peandar Fortinette" Standard Barometer.**



BORE OF TUBE - ·25-inch

The **Scales** are engine-divided, and engraved on the brass body to ·05 inch and 1 millimetre, and read by the verniers to **·002 inch** and **·05 mm.**, and are protected by an air-tight glass cover.

The **Thermometer** has both Fahrenheit and Centigrade scales, and is protected by a metal frame.

Price, complete as illustrated,

£7 7 0

National Physical Laboratory Certificate - £2 2 0 extra.
Sent **Carriage Paid**, and safe delivery guaranteed, within the British Isles.

SOLE MAKERS **PASTORELLI & RAPKIN LTD.**
46 HATTON GARDEN, LONDON, E.C.1

Actual **Manufacturers** of **Barometers, Thermometers, Hygrometers, Barographs, Thermographs, Hygrographs, Rain Gauges, Hydrometers, etc.**

PRICE LISTS POST FREE ON APPLICATION.

Any instrument sent on approval if desired.

Telegrams—"Rapkin. London." ESTABLISHED 1750. Telephone—Holborn 1981.

MACMILLAN'S NEW AND RECENT BOOKS.

ICE AGES, RECENT AND ANCIENT. By A. P. COLEMAN, M.A., Ph.D., F.R.S., Emeritus Professor of Geology, University of Toronto. With Illustrations and Maps. 8vo. 17s. net.

THE TIMES LITERARY SUPPLEMENT.—"Never before has such an array of glacial evidence been so skilfully mustered and marshalled. At last scientific workers have before them a graphic, succinct, and inspiring account of those wonderful vicissitudes of climate through which the world has passed since the dawn of its geological history—changes which have so profoundly influenced its scenery, and so greatly controlled the development and distribution of its plant and animal, including human, life."

CRYSTALLINE FORM AND CHEMICAL CONSTITUTION. By A. E. H. TUTTON, D.Sc., M.A.(Oxon), F.R.S., Past President of the Mineralogical Society, London; Author of "Crystallography and Practical Crystal Measurement." With 72 Illustrations. 8vo. 10s. 6d. net.

THE JOURNAL OF EDUCATION.—"A book for which the only adjective seems to be 'enthralling.' . . . The teacher who buys this book for his school science library will probably end by keeping it for himself."

THE FAMILIES OF FLOWERING PLANTS. I. DICOTYLEDONS. Arranged according to a New System based on their Probable Phylogeny. By J. HUTCHINSON, F.L.S., Assistant in the Herbarium, Royal Botanic Gardens, Kew. With Illustrations by W. E. TREVITHICK and the Author. 8vo. 20s. net. KEY TO THE FAMILIES OF THE DICOTYLEDONS. Reprinted from "The Families of Flowering Plants." 8vo. Manilla Cover. 2s. net.

THE PHYSIOLOGY OF THE CONTINUITY OF LIFE. By D. NOËL PATON, M.D., B.Sc., LL.D., F.R.S., Regius Professor of Physiology, University of Glasgow. With Illustrations. 8vo. 12s. net.

EVOLUTION. By J. GRAHAM KERR, F.R.S., Regius Professor of Zoology in the University of Glasgow. With 2 Plates in colour and 53 Illustrations in the Text. 8vo. 12s. net.

CONTEMPORARY REVIEW.—"Professor Graham Kerr has a charming prose style; he is a practical field naturalist of immense experience; he knows his own mind, and is not afraid to express quite bluntly his own views. He restates the Darwinian doctrine of natural selection, reinforced by Mendel's principles of heredity, by the insistence on the utility of particular characteristics amongst animals living freely, and by modern advances in physiological knowledge, with great power."

AN INTRODUCTION TO THE THEORY OF INFINITE SERIES. By T. J. I'a. BROMWICH, M.A., Sc.D., F.R.S., Fellow and Lecturer of St. John's College, Cambridge. Second Edition Revised with the assistance of T. M. MACROBERT, D.Sc., Lecturer in Mathematics in the University of Glasgow. 8vo. 30s. net.

NATURE.—"Not only to the mathematician is the book indispensable; it is also the best possible guide to any one who encounters mathematical analysis in his work. The second edition will increase the very high reputation gained by the first."

HIGHER MATHEMATICS FOR STUDENTS OF ENGINEERING AND SCIENCE. By FREDERICK G. W. BROWN, M.Sc.(London), F.C.P., Senior Mathematical Master, West Ham Secondary School. Crown 8vo. 10s.

EDUCATION.—"Everything in the book is well done. It shows that the author is a mathematical enthusiast and is bent on teaching mathematics in the proper way. . . . Mr. Brown has compiled a book that will be of inestimable service to many a teacher."

INTERMEDIATE MATHEMATICS (Analysis). By T. S. USHERWOOD, B.Sc., Wh.Ex., A.M.I.Mech.E., and C. J. A. TRIMBLE, M.A. Crown 8vo. 7s. 6d.

NATURE.—"The authors of this text-book on mathematics to the intermediate degree standard have already established a reputation by their previous works which is fully maintained in the present. The book is well planned."

⁂ ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

Trustees: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Prof. A. C. Seward, Sc.D., F.R.S., Prof. R. S. Conway, Litt.D., F.B.A.

A *free* specimen copy of "Discovery" will be sent to anyone on request.

Contents of the September issue include:

WATER MITES. By Sir Arthur Shipley, G.B.E., F.R.S.

THE SLUG PEST: ITS PROBLEMS AND EXTERMINATION. By T. H. Taylor, M.A.

SULPHUR BACTERIA AND WATER POLLUTION. By Prof. David Ellis, D.Sc.

COMPOSITION OF THE UPPER AIR. By C. Britton, B.Sc.

Copies of the special July *Empire University Number* and the August *British Association Number*, to which Sir Oliver Lodge contributed, can still be obtained, each 1s. 2d. post free.

Illustrated. 1s. Monthly.
Annual Subscription 12s. 6d. post free.

BENN BROTHERS LTD.
154 Fleet Street, London, E.C.4

ANNOUNCEMENT.

Volume VIII. of *The Journal of General Physiology* will be a memorial to its founder, Dr. Jacques Loeb. This volume will contain papers by Dr. Loeb's pupils and his associates, together with a portrait and a sketch of his life. The volume will appear simultaneously with Volume IX. The publication of this volume began September 18, 1925.

Subscribers to the Journal, and others, may obtain the extra volume by sending their subscriptions (price $5.00) to

THE JOURNAL OF GENERAL PHYSIOLOGY,
AVENUE A AND 66TH ST., NEW YORK, N.Y.

ANNOUNCEMENT OF THE CONTENTS OF THE SEPTEMBER NUMBER OF THE

PHILOSOPHICAL MAGAZINE AND JOURNAL OF SCIENCE

Conducted by Sir OLIVER JOSEPH LODGE, D.Sc., LL.D., F.R.S.; Sir JOSEPH JOHN THOMSON, O.M., M.A., Sc.D., F.R.S.; JOHN JOLY, M.A., D.Sc., F.R.S., F.G.S.; RICHARD TAUNTON FRANCIS F.R.S.E.; and WILLIAM FRANCIS, F.L.S.

DOUBLE NUMBER. (254 *pages.*) *Price* ***10s. 6d.***

On the Condenser-Telephone. By G. Green, D.Sc.
Note on the High Frequency Oscillatory Discharge in Rarefied Gas. By R. C. Richards, M.Sc. (Plate VIII.)
On the Theory of the Absorption of X-Rays. By Dr. R. A. Houstoun.
The Magnetic Stability of Permanent Magnets. By Robert Cochrane Gray, M.A., D.Sc.
Absorption and Resonance Radiation in Excited Helium and the Structure of the 3889 Line. By W. H. McCurdy, Ph.D. (Plate IX.)
On the Determination of the Velocity Constant of a Unimolecular Reaction. By E. A. Guggenheim.
The Basis of Acoustic Measurements by Reverberation Methods. By A. H. Davis, D.Sc.
On the Effect of the Shape of the Cathode on the Glow Discharge. By W. Stephenson, M.Sc.
The Milner and Debye Theories of Strong Electrolytes. By George Scatchard.
The Milner and Debye Theories of Strong Electrolytes. By G. Nonhebel, B.A., and H. Hartley, M.A.
On a Geometrical Presentment of the Constants of an Elastic Material. By R. F. Gwyther, M.A.
Intensity Variations in the Spectrum of Neon. By Mary R. Johnson, M.Sc., and R. C. Johnson, B.A., Ph.D. (Plate X.)
Note on the Structure of Cadmium and Zinc Resonance Lines. By Prof. R. W. Wood. (Plate XI.)
The Fine Structure of Certain Lines and Energy Levels of Cadmium. By W. A. MacNair. (Plate XII.)
Note on some Observations of the Nitrogen Afterglow Spectra. By R. C. Johnson, B.A., Ph.D., and H. G. Jenkins, B.Sc.
On the Arc Spectrum of Lead. By Nalini Kanta Sur, M.Sc.
Scattered X-Rays. The J Phenomenon (Part IV.). By Prof. C. G. Barkla, F.R.S., and Dr. S. R. Khastgir.
The Compton Effect and the Reflexion of X-Rays by Crystals. By E. J. Williams, M.Sc.
Radiation produced by the Passage of Electricity through Gases. By Sir J. J. Thomson, O.M., F.R.S.
On Electric Double Refraction in Colloids. By Yngve Björnståhl. (Plate XIII.)
An Oscillographic Study of Anodic Polarization. By V. H. L. Searle, M.Sc.
A New Method of obtaining a Luminous Discharge in Gases at very Low Pressures. By Dr. F. Kirchner.
A New Method of obtaining a Luminous Discharge in Gases at very Low Pressures. By E. W. Gill and R. H. Donaldson.
The Water-Spark Absorption Spectrum of Iron. By A. K. Sur.
A New Method of producing a Discharge in Hydrogen. By R. Winstanley Lunt, M.Sc., Ph.D.
Proceedings of the Geological Society

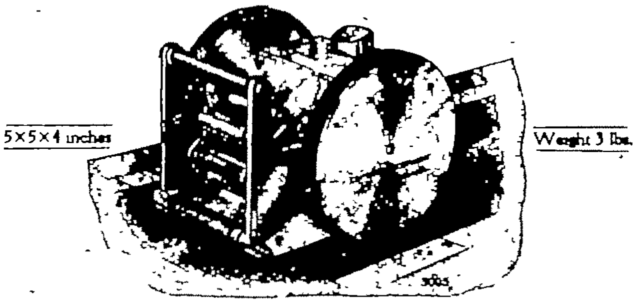
With 6 Plates and numerous Illustrations in the Text.

Subscription for 1926, £4, including six double numbers, post free to any part of the world. Any double numbers issued beyond six charged extra.

FOR BACK NUMBERS APPLY TO THE PUBLISHERS:

TAYLOR & FRANCIS,
Red Lion Court, Fleet Street, London, E.C.4

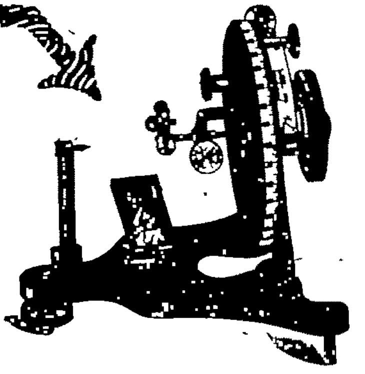
COTTON FIBRE ANALYSIS
is easily and quickly made with a
CAMBRIDGE COTTON SORTER



This instrument, designed by Dr. W. Lawrence Balls, analyses a sample of cotton fibres by distributing them on a collecting surface in order of their individual lengths: qualitative comparisons can then be made. A full description of the Cotton Sorter is given in List No. 138-N, which will be sent on request.

CAMBRIDGE
INSTRUMENT CO LTD
WORKS:- LONDON & CAMBRIDGE
Head Office & Showrooms:- 45, GROSVENOR PLACE LONDON, S.W.1
AMERICAN COMPANY:
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

93



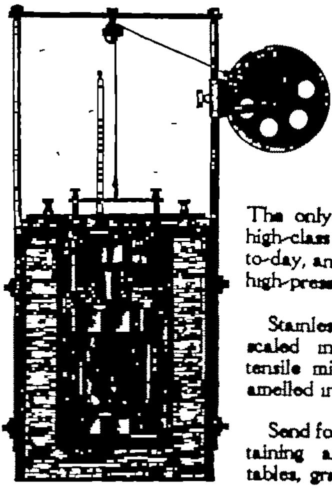
Constructed to the design of Dr. G. F. Herbert Smith, of the Mineral Department of the British Museum, and embodying many improvements over existing types.

THE STUDENT'S
GONIOMETER

The mirror is adjustable in any direction. The crystal holder and attachments facilitate the measurements of the crystal without readjustment, and a removable pointer is provided to ensure the adjustment into the axial line. The graduated circle of 5 inches (12·5 cm.) in diameter is fitted with a clamp and fine adjustment, and the silvered scale is divided to half degrees, reading by vernier to minutes of arc. £9 10 0

J. H. STEWARD, Ltd.
Scientific Instrument Makers to the British and Foreign Governments,
406 and 457 Strand, London, W.C.2.
Established 1852.

THE
MAHLER-COOK
BOMB CALORIMETER



For determining the calorific value of Fuels (Coal, Coke, Oils, etc.).

The original Bomb Calorimeter, used all over the World and first introduced by the present makers in 1900. The only reliable, accurate, and high-class apparatus on the market to-day, and made by Engineers and high-pressure experts.

Stainless steel Bombs with descaled internal finish, or high tensile mild steel Bombs with enamelled interior.

Send for Illustrated Booklet containing all working instructions, tables, graphs, etc.

High Pressure Apparatus, Centrifuges, Microtomes, Electroscopes, Steam Meters, Electric Furnaces, etc.

CHAS. W. COOK & SONS,
ROYAL HOTEL WORKS,
ASHBY-DE-LA-ZOUCH, LEICS.
LONDON STOCKISTS: Messrs. Baird & Tatlock (London) Ltd., Cross Street, Hatton Garden, E.C.1.

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

J. & A. CHURCHILL

2 Volumes. 72 Illustrations. £2 : 2s. net. Postage 1s.

THE ATMOSPHERIC NITROGEN INDUSTRY

WITH SPECIAL CONSIDERATION OF THE PRODUCTION OF AMMONIA AND NITRIC ACID

By DR. BRUNO WAESER. Translated by ERNEST FYLEMAN, B.Sc., Ph.D., F.I.C.

With a FOREWORD by J. F. CROWLEY, D.Sc., B.A., M.I.E.E.

---

50 Illustrations. 10s. 6d. net. Postage 6d.

CHEMISTRY OF THE PROTEINS AND ITS ECONOMIC APPLICATIONS

By DOROTHY JORDAN LLOYD, M.A., D.Sc., F.I.C. INTRODUCTION by SIR F. G. HOPKINS, F.R.S.

---

42 Illustrations. 15s. net. Postage 6d.

THE PREPARATION AND ANALYSIS OF ORGANIC COMPOUNDS

By J. BERNARD COLEMAN, A R.C.Sc., F.I.C., F.C.S., and FRANCIS ARNALL, Ph.D., M.Sc., F.I.C.,
Lecturer in Chemistry, Chelsea Polytechnic, London.

Nearly Ready. PART I.

ARNALL AND HODGES' THEORETICAL ORGANIC CHEMISTRY

---

38 Illustrations. 12s. 6d. net. Postage 6d.

RECENT ADVANCES IN BIOCHEMISTRY

By J. PRYDE, B.Sc., M.Sc., Lecturer in Physiological Chemistry, Welsh National School of Medicine.

DREAPER'S TEXT-BOOKS OF CHEMICAL RESEARCH AND ENGINEERING

GIBBS' CLOUDS AND SMOKES. 10s. 6d. net.

CLAYTON'S THEORY OF EMULSIONS AND EMULSIFICATION. 22 Illus. 9s. 6d. net. Post 4d.

CROWTHER'S MOLECULAR PHYSICS AND THE STRUCTURE OF THE ATOM. 3rd Ed. 7s. 6d. net.

DREAPER'S CHEMICAL RESEARCH. 2nd Ed. 7s. 6d net. Post 5d

JOBLING'S CATALYSIS AND ITS INDUSTRIAL APPLICATIONS. 2nd Ed. 12 Illus. 7s. 6d. net. Post 5d

MAXTED'S CATALYTIC HYDROGENATION AND REDUCTION. 12 Illus. 5s. net Post. 5d.

WILLOWS & HATSCHEK'S SURFACE TENSION AND SURFACE ENERGY. 3rd Ed. 25 Illus 6s 6d net.

HATSCHEK'S INTRO. TO THE PHYSICS AND CHEMISTRY OF COLLOIDS. *See below.*

BRODETSKY'S MECHANICAL PRINCIPLES OF THE AEROPLANE. 119 Illus. 21s. net Post. 6d.

HALE'S SYNTHETIC USE OF METALS IN ORGANIC CHEMISTRY. 6s. net Post. 4d.

JOHNSON'S ANALYST'S LABORATORY COMPANION. 5th Ed 10s. 6d. net. Post 4d.

SVEDBERG'S FORMATION OF COLLOIDS. 22 Illus 7s. 6d. net. Post. 4d.

SPEAR'S JUNIOR INORGANIC CHEMISTRY. 92 Illus 6s. 6d. net. Post 6d Also separately Part I.—UP TO ATOMIC THEORY. 46 Illus 3s. 6d. net. Post 3d

WILEY'S WORKS ON FOODS AND DRINKS

Foods and their Adulteration. 3rd Ed. 11 Coloured Plates, 87 Text-figures. 27s. net. Post. 9d.

Beverages and their Adulteration. With 42 Illus. 21s. net. Post. 9d.

---

55 Illustrations. 9s. 6d. net. Postage 6d.

GASWORKS LABORATORY HANDBOOK

By W. I. INESON, Chief Chemist, Bradford Corporation Gas Department, Lecturer in Gas Engineering and Gas Supply, Technical College, Bradford.

Revised New Edition, the 11th. 120 Illustrations. 35s. net. Postage 9d.

SUTTON'S VOLUMETRIC ANALYSIS

By W. L. SUTTON, F.I.C., etc., and A. E. JOHNSON, B.Sc.(Lond.), F.I.C., A.R.C.Sc.I., etc.

2nd Edition. 21 Illustrations. 7s 6d. net. Postage 3d.

HATSCHEK'S LABORATORY MANUAL OF ELEMENTARY COLLOID CHEMISTRY

"*The second revised edition is assured of a wide welcome. . . . Thoroughly practical from the first page to the last, Mr. Hatschek's manual can confidently be recommended to both teacher and student.*"—CHEMICAL TRADE JOURNAL.

5th Edition 22 Illustrations 7s. 6d net Postage 3d.

HATSCHEK'S INTRODUCTION TO THE PHYSICS AND CHEMISTRY OF COLLOIDS

"*All chemists should have a sound general idea of where modern knowledge of colloids really stands. In the acquirement of such a sound grounding in fundamentals we can suggest no better method than the study of Mr Hatschek's book.*"—CHEMICAL TRADE JOURNAL.

---

81 Illustrations. 7s. 6d. net. Postage 4d.

PRACTICAL PHARMACOGNOSY

⁂ ***Deals with the characteristics, identification and purity of crude drugs.***

By T. E WALLIS, B.Sc., F I.C., Ph.C , Lecturer in Botany to the Pharmaceutical Society of Great Britain.
INTRODUCTION by PROFESSOR H. G. GREENISH, D ès C., F.I.C., F.L.S.

---

70 Illustrations. 18s. net. Postage 6d.

DAIRY BACTERIOLOGY

Including the Cleaning, Procurement, Preservation, Grading, and Microflora of Milk Chapters on BUTTER and CHEESE.

By PROF. ORLA JENSEN, D.Ph. Translated by P. S. ARUP, B.Sc., Chief Chemist, English Margarine Works (1919), Ltd.

London : J. & A. CHURCHILL, 7 Great Marlborough Street, W.1

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE.

DIVISION OF TROPICAL MEDICINE AND HYGIENE (UNIVERSITY OF LONDON).

Director—ANDREW BALFOUR, C.B., C.M.G., LL.D., M.D., D.P.H.

The School is open to fully qualified Medical Practitioners. Other applicants may be admitted in special circumstances.

There are two Courses of Study in each academic year, commencing in October and March respectively. Each Course lasts for 20 weeks inclusive of examinations. Certificates are granted to successful students in the School Examinations.

The Course consists of Laboratory and Clinical Work, Hygiene, and other Lectures and Demonstrations. It covers the work required for the D.T.M. & H.(Eng.), and part of that required for the M.D. in Tropical Medicine of the University of London.

Special Courses are held from time to time.

Four Research Studentships, each of the value of £250 per annum, and a Wandsworth Scholarship of £370 per annum, are available.

Full details are given in the Prospectus and Calendar, which may be obtained on application to the SECRETARY of the School, 23 Endsleigh Gardens, Euston Road, W.C.1.

BATTERSEA POLYTECHNIC,

LONDON, S.W.11.

Principal—ROBERT H. PICKARD, D.Sc., F.R.S.

Head of Chemistry Department—JOSEPH KENYON, D.Sc., F.I.C.

CHEMICAL ENGINEERING.

H. GRIFFITHS, B.Sc., A.R.C.S., M.I.Chem.E.,
and H. HUNTER, D.Sc., F.I.C., A.Inst.P.

(September to Easter—50 meetings.)

Lectures—Monday, 7.15 to 9.30 P.M.

Laboratory—Friday, 7 to 9.45 P.M.

Course commences on September 27, 1926.

Fee 20s. for London, Kent, or Middlesex students.

The Course is suitable for Science Graduates and persons with works experience. The syllabus is made to depend on the requirements and experience of the students, and the facilities include access to a semi-scale laboratory.

Particulars of all classes gratis on application to the PRINCIPAL.

UNION OF SOUTH AFRICA.

WITWATERSRAND TECHNICAL INSTITUTE.

Applications are invited for the vacancy for the HEAD OF THE DEPARTMENT OF CHEMISTRY.

SALARY.—Salary £450-£25-£650, plus Local Allowance, which, in the case of married officers, brings the total emoluments from £516 to £726. The initial salary will be fixed according to the existing salary, qualifications and experience of the successful applicant.

ENGAGEMENT.—The appointment will be made subject to the conditions of service laid down in the Union Higher Education Act, 1923, which may be inspected in this office.

QUALIFICATIONS.—Applicants must be qualified chemists, and the possession of qualifications of the Pharmaceutical Society of Great Britain and knowledge of Metallurgy would be a recommendation. The possession of degrees or equivalent professional qualifications and/or teaching and practical experience will be considered in making the appointment.

DUTIES.—The post is a full-time one and includes both day and evening work, and the successful applicant will be required to take charge of the School of Pharmacy in addition to undertaking lectures in various branches of Chemistry.

Applications and copies of testimonials containing information as to the particulars of training, experience and present salary should be lodged with the SECRETARY, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2, from whom the prescribed forms of application may be obtained, not later than September 30.

COUNTY BOROUGH OF WEST HAM.

ESSEX MUSEUM OF NATURAL HISTORY,

ROMFORD ROAD, STRATFORD, E.15.

Applications are invited for the position of full-time ASSISTANT in the Museum from persons having a practical knowledge of Museum Work.

Applicants should have had some Biological training, and must be experienced in Taxidermy and be able to mount and set up specimens and prepare dissections for exhibition, and should be capable of preparing diagram drawings and taking photographs to illustrate exhibits.

The possession of a Science Degree of a British University, although desirable, will not be considered essential if other qualifications are satisfactory.

The salary will be at the rate of £150 per annum plus Civil Service Award. Applicants must be members of a recognised Professional Association.

Applications to be sent by September 30, 1926, to the PRINCIPAL of the West Ham Municipal College, Romford Road, E.15, from whom particulars and forms of application may be obtained.

September 1, 1926.

GEORGE E. HILLEARY,
Town Clerk.

A EUROPEAN SCIENCE MASTER is required for the Agricultural School at Moor Plantation, Ibadan, Nigeria. Candidates should be of good health, between 25 and 35 years of age, and should possess the Teaching Certificate of the Board of Education or the Scottish Education Department. They should be able to teach Mathematics, Chemistry, Physics and Botany to about Junior Local standard. Ability to teach elementary Surveying would be an additional qualification. Further information and forms of application are obtainable from the SECRETARY, C.A. (N.), Board of Education, Whitehall, London, S.W.1. Scottish candidates should apply to the SECRETARY, Scottish Education Department, S.E.D. (N.), Whitehall, London, S.W.1. List of applications closes September 27.

THE NATIONAL INSTITUTE OF POULTRY HUSBANDRY.

APPOINTMENT OF DIRECTOR.

Applications are invited for the above post. Scientific training and practical experience essential.

Particulars on application to the PRINCIPAL, Harper Adams Agricultural College, Newport, Shropshire.

August 28, 1926.

RESEARCH CHEMISTS are required for the CHEMICAL RESEARCH LABORATORY, Teddington, Middlesex. Candidates must possess a good Honours degree in Chemistry or equivalent qualifications, and some research experience. Scale of salary £175-£15-£235, plus Civil Service bonus. Bonus is at present approximately £91 on £175. Superannuation provision will be made under the Federated Superannuation System for Universities.

Preference will be given, other things being equal, to ex-Service men.

Applications should be made on a form to be obtained from the SECRETARY, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1, and must be received not later than October 7, 1926.

WANTED — ASTRONOMICAL TELESCOPE, 4½" or 5" Zeiss or Cooke. Full particulars. Also 2½". MORRIS, 7 Spencer Street, Leamington Spa.

RHEINBERG MICROMETERS and other GRATICULES by the processes of Grainless and of Filmless Photography. Stock list of standard articles on request. RHEINBERGS & Co., 57-60 Holborn Viaduct, London, E.C.1.

POLARIMETER or SACCHARIMETER, new or second-hand, required complete and in good condition, suitable for Sugar Beet Analysis. RIDEOUT, 9 Rodney Street, Liverpool.

TEST ROOM ASSISTANT WANTED, familiar with principles and construction of Physical apparatus. Apply in writing, with full particulars of qualifications and experience, to JOHN J. GRIFFIN & SONS, LTD., Kemble Street, London, W.C.2.

The issues for May 29 and July 3, containing, respectively, Supplements by Prof. T. M. Lowry (on "Electrons, Atoms and Molecules") and Dr. G. E. Hale (on "Some New Possibilities in Solar Research"), can still be supplied.

Office of NATURE, St. Martin's Street, W.C.2

---

for Critical Work

SIRA

MOUNTANT

A neutral mountant. The acidic properties of Canada Balsam are known to affect certain substances and stains. **SIRA** Mountant is prepared in accordance with the directions of The British Scientific Instrument Research Association, and should be used in place of Canada Balsam.

Price 2/6 per bottle.

Sole Manufacturers:

Stafford Allen & Sons, Ltd.

Estab. 1833, 7 *Cowper St., London, E.C.2.*

From all Scientific Instrument Makers and Dealers.

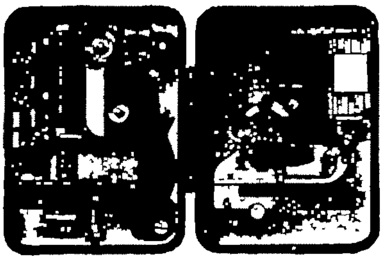
WHATMAN
FILTER PAPERS

The range of WHATMAN Filter Papers now manufactured is the most complete produced by any mill in the world, and covers practically all the requirements of modern high-grade technical work.

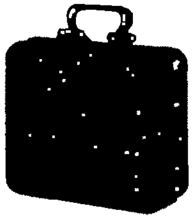
They are obtainable from all Laboratory Furnishers and are packed in sealed and labelled packages.

Manufactured by W. & R. BALSTON, LTD., Maidstone, KENT.
Samples and Price List on application.
In case of difficulty apply to Sole Mill Representatives:—
Telephone. CITY 7413 (3 lines) H. REEVE ANGEL & CO., LTD., 9 Bridewell Place, LONDON, E.C.4.

Spencer Portable Microscope



The case takes the instrument and complete equipment, including a mechanical stage and camera lucida.



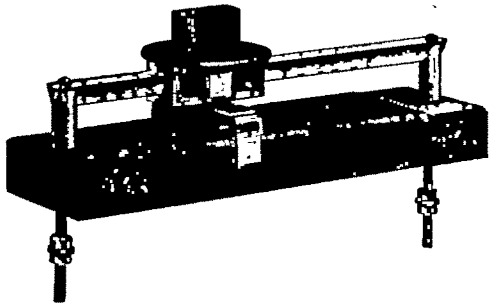
The closed case

All metal case. Total weight, with lenses, etc., 9½ lbs.

MICROTOMES
MICROSCOPE LAMPS
PHYSIOLOGICAL APPARATUS
ETC.

Catalogues free
HAWKSLEY & SONS LTD.
83 Wigmore Street, London, W.1.
Phone : Langham 3059

ZENITH
POTENTIOMETERS



Switchboard Type, specially suitable for regulating current and voltage in **TRIODE DETECTORS** and **AMPLIFIERS.**

CATALOGUE OF ALL TYPES POST FREE

THE ZENITH MANUFACTURING CO.
(Sole Makers of the "ZENITH" Patterns)
Contractors to the Admiralty, War Office, Air Ministry, Post Office, L.C.C. &c.
ZENITH WORKS, VILLIERS ROAD, WILLESDEN GREEN, LONDON, N.W.2
Telephone: Willesden 4087 8. Telegrams: Voltaohm, Willroad, London.

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

Just Issued
from the Natural History Department of
DULAU & COMPANY LTD.
54-56 Margaret St., Cavendish Square, London, W.1
CATALOGUE No. 143:
PHYTO-PATHOLOGY AND HORTICULTURE.
Post free on request.

CHEMICAL AND TECHNICAL BOOKS
We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms
Write for Catalogues—
WILLIAM BRYCE, Scientific Bookseller,
54-54a Lothian Street, EDINBURGH.

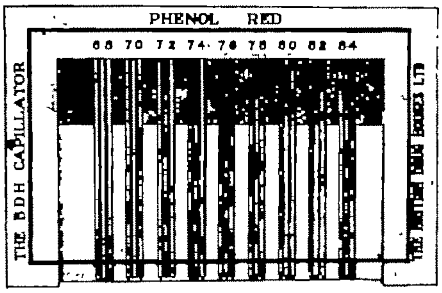
THE PRECIOUS METALS
GOLD, PLATINUM, SILVER.

SPINK & SON, LIMITED
(By Appointment)
17-18 PICCADILLY, LONDON, W.1.
Established 153 years.
VALUE, PURCHASE or ASSAY the above in any form.
Parcels can be safely sent by registered post.

B.D.H. CAPILLATOR

THE B.D.H. "Capillator" provides an improved method for the colorimetric determination of Hydrogen Ion Concentration.

The "Capillator" consists of a series of capillary tubes filled with buffer solutions containing an indicator. These tubes are mounted in threes on a white card, and form a series of coloured strips, each strip being marked with its exact PH value. Each card illustrates the complete colour change of the indicator.



A determination of PH is carried out by mixing equal quantities of liquid and indicator, and comparing the colour produced with that of the standard tubes of the "Capillator." By means of the "Capillator" determinations of PH are carried out expeditiously and accurately, and as little as one drop of the liquid will suffice for a test

Prices and further particulars will be supplied on application.

THE BRITISH DRUG HOUSES, LTD.
Makers of Fine Chemicals
Graham Street, LONDON, N.1

TO KEEP IN TOUCH WITH SCIENTIFIC MATTERS
IT IS NECESSARY TO SEE "**NATURE**" REGULARLY

Subscription rates

Inland		*Foreign*
£2 12 0	*Year*	£2 17 0
£1 6 0	*Half-year*	£1 10 0
13 0	*Quarter*	16 0

All Subscriptions are payable in advance.

Cheques and Postal Orders should be made payable to Macmillan & Co., Ltd

Please send me "NATURE" for .... months, for which I enclose remittance value

Name ....

Address ....

Date

THIS FORM MAY BE HANDED TO A BOOKSELLER OR NEWSAGENT, OR SENT DIRECT TO MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.

MACMILLAN'S NEW AND RECENT BOOKS.

THE FAMILIES OF FLOWERING PLANTS. I. DICOTYLEDONS. Arranged according to a New System based on their Probable Phylogeny. By J. HUTCHINSON, F.L.S., Assistant in the Herbarium, Royal Botanic Gardens, Kew. With Illustrations by W. E. TREVITHICK and the Author. 8vo. 20s. net. KEY TO THE FAMILIES OF THE DICOTYLEDONS. Reprinted from "The Families of Flowering Plants." 8vo. Manilla Cover. 2s. net.

THE PHYSIOLOGY OF THE CONTINUITY OF LIFE. By D. NOËL PATON, M.D., B.Sc., LL.D., F.R.S., Regius Professor of Physiology, University of Glasgow. With Illustrations. 8vo. 12s. net.

EVOLUTION. By J. GRAHAM KERR, F.R.S., Regius Professor of Zoology in the University of Glasgow. With 2 Plates in colour and 53 Illustrations in the Text. 8vo. 12s. net.

CONTEMPORARY REVIEW.—"Professor Graham Kerr has a charming prose style; he is a practical field naturalist of immense experience; he knows his own mind, and is not afraid to express quite bluntly his own views. He restates the Darwinian doctrine of natural selection, reinforced by Mendel's principles of heredity, by the insistence on the utility of particular characteristics amongst animals living freely, and by modern advances in physiological knowledge, with great power."

ICE AGES, RECENT AND ANCIENT. By A. P. COLEMAN, M.A., Ph.D., F.R.S., Emeritus Professor of Geology, University of Toronto. With Illustrations and Maps. 8vo. 17s. net.

THE TIMES LITERARY SUPPLEMENT.—"Never before has such an array of glacial evidence been so skilfully mustered and marshalled. At last scientific workers have before them a graphic, succinct, and inspiring account of those wonderful vicissitudes of climate through which the world has passed since the dawn of its geological history—changes which have so profoundly influenced its scenery, and so greatly controlled the development and distribution of its plant and animal, including human, life."

CRYSTALLINE FORM AND CHEMICAL CONSTITUTION. By A. E. H. TUTTON, D.Sc., M.A.(Oxon), F.R.S., Past President of the Mineralogical Society, London; Author of "Crystallography and Practical Crystal Measurement." With 72 Illustrations. 8vo. 10s. 6d. net.

THE JOURNAL OF EDUCATION.—"A book for which the only adjective seems to be 'enthralling.' . . . The teacher who buys this book for his school science library will probably end by keeping it for himself."

AN INTRODUCTION TO THE THEORY OF INFINITE SERIES. By T. J. I'a. BROMWICH, M.A., Sc.D., F.R.S., Fellow and Lecturer of St. John's College, Cambridge. Second Edition Revised with the assistance of T. M. MACROBERT, D.Sc., Lecturer in Mathematics in the University of Glasgow. 8vo. 30s. net.

NATURE.—"Not only to the mathematician is the book indispensable; it is also the best possible guide to any one who encounters mathematical analysis in his work. The second edition will increase the very high reputation gained by the first."

HIGHER MATHEMATICS FOR STUDENTS OF ENGINEERING AND SCIENCE. By FREDERICK G. W. BROWN, M.Sc.(London), F.C.P., Senior Mathematical Master, West Ham Secondary School. Crown 8vo. 10s.

EDUCATION.—"Everything in the book is well done. It shows that the author is a mathematical enthusiast and is bent on teaching mathematics in the proper way. . . . Mr. Brown has compiled a book that will be of inestimable service to many a teacher."

INTERMEDIATE MATHEMATICS (Analysis). By T. S. USHERWOOD, B.Sc., Wh.Ex., A.M.I.Mech.E., and C. J. A. TRIMBLE, M.A. Crown 8vo. 7s. 6d.

NATURE.—"The authors of this text-book on mathematics to the intermediate degree standard have already established a reputation by their previous works which is fully maintained in the present. The book is well planned."

⁂ ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

"In years to come the publication of this monumental work will rank as one of the milestones in British applied science."—*Nature.*

Sir Richard Glazebrook's

DICTIONARY

OF

APPLIED PHYSICS

Can NOW be purchased
on the Convenient System of

DIVIDED PAYMENTS

CONTENTS

Vol. I. Mechanics—Engineering—Heat.
„ II. Electricity.
„ III. Meteorology, Metrology, and Measuring Apparatus.
„ IV. Light—Sound—Radiology.
„ V. Aeronautics—Metallurgy—General Index.

THE COMPLETE WORK
IN **5** VOLUMES
Delivered at once
FOR A FIRST PAYMENT OF
21/-
AND 14 FURTHER MONTHLY PAYMENTS OF 21/- THUS COMPLETING THE SUBSCRIPTION
PRICE - £15 15 0

Authoritative Reviews:

"This encyclopædic work differs from many that have preceded it in that it is produced by those who have worked strenuously and successfully to promote knowledge. Originality of treatment and masterly handling are everywhere exhibited."—*Engineering.* (Vol. 1.)

"A book which every electrical engineer ought to possess. . . . A mine of information in a field which, at present, is not adequately covered by any one work."—*The Electrician.* (Vol. 2.)

"As a summary of our present knowledge of certain aspects of meteorology, the work is of great value. It will perhaps be regarded in future as a milestone showing the stage reached by the science at the end of the great war."—*The Meteorological Magazine.* (Vol. 3.)

SINGLE VOLUMES
ALSO SUPPLIED ON DIVIDED MONTHLY PAYMENTS AS FOLLOWS:
Immediate Delivery
AGAINST A FIRST PAYMENT OF
2/6
AND 13 FURTHER MONTHLY PAYMENTS OF 5/- THUS COMPLETING THE
SUBSCRIPTION PRICE
£3 7 6

7 DAYS
FREE ☛
EXAMINATION

To the GLOBE PUBLISHING COMPANY, LIMITED,
Gloucester House, 19 Charing Cross Road, London, W.C.2.

Please send me for 7 days free examination
A complete copy of the "Dictionary of Applied Physics" in 5 volumes.
Volume....................of the "Dictionary of Applied Physics."
(Strike out lines not applicable.)

It is understood that I can examine the $\frac{\text{work}}{\text{volume}}$ for seven days after I receive it, and that I can return it to you on the eighth day if I decide not to keep it. Should I decide to retain the volume(s) I undertake to send you a first payment of $\frac{\text{21/- for the complete work}}{\text{2/6 for Volume........only}}$ on the eighth day and to complete the purchase of the $\frac{\text{complete work}}{\text{Volume}}$ by remitting $\frac{14}{13}$ further monthly payments of $\frac{\text{21/-}}{\text{5/-}}$ until the full price $\frac{\text{£15:15:0}}{\text{£3:7:6}}$ is paid. (I am not under 21 years of age.)

NAME ....

ADDRESS ....

N.100 ....

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals, General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

That Book you want!

Foyles can supply any Scientific Book that is in print and most of those that are out of print. They have a Special Department for this class of literature under a Manager who has experience and knowledge of the Natural Sciences. Call and consult him, or write and you will get an intelligent reply. Books sent on approval. Over a million volumes Second-hand and New on every conceivable subject in stock. Twenty-one Departmental Catalogues issued, any of which will be sent gratis and post free on mentioning interests.

That Book you do not want!

Foyles will buy it.—A single volume to a library.

Expert valuers sent any distance.

FOYLES, 121 Charing Cross Road, London.

¶ **W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE,** will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ CATALOGUE 269. Scientific Books and Publications of learned Societies.

Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone: [illegible] (2 lines).

J. POOLE & CO.

ESTABLISHED 1854

NEW & SECOND-HAND

SCIENTIFIC AND EDUCATIONAL

BOOKSELLERS

ENQUIRIES BY LETTER
RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

MESSRS. RIVINGTON'S LIST

ELEMENTARY CALCULUS.

By C. H. P. MAYO, M.A., Formerly Senior Mathematical Master at Harrow School. Crown 8vo. With numerous Diagrams. 10s.

CONTENTS. Definitions and Limits. Differential Coefficients—The Use of a Differential Coefficient—Maxima and Minima Values—The Functional Notation—A Function of a Function—Circular Measure—Polar Co-ordinates—Second and Higher Differential Coefficients—Further Considerations of Maxima and Minima Values—Small Errors and Approximations in Measuring—The Differential of an Arc of a Curve—Curve Tracing—Rolle's Theorem—Application of the Integral Calculus to Physical Problems—Reduction of Integral to Standard Forms—The Length of an Arc of a Curve—Solids of Revolution—Successive Integration—Differential Equations—Cusps, etc.

PLANE GEOMETRY FOR SCHOOLS

By T. A. BECKETT, M.A., and F. E. ROBINSON, M.A., Mathematical Masters at St. Paul's School. In Two Parts. Crown 8vo. 5s. each.

CONTENTS: Part I.—Straight lines, angles, triangles, parallelograms, circles, areas, Pythagoras's theorem and constructions arising therefrom, co-ordinates, and easy trigonometry. Part II.—Harder properties of areas, extension of Pythagoras's theorem, rectangle properties of the circle, radical axis, propositions on inequalities, maxima and minima, and regular polygons, ratio and proportion. Numerous examples.

SOLID GEOMETRY, INCLUDING THE MENSURATION OF SURFACES AND SOLIDS.

By R. S. HEATH, D.Sc., Formerly Professor of Mathematics and Vice-Principal of the University of Birmingham. Fifth Edition, Enlarged. Crown 8vo. 4s.

SCHOOL STATICS.

By W. G. BORCHARDT, M.A., B.Sc. Crown 8vo. With or without Answers, 7s. 6d.

SCHOOL DYNAMICS.

By W. G. BORCHARDT, M.A., B.Sc. Crown 8vo. With or without Answers, 7s. 6d.

COMMERCIAL ARITHMETIC.

By W. G. BORCHARDT, M.A., B.Sc. Crown 8vo. With Answers, 3s. 6d.

A SYSTEMATIC COURSE OF PRACTICAL SCIENCE FOR SECONDARY AND OTHER SCHOOLS.

By ARTHUR W. MASON, B.Sc., B.A. (Lond.), Headmaster of the Grammar School, Tadcaster. Small Quarto. With numerous Diagrams.

BOOK I. INTRODUCTORY PHYSICAL MEASUREMENTS. Forming a First Year Course in Physics. 2s. 6d.

BOOK II. EXPERIMENTAL HEAT. Dealing with all those parts of HEAT usually taken in a school course up to the standard of the Matriculation and Senior Local Examinations. 3s.

PRACTICAL EXPERIMENTS IN HEAT AND LIGHT, CONTAINING OVER 120 TYPICAL EXPERIMENTS.

By W. ST. B. GRIFFITH, B.A., B.Sc., and P. T. PETRIE, M.Sc., A.M.I.C.E. Crown 8vo. With Diagrams. One Vol., 4s. 6d.; or in Two Parts—**Heat, 2s. 6d. Light, 2s. 6d.**

A FIRST AND SECOND YEARS' COURSE OF PRACTICAL CHEMISTRY.

By GEORGE H. MARTIN, M.A., F.C.S., and ELLIS JONES, M.A., Science Masters, Bradford Grammar School. Quarto. 2s. 6d. each.

AN INTRODUCTION TO PRACTICAL QUANTITATIVE ANALYSIS.

By H. P. HIGHTON, M.A., Late Assistant Master at Rugby School. With Diagrams. Crown 8vo. 4s.

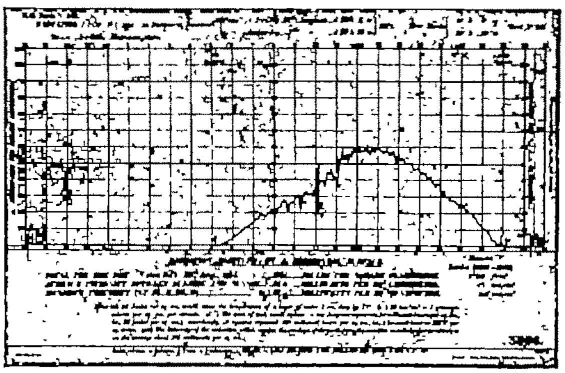
AN INTRODUCTION TO QUALITATIVE ANALYSIS.

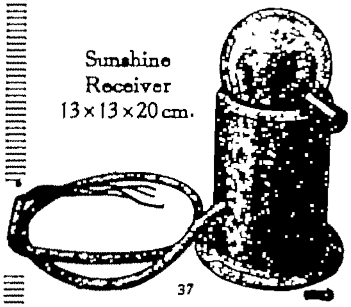
By H. P. HIGHTON, M.A. With Diagrams. Crown 8vo. 4s.

RIVINGTONS, 34 King Street, Covent Garden, London.

CALLENDAR SUNSHINE RECORDER

enables information to be obtained which is of considerable value in meteorological and agricultural research.





Sunshine Receiver 13 × 13 × 20 cm.

Further particulars sent on request.

CAMBRIDGE INSTRUMENT CO. LTD.

Works:-
LONDON. & CAMBRIDGE

Head Office & Showrooms:- 45, GROSVENOR PLACE LONDON, S.W.1

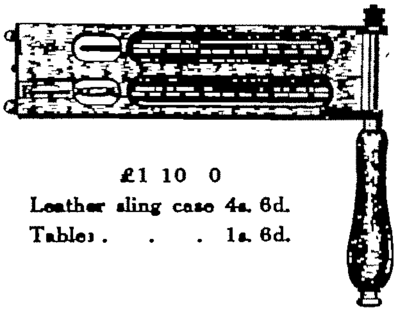
AMERICAN COMPANY
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

This apparatus has been developed from the design of Prof. H. L. Callendar to record the total vertical component of the solar radiation received at the surface of the earth, both directly from the sun and also from the sky.

The record shown was obtained at the Meteorological Office, London, on August 29, 1914.

WHIRLING HYGROMETER

For the Accurate Measurement of Humidity



£1 10 0
Leather sling case 4s. 6d.
Tables . . . 1s. 6d.

Recommended by the Hot and Deep Mines Temperature Committee

C. F. CASELLA & CO. LTD.
49-50 Parliament Street,
London, S.W.1

HOPKIN & WILLIAMS, Ltd.

16 & 17 Cross St., Hatton Garden, London, E.C.1
Works: Ilford, Essex.
Telegrams: "Cerium, South, London"
Telephone: Holborn 6864 and 6865

The Leading British House for

CHEMICAL REAGENTS

PURE, FINE, AND RARE CHEMICALS

Manufacturers of Guaranteed
Chemical Reagents for Analysis and Research.

Made and supplied to standards and specifications described in the publication

"Analytical Reagents: Standards and Tests."

Compiled by
EDMUND WHITE, B.Sc. (Lond.), F.I.C.

Published by
HOPKIN & WILLIAMS, LTD.

NEW EDITION, 1925.
CLOTH BOUND. INTERLEAVED.

Price 1/6 post free from the Publishers.

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

Chance's "Resistance"

Samples—Free of Cost.

We are prepared to send buyers of Chemical Glass a few samples of Chance's "Resistance" Laboratory Glassware, Free of Cost, to enable users to verify the following statement for themselves :—

For heat-resisting qualities combined with general resistance to chemical attack—CHANCE'S LABORATORY GLASSWARE is superior to any other make, whether British or Foreign.

Send us your Trade Card and ask for samples.

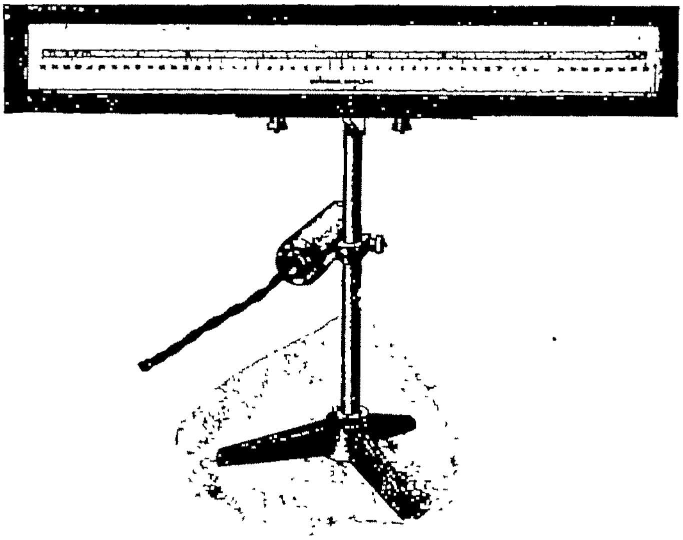
STOCKED BY ALL THE MOST IMPORTANT LABORATORY FURNISHERS.

CHANCE BROTHERS and Co. LIMITED
GLASS WORKS SMETHWICK BIRMINGHAM

Laboratory Glassware

GAMBRELL BROS. LTD.

Established 1898.



Lamp and Scale, Pattern No. 1000.

The following are some of our standard lines :

Please send for Lists in which you are interested.

LIST	
"G"	Galvanometers, moving coil, pointer and reflecting.
"OG"	Galvanometers, "Onwood" pattern.
"GA"	Galvanometer Accessories, including Lamps, Scales, Universal Shunts, etc.
"K.S"	Keys and Switches.
"IR"	Gambrell's "Independent" Plug Contact Resistance Boxes and Wheatstone Bridges.
"HR"	Megohms and High Resistances.
"SR"	Switch Pattern Resistance Boxes and Wheatstone Bridges, all grades, including Direct Reading.
"P.K"	Potentiometers, Kelvin Low Resistance Bridges, Kelvin Double Ratio Boxes, Volt Ratio Boxes, Standard Cells, Low Resistance Shunts.
"RR"	Rheostats and Single Resistances.
"C"	Condensers, Standard and Secondary.
"V.A"	Voltmeters, Ammeters, Milliameters.
"T.A"	Apparatus for Electro-Titration.

MERTON ROAD, SOUTHFIELDS,
London, S.W.18.

Phones: PUTNEY 3641-2 (Instrument).
VICTORIA 9938 (Wireless).

Radio Sales Dept. for Wireless Apparatus 76 VICTORIA ST., LONDON, S.W.1.

MACMILLAN'S NEW AND RECENT BOOKS.

COTTON AND ITS PRODUCTION. By W. H. JOHNSON, lately Agricultural Adviser to the Australian Cotton Growing Association. With an Introduction by SIR WYNDHAM DUNSTAN, F.R.S., and a Foreword by SIR WILLIAM HIMBURY, Managing Director of the British Cotton Growing Association. With 26 Maps showing the Cotton Areas of the World. Med. 8vo. 30s. net.

RITUAL AND BELIEF IN MOROCCO. By EDWARD WESTERMARCK, Ph.D., author of "The History of Human Marriage," etc Illustrated. 2 vols. 8vo. 50s. net.

This work is a systematic account of the popular religion and magic of the Muhammadan natives of Morocco based on seven years' experience among them.

ORIGINS OF EDUCATION AMONG PRIMITIVE PEOPLES. A Comparative Study in Racial Development. By W. D. HAMBLY, B.Sc., Anthropologist in the Wellcome Expedition in the Sudan, Assistant Curator, African Ethnology, Field Museum, Chicago. With a Preface by DR. CHARLES HOSE, of Sarawak. With 74 pages of Illustrations in half-tone and line. 8vo. 25s. net.

The aim of this work is to make an historical and regional survey of customs of primitive races with special reference to moral, religious, physical, and social education, in so far as it has been developed without intrusion of European influences.

CRYSTALLINE FORM AND CHEMICAL CONSTITUTION. By A. E. H. TUTTON, D.Sc., M.A.(Oxon), F.R.S., Past President of the Mineralogical Society, London; Author of "Crystallography and Practical Crystal Measurement." With 72 Illustrations. 8vo. 10s. 6d. net.

THE MINERALOGICAL MAGAZINE.—"The book is well printed and illustrated, and it gives a very clear and readable account of the subject. It should be seen by all students of chemistry as well as those of crystallography."

THE FAMILIES OF FLOWERING PLANTS. I. DICOTYLEDONS. Arranged according to a New System based on their Probable Phylogeny. By J. HUTCHINSON, F.L.S., Assistant in the Herbarium, Royal Botanic Gardens, Kew. With Illustrations by W. E. TREVITHICK and the Author. 8vo. 20s. net. KEY TO THE FAMILIES OF THE DICOTYLEDONS. Reprinted from "The Families of Flowering Plants." 8vo. Manilla Cover. 2s. net.

THE PHYSIOLOGY OF THE CONTINUITY OF LIFE. By D. NOËL PATON, M.D., B.Sc., LL.D., F.R.S., Regius Professor of Physiology, University of Glasgow. With Illustrations. 8vo. 12s. net.

EVOLUTION. By J. GRAHAM KERR, F.R.S., Regius Professor of Zoology in the University of Glasgow. With 2 Plates in colour and 53 Illustrations in the Text. 8vo. 12s. net.

DISCOVERY.—"It is altogether a good book far and above the average, and besides its theme of evolution it has a valuable secondary characteristic. It is a sound guide to really scientific thinking and a valuable corrective to some of the cheap 'scientific' posing of to-day. Heartily commended for general reading as well as to those interested."

HIGHER MATHEMATICS FOR STUDENTS OF ENGINEERING AND SCIENCE. By FREDERICK G. W. BROWN, M.Sc.(London), F.C.P., Senior Mathematical Master, West Ham Secondary School. Crown 8vo. 10s.

NATURE.—"This work embodies those branches of pure mathematics required by senior engineering students up to degree standard and it covers the field very adequately. . . . For an attempt to return from the monograph to the 'comprehensive' type of book it is eminently successful, and the numerous examples are well chosen with the correct practical bias . . . A really useful book."

⁂ ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

Just Published. Volume VIII. of the New Edition of

CHAMBERS'S

ENCYCLOPÆDIA

A Dictionary of Universal Knowledge.

Edited by DAVID PATRICK, LL.D., and WILLIAM GEDDIE, M.A., B.Sc.

To be completed in 10 Vols., Imp. 8vo. Cloth, 20/- net; half-moro., 35/- net per vol.

Chambers's Encyclopædia has a character of its own. It strives to be at once comprehensive, compact, accurate, lucid, readable, and handy for reference. The larger themes are broken up into many articles; but provision is throughout made for securing a systematic conspectus of the whole subject. Thus the article GEOLOGY gives a history of the science and plans out the whole field; while the reader in search of information on single items such as Plesiosaurus, Boulder-Clay, Denudation, Caves, Pitchstone, Greensand, Mammoth, Coprolites, Dykes, Trilobites, Pterodactyl, the Antiquity of Man, will not have to hunt for these hidden in a trackless wilderness of continuous dissertation, but will find each under its several head

Some Contributors whose Articles appear in the New Edition:

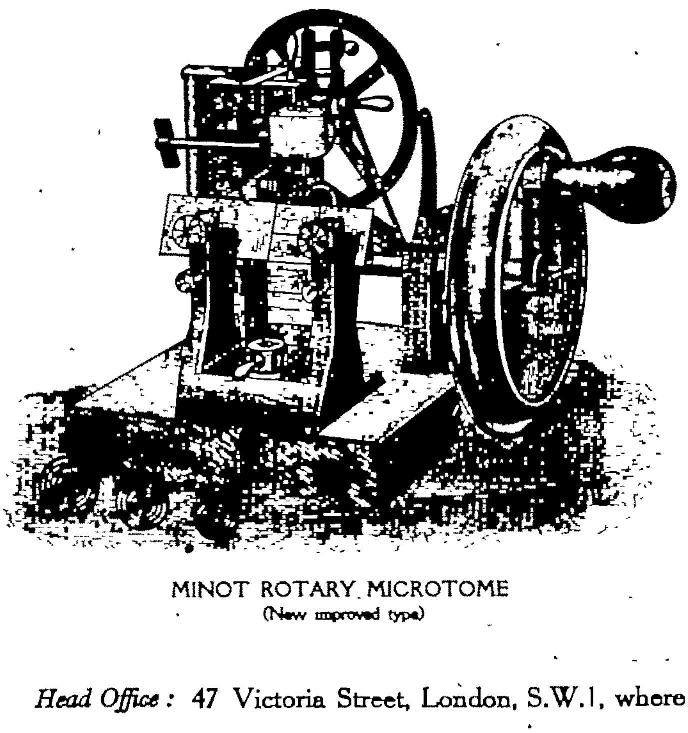
J. W. Mackail.
Lascelles Abercrombie.
Lord Riddell.
Sir Stanley Chapman, K.C.B.
Northcote W. Thomas
Lord Birkenhead.
George Bernard Shaw.
G. K. Chesterton.
Dr. Henry Bradley.
Prof. L. W. Lyde.
Prof. J. A. S. Watson.
W. J. Perry.
C. T. Onions.
Prof. A. Seth Pringle-Pattison.
Andrew Lang.
Sir John Simon.
Sir Ronald Ross.
Sir Frank Dyson.
Prof. H. Cecil Wyld.
Sir Oliver Lodge.
Sir Edmund Gosse.
Prof. Halliburton.
Prof. Daniel Jones.
Dr. Peter Giles.
Sir T. Hudson Beare.
Prof. Sir John Macpherson.
Prof. H. H. Parker.
Admiral Sir R. Tupper, K.C.B.
Sir H. W. Barlow.
Prof. Herbert T. Andrews.
Prof. J. Arthur Thomson.
Dr. Thos. Ashby.
Prof. C. G. Barkla.
Sir W. H. Bragg.
Prof. W. Peddie.
Sir Joseph Fayrer.
Prof. A. Harden.
Prof. A. Berriedale Keith.
Sir A. Daniel Hall.
Prof. Gilbert Murray.

A Volume will be issued every few months. For this edition Messrs. J. Bartholomew & Son, Ltd., are producing a thoroughly up-to-date set of Authoritative Political and Physical Maps.

AT ALL BOOKSELLERS.

W. & R. CHAMBERS, Ltd., 38 Soho Sq., London, W.1, and 339 High St., Edinburgh.

BRITISH INDIA BRITISH INDIA



MINOT ROTARY MICROTOME
(New improved type)

MICROTOMES
by
R. JUNG, Heidelberg

For every scientific purpose, with the finest knives and accessories

HAND, FREEZING, MINOT, THOMA, HEIDELBERG, TANK MODELS, ETC.

Full description lists and Rupee prices from the
SOLE DISTRIBUTORS FOR BRITISH INDIA:

ADAIR, DUTT & CO. LTD.
(Incorporated in England)
Stephen House, Dalhousie Square East,
CALCUTTA
and
Exchange Building, Graham's Road,
Ballard Estate,
BOMBAY

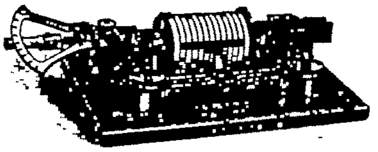
Head Office: 47 Victoria Street, London, S.W.1, where Government indents may be sent.

SIR HOWARD GRUBB, PARSONS & COMPANY
OPTICAL WORKS
NEWCASTLE-ON-TYNE

STANDARD PRODUCTS

Astronomical Telescopes
Chronographs
Spectrographs
Revolving Domes
Rising Floors
Star Plate Measuring Machines
Transit House Roofs
Submarine Periscopes, etc.
Object Glasses, Prisms, etc.
COMPLETE OBSERVATORY EQUIPMENTS

STEEL TESTING IN THE WORKSHOP



Capt. Sankey's
METAL BENDING TESTER

Write for Pamphlet

C. F. CASELLA & CO. LTD.
Parliament Street,
S.W.1

MICROSCOPIC STAINS

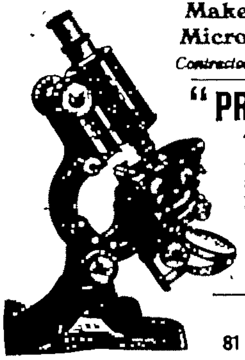
Specially made for Bacteriological and Histological work.

The B.D.H. Standard Stains are tested histologically before they are issued. They can be relied upon to give the correct reaction for each stain.

Applications are invited for a copy of our Price List and Booklet upon Clinical Pathology and the use of Stains.

THE BRITISH DRUG HOUSES, LTD.
Makers of Fine Chemicals,
Graham Street, City Road, London, N.1.
Chemical Works: Wharf Road, London, N.1.

JAMES SWIFT & SON LTD.



Makers of the highest grade
Microscopes and Accessories.
Contractors to all Scientific Departments of H M. Govt

"PREMIER" MICROSCOPE

This stand is pre-eminent before all others for perfection of design, finish and adjustment. It is without equal both for advanced visual research and for photo-micrography.

☞ *"NATURE" says: "One of the most perfect stands we have seen."*

UNIVERSITY OPTICAL WORKS
81 TOTTENHAM COURT ROAD, LONDON, W.

For Critical Work

SIRA
IMMERSION OIL

Refractive index 1·524. For use with modern immersion oil objectives, condensers and other optical instruments. Free from corrosive action on metal and glass. Prepared in accordance with the directions of The British Scientific Instrument Research Association, and positively the only oil that will give the best results in critical work. *Sole Manufacturers. Stafford Allen & Sons, Ltd. Established* 1833, 7 *Cowper St., London, E.C.2.*

Price
2/6
per
bottle.

From all Scientific Instrument Makers and Dealers.

Recent Scientific and Technical Books.

Volumes marked with an asterisk have been received at "NATURE" *Office.*

Mathematics: Mechanics: Physics

Abderhalden, Emil, Herausgegeben von. Handbuch der biologischen Arbeitsmethoden. Lieferung 197 Abt. 2: Physikalische Methoden, Teil 2, Heft 3. Mikrokinematographie und biologische Filmaufnahmen, von Fritz Kohler; Allgemeine Aufnahmetechnik und Deutung der Rontgenbilder, von Rudolf Grashey; Untersuchungsmethoden biochemisch wichtiger Lichtreaktionen im sichtbaren und ultravioletten Spektralgebiet, von Torsten Swensson; Die Diathermie, von Franz Nagelschmidt. Sup. Roy. 8vo Pp 1109–1344 10.80 gold marks. Lieferung 205 Abt 2: Physikalische Methoden, Teil 2, Heft 4. Polarimetrie, von Heinrich Kessler; Spektroskopische Methoden des Mediziners, von Fritz Lowe, Nephelometrie, von Marie Anna Schirmann. Sup. Roy. 8vo. Pp. 1345–1536 8 70 gold marks. (Berlin und Wien: Urban und Schwarzenberg, 1926.)*

Ambronn, Hermann, und **Frey, Albert.** Das Polarisationsmikroskop: seine Anwendung in der Kolloidforschung und in der Färberei (Kolloidforschung in Einzeldarstellungen, Band 5.) Med. 8vo. Pp. x+195. (Leipzig: Akademische Verlagsgesellschaft m.b.H, 1926) 13 50 gold marks *

Bowley, Arthur L. Elements of Statistics. (Studies in Economics and Political Science.) Fifth edition, revised. Demy 8vo. Pp. 475 (London: P S. King and Son, Ltd., 1926.) 18*s.* net.

Crandall, Irving B. Theory of Vibrating Systems and Sound. Med. 8vo. Pp. x+272. (New York: D Van Nostrand Co, 1926.) 5 dollars.

Dalgleish, I. S. The Lightning Graphs. Series 1 (General): For the Instant Solution of Unknown Variables in $a^2=b^2+c^2$; $a^n=d$, $\sqrt[n]{a}=d$; and also giving Hyperbolic Logarithms and Reciprocals; designed and drawn for the Use of Engineers, Physicists, Architects, Surveyors, Draughtsmen, Students, etc. Oblong Sup Roy 8vo. Pp. 22. (London: Crosby Lockwood and Son, 1926.) 5*s* net.

Dudeney, Henry Ernest. Modern Puzzles and How to Solve Them. Cr. 8vo. Pp 190. (London: C. Arthur Pearson, Ltd., 1926) 3*s.* 6*d.* net.*

Dull, Raymond W. Mathematics for Engineers. Demy 8vo Pp. xvii+780. (New York: McGraw-Hill Book Co, Inc.; London: McGraw-Hill Publishing Co., Ltd, 1926) 25*s* net *

Geiger, H., und **Scheel, Karl** Handbuch der Physik Band 9: Theorien der Warme Redigiert von F Henning. Roy. 8vo Pp. viii+616. (Berlin. Julius Springer, 1926.) 46 50 gold marks.*

Glauert, H. The Elements of Aerofoil and Airscrew Theory. Demy 8vo. Pp. viii+228. (Cambridge: At the University Press, 1926) 14*s* net.*

Heath, Sir Thomas L. The Thirteen Books of Euclid's Elements Translated from the Text of Heiberg, with Introduction and Commentary Second edition, revised with Additions Roy. 8vo. Vol. 1: Introduction and Books I, II Pp xii+432 Vol 2: Books III.-IX. Pp vi+436 Vol 3: Books X-XIII and Appendix. Pp. vi+546. (Cambridge: At the University Press, 1926.) 70*s.* net.*

Jeans, J. H. Dynamische Theorie der Gase. Nach der vierte englischen Auflage ubersetzt und mit einer Erganzung versehen von Reinhold Furth Pp 614. (Braunschweig: Friedr. Vieweg und Sohn A.-G, 1926.) 35 gold marks.

Millikan, R. A. L'électron. Traduit sur la deuxième édition américaine par Ad. Lepape. (Nouvelle Collection scientifique) Cr. 8vo. Pp. 346. (Paris: Félix Alcan, 1926) 12 francs.

Mines Department. Safety in Mines Research Board. Paper No. 25: Some Problems connected with the Determination of the Fineness of Coal Dust. By E F. Grieg. Roy. 8vo. Pp. 31. (London: H.M. Stationery Office, 1926.) 1*s.* net *

Moulton, Forest Ray. New Methods in Exterior Ballistics. Demy 8vo. Pp. vi+258. (Chicago, Ill: University of Chicago Press; London: Cambridge University Press, 1926.) 20*s.* net.*

Nernst, W. The New Heat Theorem: its Foundations in Theory and Experiment. Translated from the second German edition by Guy Barr Demy 8vo. Pp. xvi+281. (London: Methuen and Co., Ltd, 1926.) 12*s* 6*d* net *

Orwin, C. S., and **Kersey, H. W.** Estate Accounts. Demy 8vo. Pp vi+45. (Cambridge: At the University Press, 1926) 3*s.* 6*d.* net *

Peake, E. G. An Academic Study of some Money Market and other Statistics. Second edition. Cr. 4to. Pp. xi+105. (London: P. S King and Son, Ltd., 1926.) 15*s.* net.*

Potron, l'Abbé. Exercices de calcul différentiel et intégral Premier volume: Résumé théorique et énoncés d'exercices. Roy. 8vo. Pp xviii+332. (Paris: J Hermann, 1926) 35 francs.*

Sherrin, George C., Designed by. Philips' Apparatus for demonstrating Popular Experiments in Dynamics. Supplied in Wooden Box, with fully illustrated Handbook. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1926) 20*s.* net.*

Staines, P. G., and **Ingram, T.,** Compiled by, under the Direction of **Burns, P. F.** The Way of Arithmetic. Book 1. Cr. 8vo. Pp. 80. Paper, 7*d*, cloth, 10*d*. Book 2. Cr. 8vo. Pp. 80. Paper, 8*d.*; cloth, 11*d*. (London and Glasgow: Collins' Clear-Type Press, 1926)

Stoner, Edmund C. Magnetism and Atomic Structure Demy 8vo Pp. xiii+371. (London: Methuen and Co., Ltd., 1926) 18*s.* net.*

Wilkins, F. G. R. Elementary Heat and Heat Engines. Cr 8vo. Pp. vii+312. (London: Oxford University Press, 1926.) 7*s* 6*d* net.*

Wilkins, Harold T. Marvels of Modern Mechanics: The Mastery of Land, Sea and Air. Demy 8vo. Pp 251+16 plates. (London: T. Fisher Unwin, Ltd, 1926.) 10*s.* 6*d.* net.*

Engineering

Aeronautics. Technical Report of the Aeronautical Research Committee for the Year 1924–25 (with Appendices) Vol. 1: Aeroplanes (Model and Full Scale). Roy. 8vo. Pp. xix+365+186 plates Vol. 2. Airscrews, Engines, Materials, etc. Pp xxiv+367–682+142 plates. Roy. 8vo (London: H.M. Stationery Office, 1926) 17*s.* 6*d.* net each vol.*

Bonomo, O. L'aviation commerciale. Pp. 122. (Paris: F. Louis Vivien, 1926.) 12 francs.

Brown, H. G. The Lead Storage Battery. Second edition Demy 8vo. Pp. 186. (London: The Locomotive Publishing Co, Ltd., 1926) 5*s* net

Couffon, René. Transport de l'électricité (Collection Armand Colin.) Cr 8vo. Pp. 219. (Paris: Armand Colin, 1926.) 8 40 francs

Department of Scientific and Industrial Research. Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea-Water Sixth (Interim) Report of the Committee of the Institution of Civil Engineers. Edited by P. M. Crosthwaite and Gilbert R. Redgrave. Roy 8vo. Pp. iv+40. (London: H M. Stationery Office, 1926) 2*s* net *

Hall, A. J. Textile Bleaching, Dyeing, Printing and Finishing Machinery Imp. 8vo. Pp. 320. (London: Ernest Benn, Ltd, 1926.) 50*s.* net.*

Hickerson, Thomas F. Highway Curves and Earthwork. (New York: McGraw-Hill Book Co., Inc; London: McGraw-Hill Publishing Co., Ltd., 1926.) 17*s* 6*d.* net.

Malcolm, John. Agricultural Surveying: including Mensuration, Road Construction and Drainage (Text-Books for Agricultural Students) Cr 8vo. Pp vii+313. (London: University Tutorial Press, Ltd., 1926) 5*s* 6*d* *

Mitchell, J. Shipbuilding and the Shipbuilding Industry. (Pitman's Common Commodities and Industries Series.) Cr. 8vo Pp xi+116. (London: Sir Isaac Pitman and Sons, Ltd, 1926.) 3*s.* net.*

Nesbit, William, Compiled by Electrical Characteristics of Transmission Circuits. (East Pittsburgh, Pa.: Westinghouse Technical Night School Press, 1926.) 6 dollars.

Stevens, H. P., and **Porritt, B. D.** Rubber and Engineering: being a Short Account of the Preparation and Properties of Rubber, with Particular Reference to its Uses in the Engineering Industry (London: The Rubber Growers' Association, 1926.)

Urquhart, Leonard Church, and **O'Rourke, Charles Edward**. Steel Structures: Stresses in Simple Structures Med. 8vo. Pp. ix + 278. (New York: McGraw-Hill Book Co, Inc.; London McGraw-Hill Publishing Co, Ltd, 1926.) 17*s* 6*d* net.*

Chemistry: Chemical Industry

Freundlich, Herbert. Colloid and Capillary Chemistry. Translated from the third German edition by H. Stafford Hatfield. Roy. 8vo. Pp. xv + 883. (London: Methuen and Co., Ltd, 1926.) 50*s*. net.*

Gilman, Henry, Editor-in-Chief. Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals Editorial Board: Henry Gilman, Roger Adams, H. T. Clarke, J B. Conant, C. S. Marvel, Frank C Whitmore. Vol 6. Med. 8vo. Pp vii + 120. (New York: John Wiley and Sons, Inc; London: Chapman and Hall, Ltd, 1926) 7*s*. 6*d*. net.*

Heuser, E., Herausgegeben von. Technik und Praxis der Papierfabrikation. Band 2: Die Fabrikation des Zellstoffes aus Holz Teil 2: Natronzellstoff. Von E. Hagglund. Pp. xii + 360 (Berlin · Otto Elsner, 1926) 16 gold marks.

Kolthoff, I. M., and **Furman, N. Howell.** Potentiometric Titrations: a Theoretical and Practical Treatise. Med. 8vo. Pp. xii + 345. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd, 1926.) 22*s*. 6*d* net.*

Lehne, Adolf. Farberei und Zeugdruck. Vorschriften zur Anwendung in der Farberei und im Zeugdruck gebrauchlichen Farbstoffe und Hilfsstoffe Pp. 204. (Wittenberg-Berlin: A. Ziemsen Verlag, 1926) 15 gold marks.

Marsh, J. E. Stone Decay and its Prevention. Cr 8vo Pp. 64. (Oxford Basil Blackwell, 1926) 3*s*. 6*d*. net.

Martinet, J. Matières colorantes: l'indigo et ses dérivés. (Encyclopédie de chimie industrielle) Roy. 8vo. Pp. 700. (Paris: J-B. Baillière et fils, 1926.)

Mines Department: Safety in Mines Research Board. Paper No. 27: Firedamp Explosions; the Projection of Flame. By M J. Burgess. Roy 8vo. Pp. 14. (London: H.M. Stationery Office, 1926.) 6*d* net*

Noüy, P. Lecomte du. Surface Equilibria of Biological and Organic Colloids. (American Chemical Society Monograph Series) Med 8vo. Pp 212. (New York: The Chemical Catalog Co., Inc, 1926.) 4.50 dollars*

Oscroft, P. W. Inorganic Chemistry for Upper Forms. Cr 8vo Pp. 556 (London · G. Bell and Sons, Ltd., 1926) 6*s*.

Rose, H. Das Hafnium. (Sammlung Vieweg, Heft 86.) Demy 8vo. Pp iv + 60. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1926) 3.75 gold marks.*

Ryschkewitsch, Eugen. Graphit: Charakteristik, Erzeugung, Verarbeitung und Verwendung (Chemie und Technik der Gegenwart, Band 7.) Med. 8vo. Pp xii + 323. (Leipzig: S Hirzel, 1926) 14 50 gold marks.*

Schotz, S. P. Synthetic Rubber. Cr. 4to. Pp 144 (London: Ernest Benn, Ltd, 1926.) 21*s*. net.*

Vernon, C. G. An Introduction to Chemistry. Gl 8vo. Pp. 276 (London, Calcutta and Sydney: George G. Harrap and Co, Ltd., 1926.) 4*s*. 6*d**

Waeser, Bruno. The Atmospheric Nitrogen Industry: with Special Consideration of the Production of Ammonia and Nitric Acid Translated by Ernest Fyleman. Roy 8vo Vol. 1. Pp xxvi + 330 Vol. 2 Pp 331-746 (London: J and A Churchill, 1926.) 42*s*. net.*

Technology

Kneeland, Frank H., Compiled by. Practical Coal Production Mine Transportation and Market Preparation. Mine Transportation, Hoisting and Hoisting Equipment, Coal Preparation. Demy 8vo. Pp. vii + 354. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd, 1926.) 15*s* net*

Liddell, Donald M., Editor-in-Chief. Handbook of Non-Ferrous Metallurgy. Prepared by a Staff of Specialists In 2 vols Med. 8vo. Vol 1. Pp. xi + 692 Vol. 2 Pp. v + 693-1440 (New York · McGraw-Hill Book Co., Inc.; London. McGraw-Hill Publishing Co., Ltd., 1926.) 60*s*. net.*

Osann, E. H. Bernhard. Lehrbuch der Eisenhüttenkunde. Band 2. Erzeugung und Eigenschaften des schmeidbaren Eisens. Zweite Auflage. (Leipzig: Wilhelm Engelmann, 1926.) 32 gold marks.

Simpkin, N., and **Sinnatt, F. S.**; with the Collaboration of A. Dawe, J Lomax, J. R. Lomax, A. McCulloch, A. B Owles, L Slater Coal and Allied Subjects Compendium 2 A Compendium of Bulletins Eleven to Sixteen issued by the Lancashire and Cheshire Coal Research Association Cr. 8vo Pp. iv + 27 + 3 plates + 36 + 22 + 1 plate + 25 + 3 plates + 24 + 45 (London: H F. and G Witherby, 1926) 15*s* net.*

Wilson, Samuel P. Pyroxylin Enamels and Lacquers: their Raw Materials, Manufacture and Application Demy 8vo. Pp. x + 214 (London · Constable and Co., Ltd, 1926.) 18*s*. net.

General Biology: Natural History Botany: Zoology

Abderhalden, Emil, Herausgegeben von Handbuch der biologischen Arbeitsmethoden. Lieferung 199. Abt. 9: Methoden zur Erforschung der Leistungen des tierischen Organismus, Teil 4, Heft 2. Methoden der Erforschung bestimmter Funktionen bei einzelnen Tierarten. Methoden zur Erforschung des Vogelzuges, von J Thienemann; Methoden zur Behandlung der Atemphysiologie der Insekten, von Albert Koch; Die Verfahren zur Erforschung der Tierfluges, von Oskar Prochnow. Sup. Roy. 8vo. Pp 123-294. 7 50 gold marks Lieferung 204. Abt. 9: Methoden der Erforschung der Leistungen des tierischen Organismus, Teil 1, Halfte 2, Heft 2. Spezielle Methoden: Tierhaltung und Tierzuchtung Zuchtung der Homopteren, von Carl Borner, Zuchtung von Neuropteren, Trichopteren und Panorpaten (Mecopteren), von Franz Heikertinger; Zuchtung der Lepidopteren, von E. Fischer, Zuchtung der Dipteren, von Franz Heikertinger; Zuchtung der Coleopteren, von Franz Heikertinger; Züchtung der Hymenopteren, von Josef Fahringer. Sup. Roy. 8vo Pp 215-484. 12.30 gold marks Lieferung 207 Abt 9: Methoden der Erforschung der Leistungen der tierischen Organismus, Teil 1, Halfte 2, Heft 3. Spezielle Methoden: Tierhaltung und Tierzuchtung. Züchtung von Ameisen, von Heinrich Kutter; Haltung und Zucht der Honigbiene, von Max Hartmann; Die Zucht des chinesischen Seidenspinners (Bombyx mori), von Herbert Michael; Methoden zum Züchten von Landpulmonaten, von Karl Kunkel; Pflege und Zucht weiterer wirbelloser Landtiere, von Paul Kammerer; Methoden der biologischen Bekampfung schadlicher Insekten im Pflanzenschutz, von F. Stellwaag. Sup Roy. 8vo. Pp. 485-660 8.40 gold marks. (Berlin und Wien Urban und Schwarzenberg, 1926)*

Aitken, H. H., and **Thomas, H. H.** Plant Pests and Diseases: how to Identify and Destroy Them. Cr. 8vo Pp 126. (London: Cassell and Co, Ltd., 1926) 1*s* 6*d*. net

Baker, John R. Sex in Man and Animals Demy 8vo. Pp xvi + 175 + 4 plates (London: George Routledge and Sons, Ltd, 1926) 7*s*. 6*d* net.

Bower, F. O. The Ferns (Filicales). Treated Comparatively with a View to their Natural Classification Vol. 2. The Eusporangiatae and other relatively Primitive Ferns. (Cambridge Botanical Handbooks) Imp. 8vo Pp vi + 344. (Cambridge: At the University Press, 1926) 30*s* net*

Carpenter, Capt. Alfred, and **Barker, Capt. Sir David W.** Nature Notes for Ocean Voyagers: being Personal Observations upon Life in "The Vasty Deep," and Fishes, Birds and Beasts seen from a Ship's Deck; with Popular Chapters on Weather, Waves and Legendary Lore. Second edition, revised throughout and reset. Med. 8vo. Pp. xi + 212. (London: Charles Griffin and Co, Ltd, 1926.) 10*s* 6*d* net*

Duesberg, J. L'œuf et ses localisations germinales (Les problèmes biologiques) Roy. 8vo. Pp. viii + 107. (Paris: Les Presses universitaires de France, 1926) 18 francs.

Ellis, Havelock. Man and Woman: a Study of Human Secondary Sexual Characters. Sixth edition Demy 8vo. Pp xxiii + 563 (London: A. and C. Black, Ltd, 1926.) 10*s.* 6*d* net.*

Enriques, P. Zoologia e anatomia comparata. 8vo. Pp. viii + 356 + 67 tavole. (Padova. A. Milani, 1926) 55 lire.

Farmer, Sir J. Bretland, and **Chaudhuri, Haraprasad.** A Practical Introduction to the Study of Botany. (Specially intended for the Use of Indian Students) New edition Cr. 8vo. Pp viii + 300. (Calcutta, Bombay and London: Longmans, Green and Co, Ltd, 1926.) 3 rupees.*

Fawcett, William, and **Rendle, Alfred Barton.** Flora of Jamaica: containing Descriptions of the Flowering Plants known from the Island. Vol. 5: Dicotyledons, families Buxaceae to Umbelliferae Demy 8vo. Pp. xxviii + 453. (London: British Museum (Natural History), 1926.) 35*s.**

Gilg, Ernst, und **Schürhoff, P. N.** Aus dem Reiche der Drogen: Geschichtliche, kulturgeschichtliche und botanische Betrachtungen über wichtigere Drogen. Pp. 272. (Dresden: Schwarzeck-Verlag G m.b H., 1926) 14 50 gold marks.

Grimpe, G., und **Wagler, E.** Die Tierwelt der Nord- und Ostsee. Lieferung 5. Teil 9.d$_1$. Lamellibranchia, von F Haas; Teil 12.a$_1$: Copelata, von A. Buckmann Demy 8vo. Pp 96 + 20 (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 8.80 gold marks *

Hayek, A. Allgemeine Pflanzengeographie 4to. Pp viii + 409 (Berlin: Gebruder Borntraeger, 1926) 18 gold marks.

Hering, Martin. Die Ökologie der blattminierenden Insektenlarven (Zoologische Bausteine: Ausschnitte aus dem Gesamtgebiet der Zoologie, Band 1, Heft 2.) Roy 8vo Pp. iv + 253 + 2 Tafeln (Berlin: Gebruder Borntraeger, 1926) 18 gold marks.*

Kükenthal, Willy, Gegründet von Handbuch der Zoologie: eine Naturgeschichte der Stamme des Tierreiches. Herausgegeben von Thilo Krumbach. Vierter Band: Progoneata, Chilopoda, Insecta. Zweite Lieferung. Med. 4to. Pp. 129-240 (Berlin und Leipzig: Walter de Gruyter und Co., 1926.) *

Ministry of Agriculture and Fisheries. Miscellaneous Publications, No 54: Edible and Poisonous Fungi Demy 8vo. Pp 29 + 25 plates (London: Ministry of Agriculture and Fisheries, 1926.) 2*s.* 6*d.* net.*

Reid-Heyman, Stephen. Life, How it Comes: a Child's Book of Elementary Biology. Second edition, revised. Cr. 8vo Pp. 188. (Oxford: Basil Blackwell, 1926) 3*s.* 6*d.* net.

Schiffner, Victor. Die Existenzgründe der Zellbildung und Zellteilung, der Vererbung und Sexualitat. Untersuchungen aus dem Gebiete der exakten Biologie. Roy 8vo Pp. v + 160. (Jena. Gustav Fischer, 1926.) 7.50 gold marks *

Stempell, W. Zoologie im Grundriss. Funfte Lieferung (Schluss des Werkes). Sup. Roy. 8vo Pp. xx + 689-900. (Berlin: Gebrüder Borntraeger, 1926) 10.50 gold marks.*

Uexküll, J. von. Theoretical Biology. Translated by D L. Mackinnon. (International Library of Psychology, Philosophy and Scientific Method.) Demy 8vo. Pp. xvi + 362. (London · Kegan Paul and Co, Ltd.; New York: Harcourt, Brace and Co, Inc., 1926.) 18*s* net.*

Horticulture: Forestry: Agriculture

Fawcett, Howard S. Citrus Diseases and their Control With Sections on Oriental Citrus Diseases, by H. Atherton Lee (McGraw-Hill Publications in the Agricultural and Botanical Sciences) Med. 8vo. Pp. xii + 582. (New York: McGraw-Hill Book Co., Inc.; London · McGraw-Hill Publishing Co., Ltd., 1926.) 25*s.* net.*

Forestry Commission. Bulletin No. 6: The Phomopsis Disease of Conifers. By Malcolm Wilson. Roy 8vo Pp 34 + 12 plates. (London: H.M. Stationery Office, 1926) 1*s* 6*d* net.*

Hunter, Herbert. The Barley Crop: a Record of some recent Investigations Demy 8vo. Pp viii + 166. (London: Ernest Benn, Ltd, 1926.) 10*s.* 6*d.* net.*

Nacevičius, St. Fenologija tiriamųjų mokslų tarpe. Demy 8vo Pp. 30 (Dotnuva, Lithuania: "Žinija," Ž Ū. Akademija, 1926.) 1 lt.*

Prewett, F. J. The Marketing of Farm Produce Part 1: Live Stock. Demy 8vo. Pp. viii + 103 (London: Oxford University Press, 1926.) 3*s.* 6*d.* net.

Russell, E. J. Plant Nutrition and Crop Production. Med 8vo. Pp. ix + 115 + 21 plates. (Berkeley, Calif: University of California Press; London: Cambridge University Press, 1926.) 12*s* 6*d* net.*

Stremme, Hermann. Grundzuge der praktischen Bodenkunde. Roy. 8vo. Pp. viii + 332 + 10 Tafeln (Berlin: Gebrüder Borntraeger, 1926) 16 50 gold marks.*

Thomas, H. H., Edited by Chrysanthemums for Amateurs: the Cultivation of all Types Cr. 8vo Pp. 126 (London: Cassell and Co, Ltd, 1926) 1*s* 6*d.* net.

Thomas, H. H., Edited by. Dahlias, Gladioli and Begonias · the Amateur Gardener's Guide to their Cultivation. Cr 8vo. Pp. 121. (London · Cassell and Co, Ltd., 1926) 1*s* 6*d* net

Wagner, Wilhelm. Die chinesische Landwirtschaft. Sup. Roy. 8vo Pp. xv + 668. (Berlin: Paul Parey, 1926) 42 gold marks.*

Anatomy: Physiology

Beer, G. R. de. An Introduction to Experimental Embryology. Cr. 8vo Pp. iv + 148. (Oxford: Clarendon Press; London: Oxford University Press, 1926) 7*s.* 6*d.* net *

Evans, C. Lovatt. Recent Advances in Physiology. Second edition. Ex. Cr. 8vo. Pp xiii + 370. (London: J. and A. Churchill, 1926.) 12*s.* 6*d.* net *

Herrick, C. Judson. Brains of Rats and Men: a Survey of the Origin and Biological Significance of the Cerebral Cortex. Cr. 8vo. Pp. xiii + 382 (Chicago, Ill.: University of Chicago Press, London: Cambridge University Press, 1926.) 15*s* net *

Kisch, E. Heinrich. The Sexual Life of Woman in its Physiological, Pathological and Hygienic Aspects. Only authorised translation from the German by Eden Paul. Roy 8vo. Pp. 698. (London: William Heinemann (Medical Books) Ltd., 1926.) 25*s* net.

McGowan, J. P. Pernicious Anaemia, Leucaemia and Aplastic Anaemia: an Investigation from the Comparative Pathology and Embryological Point of View. Demy 8vo. Pp vii + 116 + 5 plates (London: H. K Lewis and Co, Ltd, 1926) 7*s.* 6*d.* net.*

Medical Research Council. Special Report Series, No. 104: Reports of the Committee upon the Physiology of Vision. 1: Illumination and Visual Capacities (a Review of Recent Literature). 2*s* 6*d* net Special Report Series, No. 105 · Diets for Boys during the School Age. 2*s.* 6*d.* net. (London: H.M. Stationery Office, 1926)

Pryde, John. Recent Advances in Biochemistry. Ex. Cr. 8vo. Pp. viii + 348. (London: J. and A. Churchill, 1926.) 12*s.* 6*d* net.*

Anthropology: Archæology

Grenier, Albert. The Roman Spirit in Religion, Thought and Art Translated by M. R. Dobie. (The History of Civilization Series.) Roy 8vo Pp. xvi + 423 + 16 plates (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 16*s.* net.*

d'Harcourt, R. et M. La musique des Incas et ses survivances. 8vo. Pp. 576, et un atlas de 39 planches. (Paris: Paul Geuthner, 1926) 200 francs.

Jardé, A. The Formation of the Greek People. Translated by M. R Dobie. (The History of Civilization Series) Med 8vo. Pp. xvi + 359 (London: Kegan Paul and Co, Ltd; New York: Alfred A. Knopf, 1926) 16*s.* net.*

Kelley, Truman Lee. The Influence of Nurture upon Native Differences. Cr 8vo. Pp. vii + 49. (New York: The Macmillan Co., 1926.) 6*s.* net.*

Wells, H. G. The Outline of History: a Plain History of Life and Mankind New edition, fully revised. Demy 4to. Part 23. Pp. 705-736. Part 24 Pp. 737-768 (London · Cassell and Co, Ltd, 1926) 1*s.* 3*d* net each part.*

Westermarck, Edward. The Goodness of Gods. (The Forum Series) Cr. 8vo. Pp. vi+58. (London: Watts and Co., 1926) 1s net.*

Philosophy: Psychology

Cornelius, Hans. Grundlagen der Erkenntnistheorie Transcendentale Systematik. Zweite Auflage. Pp. 264. (Munchen: Ernst Reinhardt, 1926.) 7 gold marks.

Ellis, Havelock. The Dance of Life. New edition Cr 8vo. Pp xiv+340. (London: Constable and Co., Ltd., 1926) 6s. net.

Flower, J. Cyril. The Mastery of Mind. Cr. 8vo Pp. 204. (London: Lutterworths, Ltd., 1926.) 5s net

Freud, Sigmund. La science des rêves. Traduit sur la septième édition allemande par I. Meyerson (Bibliothèque de la Philosophie contemporaine.) 8vo. Pp vi+641. (Paris: Félix Alcan, 1926.) 50 francs.

Freud, Sigmund. Psychopathology of Everyday Life Authorised English edition, with introduction by A. A. Brill. Tenth impression. Med 8vo. Pp 350. (London: George Allen and Unwin, Ltd., 1926.) 12s. 6d net.

Goddard, E. H., and **Gibbons, P. A.** Civilisation or Civilisations: an Essay in the Spenglerian Philosophy of History. Ex. Cr 8vo. Pp xvi+231. (London. Constable and Co., Ltd., 1926) 7s 6d net.*

Joad, C. E. M. The Babbitt Warren. Cr 8vo. Pp. xvi+230. (London: Kegan Paul and Co., Ltd., 1926) 6s.*

Jordan, Rev. G. J. The Story of Psychology: a Handbook for Everyman. Cr. 8vo. Pp. 147. (London: Ernest Benn, Ltd, 1926) 4s. 6d net.

Kottje, F. Erkenntnis und Wirklichkeit: Untersuchungen uber die metaphysischen Grundlagen der organischen und anorganischen Natur. 8vo Pp viii+185. (Leipzig: Felix Meiner, 1926.) 6 gold marks.

Montet, Ch. de. Le relativisme psychologique et la recherche médicale. Gl 8vo Pp. xi+152 (Paris: Félix Alcan, 1926.) 10 francs.*

Ogden, Robert Morris. Psychology and Education Demy 8vo Pp xiii+364 (London: George Routledge and Sons, Ltd, 1926) 12s 6d. net *

Overstreet, H. A. Influencing Human Behaviour Cr. 8vo Pp 286. (London: Jonathan Cape, Ltd, 1926.) 7s. 6d net.

Richardson, Frank Howard. Parenthood and the Newer Psychology: being the Application of Old Principles in a New Guise to the Problems of Parents with their Children Demy 8vo. Pp xx+200 (New York and London: G P. Putnam's Sons, Ltd, 1926) 7s 6d. net

Rivers, W. H. R. L'instinct et l'inconscient. Traduit de l'anglais par René Lacroze. (Bibliothèque de Philosophie contemporaine) 8vo. Pp. xvi+324 (Paris: Félix Alcan, 1926.) 30 francs

Robinson, James Harvey. The Mind in the Making (The Travellers' Library.) Cr. 8vo. Pp 247. (London: Jonathan Cape, Ltd, 1926.) 3s 6d. net.

Saxby, I. B. The Psychology of the Thinker. Cr. 8vo. Pp. viii+355. (London: University of London Press, Ltd., 1926) 7s 6d. net.*

Stutsman, Jesse O. Curing the Criminal: a Treatise on the Philosophy and Practices of Modern Correctional Methods. Ex. Cr. 8vo. Pp. x+419. (New York: The Macmillan Co., 1926) 10s. 6d. net

Tickell, Rev. S. Claude. Psychology really Simplified, in Terms of Machinery: a Science at Last; a Rationalistic and Unreligiotistic but not Anti-Religionistic, and Mechanistic but not Materialistic Simplification of Psychology, addressed to Rationalists and Religionists as a Basis of "Re-Union," suitable as a Text-book for Examinations, and Indispensable as an Introduction to all the "Psycho-s." Cr. 8vo. Pp. 22. (Cricklade, Wilts: The Author, Latton-with-Eysey, 1926.) 1s *

Turner, J. E. Personality and Reality: a Proof of the Real Existence of a Supreme Self in the Universe. Med. 8vo. Pp. 190. (London: George Allen and Unwin, Ltd., 1926.) 7s. 6d. net.

Weigel, W. Vom Wertereich der Jugendlichen: Untersuchungen uber Tatbestande des emotionalen Lebens in der Reifezeit. (Padagogische Monographien, Band 24) Roy. 8vo. Pp. x+214. Erster Band (1 und 2 Teil) (Leipzig und Munchen. Otto Nemnich, 1926.) 6 gold marks

Wolf, A. Exercises in Logic and Scientific Method. New edition, revised and enlarged. Cr. 8vo. Pp. 125. (London: George Allen and Unwin, Ltd., 1926) 4s. net.

Bacteriology: Hygiene

Imperial Social Hygiene Congress. Proceedings of the Imperial Social Hygiene Congress at the British Empire Exhibition, Wembley, Monday, Tuesday, Wednesday, October 5th, 6th and 7th, 1925. Organized by the British Social Hygiene Council Demy 8vo. Pp. vi+301. (London: British Social Hygiene Council, Inc., 1926) 4s net *

Norton, John F., and **Falk, I. S.** Laboratory Outlines in Bacteriology and Immunology. Demy 8vo. Pp. viii+114. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1926.) 10s. net.*

Miscellany

A. F. Leaves from a Northern University. Cr. 8vo. Pp xi+276. (London: Kegan Paul and Co., Ltd., 1926) 7s 6d. net.*

Chaplet, A. Pour l'inventeur. Pp. 212. (Paris: Libr. Dunod, 1926) 16.10 francs.

Cutten, George Barton. The Threat of Leisure. Ex. Cr. 8vo Pp. x+166 (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1926) 9s net.

Duncanson, David B. Experimental Science for Schools Parts 1-3 Cr. 8vo. Pp. 256+7. (London, Calcutta and Sydney. George G. Harrap and Co., Ltd, 1926.) 3s. 6d.*

Hogarth, David George. The Twilight of History: being the Eighth Earl Grey Memorial Lecture, delivered at King's Hall, Armstrong College, Newcastle-on-Tyne, February 17, 1926. Med. 8vo Pp 19. (London: Oxford University Press, 1926) 1s net *

King, E. L. M. Forms and Fancies. Cr. 8vo. Pp. ii+34 (Oxford: Basil Blackwell, 1926.) 3s 6d. net.*

Locke, William J. The Old Bridge. Cr. 8vo. Pp. vi+347. (London: John Lane, The Bodley Head, Ltd., 1926.) 7s. 6d. net *

Lynch, A. J. The Rise and Progress of the Dalton Plan: Reflections and Opinions after more than Three Years' Working of the Plan. Imp. 16mo. Pp xii+164. (London: George Philip and Son, Ltd., Liverpool: Philip, Son and Nephew, Ltd, 1926) 4s net

Mace, C. A. Sibylla: or, The Revival of Prophecy. (To-day and To-morrow Series) Pott 8vo Pp 96. (London: Kegan Paul and Co, Ltd; New York: E P. Dutton and Co., 1926) 2s 6d net.*

Marvin, F. S., Arranged and Edited by. Science and Civilization: Essays. (The Unity Series, 6) Cr. 8vo. Pp 350. (London: Oxford University Press, 1926.) 6s. net *.

Science for All: an Outline for Busy People Med. 8vo. Pp. 384. (London: Ward, Lock and Co, Ltd, 1926.) 6s. net.

Seton-Watson, R. W. Sarajevo: a Study in the Origins of the Great War. Med 8vo. Pp. 303 (London: Hutchinson and Co, Ltd, 1926.) 18s. net *

Statistics. Permanent Consultative Committee on Official Statistics. Guide to Current Official Statistics of the United Kingdom Vol. 4 (1925): being a Systematic Survey of the Statistics appearing in all Official Publications issued in 1925 and in certain Selected Publications issued in 1926. Roy 8vo. Pp. 262. (London: H M. Stationery Office, 1926.) 1s. net.*

Wells, H. G. Mr Belloc objects to "The Outline of History." (The Forum Series.) Cr. 8vo Pp. vii+55. (London: Watts and Co, 1926) 1s net.*

Woodburne, A. S. Human Nature and Education. Demy 8vo. Pp. ix+292. (London: Oxford University Press, 1926.) 12s. 6d. net

LEWIS'S CIRCULATING
MEDICAL AND SCIENTIFIC LIBRARY

Covering the widest range of subjects (pure and applied), including **Astronomy, Aviation, Biology, Botany, Chemistry, Electricity, Engineering, Geology, Microscopy, Mining, Philosophy, Physics, Sociology, Technology, Travels, Zoology, &c.,** in addition to **Every Branch of Medical Science.**

Duplicates of NEW BOOKS are added in UNLIMITED SUPPLIES, as long as the demand requires.

ANNUAL SUBSCRIPTION (Town or Country) FROM ONE GUINEA,
according to the number of books required at one time. Subscriptions may begin at any date. Books may be retained as long or exchanged as frequently as desired.

The Library READING AND WRITING ROOM (first floor) is open daily.

Prospectus, with monthly list of additions, post free.

H. K. LEWIS & CO. Ltd., 136 GOWER STREET, and 24 Gower Place, **LONDON, W.C.1.**

J. POOLE & CO.
ESTABLISHED 1854

NEW & SECOND-HAND
SCIENTIFIC AND EDUCATIONAL
BOOKSELLERS

ENQUIRIES BY LETTER
RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

¶ W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE, will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ CATALOGUE 269. Scientific Books and Publications of learned Societies.

Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone. [illegible] (2 lines).

CHEMICAL AND TECHNICAL BOOKS

We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms

Write for Catalogue—

WILLIAM BRYCE, Scientific Bookseller,
54-54a Lothian Street, EDINBURGH.

NOTICE.

Copies of NATURE for May 29 and July 3, containing, respectively, Supplements by Prof. T. M. Lowry (on "Electrons, Atoms and Molecules") and Dr. G. E. Hale (on "Some New Possibilities in Solar Research"), can still be supplied at published price, plus postage.

St. Martin's Street, London, W.C.2.

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals, General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connection with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

That Book you want!

Foyles can supply any Scientific Book that is in print and most of those that are out of print. They have a Special Department for this class of literature under a Manager who has experience and knowledge of the Natural Sciences. Call and consult him, or write and you will get an intelligent reply. Books sent on approval. Over a million volumes Second-hand and New on every conceivable subject in stock. Twenty-one Departmental Catalogues issued, any of which will be sent gratis and post free on mentioning interests.

That Book you do not want!

Foyles will buy it.—A single volume to a library.

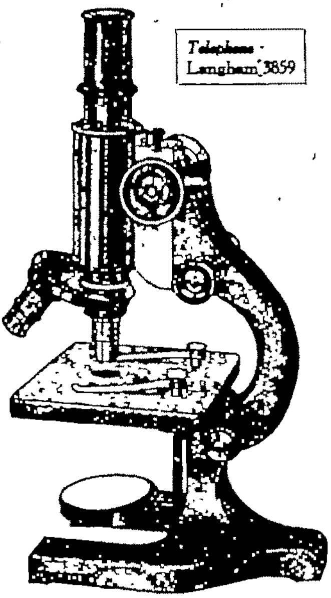
Expert valuers sent any distance.

FOYLES, 121 Charing Cross Road, London.

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

THE PRUNING OF TREES AND SHRUBS
Being a Description of the Methods practised in the Royal Botanic Gardens, Kew.
By W. DALLIMORE, Assistant, Royal Botanic Gardens, Kew.
Cr. 8vo. Fully illustrated with half-tone illustrations. 4s. 6d. net, or post free 4s. 9d.
Of all Booksellers, or direct from
DULAU & COMPANY LTD.
34 Margaret Street, London, W.1

STUDENTS' MICROSCOPES



Telephone: Langham 3859

SPENCER MODEL 64
(as illustrated)
Complete with iris diaphragm, double nosepiece, 2 objectives—16 mm. and 4 mm., 2 oculars—6 × and 10 ×, in case.
£13.2.0

SECOND-HAND MICROSCOPES
by makers of repute.
From £10.0.0

STUDENTS' REQUISITES
including Dissecting Instruments in Rolls or separately.

Microscopes and other instruments repaired and adjusted.

HAWKSLEY & SONS, LTD.
83 Wigmore Street, London, W.1.

RADIUM

Sole Agents for the British Empire (excluding only Canada) of the

ANGLO-BELGIAN MINING CORPORATION

THE UNION MINIÈRE DU HAUT KATANGA (RADIUM SECTION) OPERATING IN THE BELGIAN CONGO

We can supply
RADIUM ELEMENT in all forms
for physical and medical purposes.

A PRACTICAL HANDBOOK

Radium: Its Production and Therapeutic Application

55 pages, 10 plates, numerous figures of applicators, etc.

POST FREE ON REQUEST

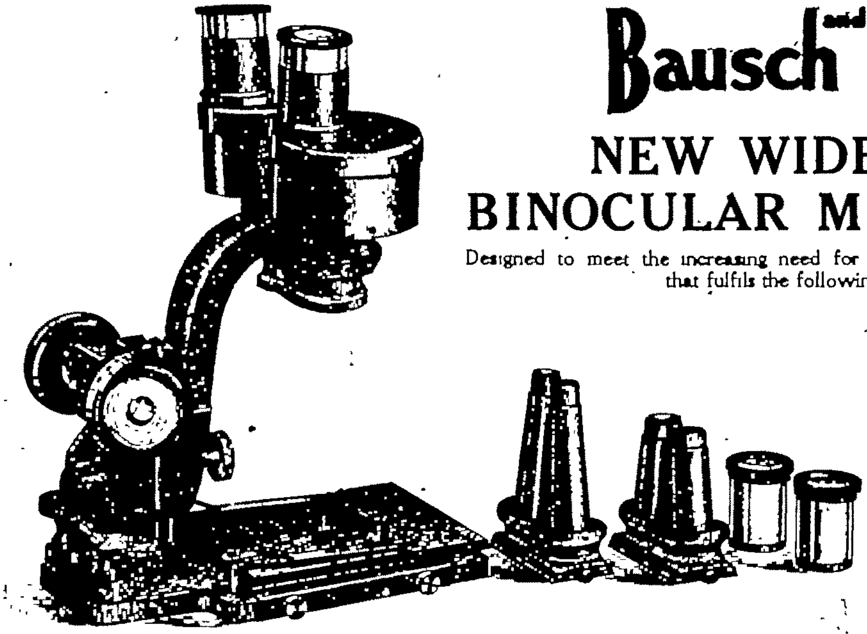
Many of the most important institutions in the Empire have purchased Radium from us.

WATSON & SONS
(ELECTRO-MEDICAL) LTD.
SUNIC HOUSE, PARKER ST.,
KINGSWAY, LONDON, W.C.2.

Telephone: Regent 1227. *Telegrams: "Skiagram, Westcent, London."*

Bausch and Lomb

NEW WIDE FIELD BINOCULAR MICROSCOPE



Designed to meet the increasing need for a high grade binocular microscope that fulfils the following conditions:

1. Stereoscopic Vision.
2. Extremely Large Field.
3. Long Working Distance.
4. High Eye Point.
5. Wide Range of Magnification.

It gives the advantage of viewing the image in its true position, not inverted or reversed.

Supplied on four different stands covering every requirement, the microscope bei g interchangeable on each stand.

Illustrated descriptive list sent on request.

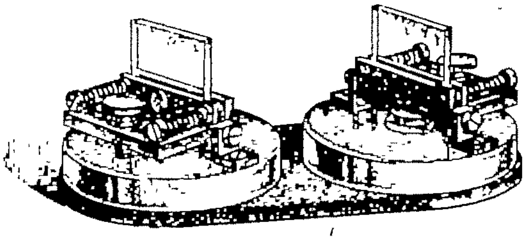
Also Microscopes for all purposes, Microtomes, Photomicrographic Apparatus, Centrifuges, Colorimeters, Hæmoglobinometers, Balopticon Projection Lanterns, etc.

Bausch & Lomb Optical Co. Ltd.
Contractors to British, Indian, Colonial and Foreign Governments.

37-38 HATTON GARDEN
LONDON E.C.1.
Our instruments may be obtained through all Dealers.

Max Kohl A.G.
Chemnitz A1 (Germany)

Manufacturers of
Physical Apparatus
Laboratory Furniture
Induction Coils · Oil Air Pumps
Experimental Switchboards
Projection Apparatus

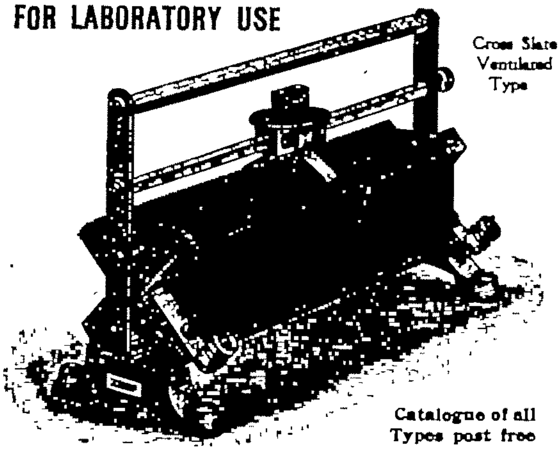


Interference Apparatus after Classen for demonstrating the interference phenomena before a large audience.

Special Lists on request

ZENITH

REGULATING RESISTANCES
FOR LABORATORY USE

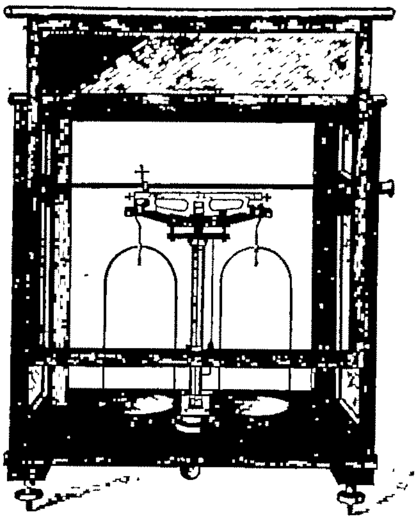


Cross Slate Ventilated Type

Catalogue of all Types post free

THE ZENITH MANUFACTURING CO.
(Sole Makers of the "ZENITH" Patterns)
Contractors to the Admiralty, War Office, Air Ministry, Post Office, L.C.C., &c
ZENITH WORKS, VILLIERS ROAD,
WILLESDEN GREEN, LONDON, N.W.2.

A
NEW
OERTLING
BALANCE



No. 43

PRICE £16:16:0

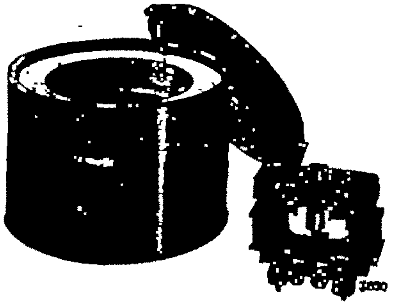
This Balance has been carefully constructed, and has all the essentials contained in higher priced instruments. Capacity 200 grm. Sensitivity 0·0001 grm.

Write for our 1926 Catalogue (post free) giving particulars of the above and all our other Models.

L. OERTLING LTD.
88-90 Turnmill Street
LONDON, E.C.1

Phone: CLERKENWELL 1959 Est. 1849

SCHERING VIBRATION GALVANOMETER



Size = 22 × 21 × 15 cm.

This galvanometer is particularly suitable for use in conjunction with the Schering Bridge method of measuring power losses in dielectrics, and for precision measurements on standard condensers. It may be tuned from a distance by varying the intensity of a D.C. electromagnetic field. The movement is protected from external magnetic fields by a laminated shield (shown on the left of the illustration). The instrument is robust, and has low capacity.

APPROXIMATE SENSITIVITY DATA
for a galvanometer having a frequency range of 25 to 120 cycles per second.

Resistance at 20° C.		Period (without magnetic control)	Deflection per microamp. at 1 m.		Magnetising current for 50 cycles.
D.C. polarising windings	A.C. winding		25~	120~	
112 ohms.	250 ohms.	0.05 second.	48 mm.	13 mm	0.09 amp.

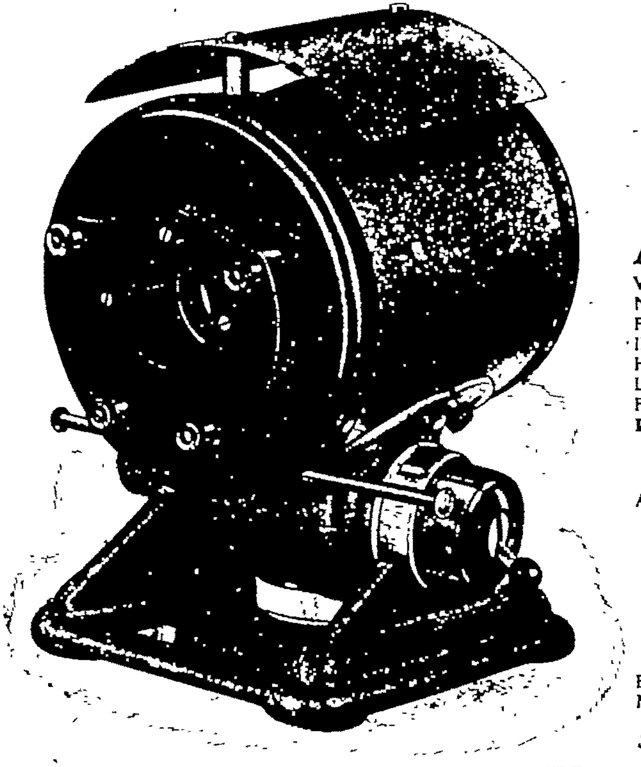
CAMBRIDGE INSTRUMENT CO LTD

Works: London & Cambridge

Head Office & Showrooms: 45, GROSVENOR PLACE LONDON, S.W.1

AMERICAN COMPANY:
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

41



ALL INSTRUMENTS BRITISH MANUFACTURE

LABORATORY EQUIPMENT CO.

ONE EXAMPLE OF
IMPROVEMENT IN DESIGN.

A MICROSCOPE LAMP

WITH.—
NEW CLOSE-UP DIAPHRAGM, ROD ADJUSTMENT.
FITTING FOR 2" SCREENS.
INSTANTLY REMOVABLE, WELL-VENTILATED HOUSING.
LOW CENTRE.
FIRM CLAMP.
PRICE, INCLUDING 60-W. BULB, 6-ft. FLEX AND PLUG

£4 : 17 : 6

ALSO —MICROSCOPES—	RESEARCH BACTERIOLOGICAL STUDENTS' DISSECTING
LAMPS —	POINTOLITE ACETYLENE
MICROTOMES:—	TWO TYPES
PHOTOMICROGRAPHIC APPARATUS:—	TWO TYPES

EMBEDDING APPARATUS, LIGHT FILTERS, TISSUE MINCERS, METAL BENCHING AND CHAIRS, SUPPLIES

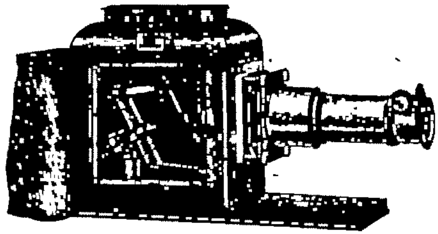
***Showroom*: 310/12 Regent Street, London, W.1**
(Close Oxford Circus)
Telephone · Langham 3111

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

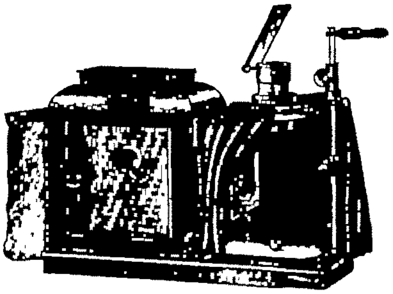
NEWTON'S SCIENCE LANTERNS

FOR

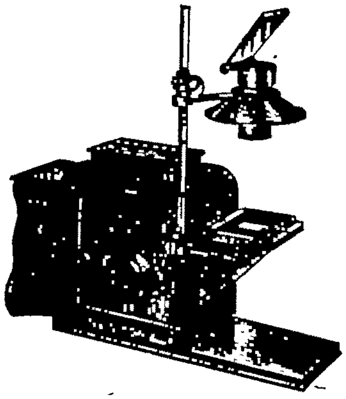
TRANSPARENT AND OPAQUE PROJECTION



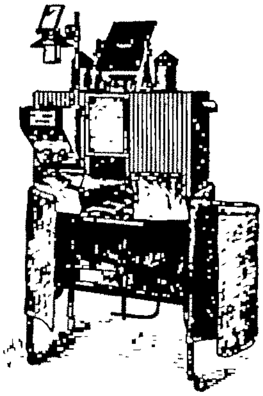
The "Intermediate" Lantern.



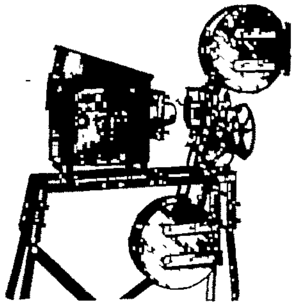
The "Demonstrator's" Lantern.



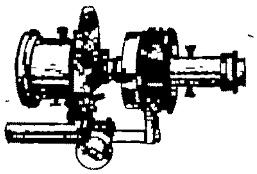
The "Vertical" Lantern for the Lecture Table.



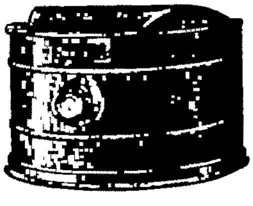
The "Episcope," Model C.



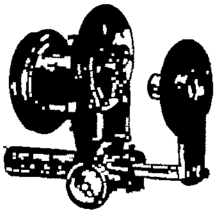
Kinematographs for Lecture Theatres and Class Rooms.



Combined Projection Microscope, Polariscope, Micro-Polariscope, and Spectroscope.



The "Projectoscope," New Model G, Improved Illumination and Definition.



Projection Microscope, for use with any Standard Optical Lantern.

MANUFACTURED IN THEIR LONDON WORKS BY

Opticians to H.M. the King. **NEWTON & COMPANY** **Established over 200 Years.**

Specialists in Optical Projection Apparatus for Visual Instruction,

72 WIGMORE STREET, LONDON, W.1.

For Critical Work

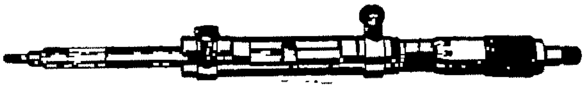
SIRA
MOUNTANT

A neutral mountant. The acidic properties of Canada Balsam are known to affect certain substances and stains **SIRA** Mountant is prepared in accordance with the directions of The British Scientific Instrument Research Association, and should be used in place of Canada Balsam.

Price 2/6 per bottle.

Sole Manufacturers:
Stafford Allen & Sons, Ltd.
Estab. 1833, 7 *Cowper St., London, E.C.2.*

From all Scientific Instrument Makers and Dealers.



'AGLA'
Micrometer Syringe Apparatus

Secures a fine degree of accuracy in—
Immunological titrations with small quantities of Sera. Micro-chemical titrations and micro-gas analyses. Calibration of pipettes of small volume.

Price in London, 55/- Net. ***Further information on request***

BURROUGHS WELLCOME & CO., LONDON
XX 4609 *All Rights Reserved*

ULTRA VIOLET RAYS

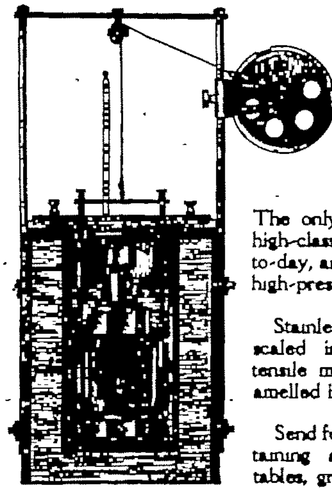
WHICH ARE STOPPED BY
GLASS PASS THROUGH
WINDOLITE,
The Practical Glass Substitute
for windows in **FACTORIES, SCHOOLS,** and **HOSPITALS;**
for **POULTRY HOUSES, BROODERS,** and **CATTLE SHEDS;**
for all **GARDEN USES.**
Light. Flexible. Unbreakable.
Easy to cut and fix
Particulars post free, or Sample 3 ft. by 1 ft. for 4/6.
WINDOLITE (Dept. M), 179/185 Great Portland St.,
LONDON, W.1.

G. C. DYMOND, F.I.C.P.A. H. E. POTTS, F.I.C.P.A.
W. P. THOMPSON & CO.,
CHARTERED PATENT AGENTS,
12 CHURCH STREET, LIVERPOOL,
and 50 LINCOLN'S INN FIELDS, LONDON.
J. V. ARMSTRONG, F.I.C.P.A. W. H. BEESTON, R.P.A.

RHEINBERG MICROMETERS and other GRATICULES by the processes of Grainless and of Filmless Photography Stock list of standard articles on request. RHEINBERG & Co., 57-60 Holborn Viaduct, London, E.C.1.

KING'S PATENT AGENCY LTD., 146a Queen Victoria Street, E.C.4. Advice handbook free. 40 years' refs.

THE
MAHLER-COOK
BOMB CALORIMETER



For determining the calorific value of Fuels (Coal, Coke, Oils, etc.).

The original Bomb Calorimeter, used all over the World and first introduced by the present makers in 1900. The only reliable, accurate, and high-class apparatus on the market to-day, and made by Engineers and high-pressure experts.

Stainless steel Bombs with descaled internal finish, or high tensile mild steel Bombs with enamelled interior.

Send for Illustrated Booklet containing all working instructions, tables, graphs, etc.

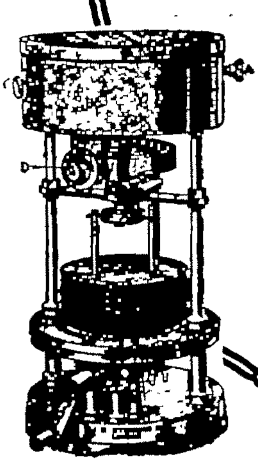
High Pressure Apparatus, Centrifuges, Microtomes, Electroscopes, Steam Meters, Electric Furnaces, etc.

CHAS. W. COOK & SONS,
ROYAL HOTEL WORKS,
ASHBY-DE-LA-ZOUCH, LEICS.
LONDON STOCKISTS. **Messrs. Baird & Tatlock (London) Ltd., Cross Street, Hatton Garden, E.C.1.**

For ascertaining easily and accurately the Lubricating Value of Oils

also the Oiliness, or Efficiency, by determining the Static Friction between any desired Metals.

The Deeley
FRICTION MACHINE
(PATENT)



Descriptive Pamphlet of the Machine, stating the principles upon which it is based, together with directions for testing Oils, will be forwarded on application to the Sole Manufacturers:

J. H. STEWARD, Ltd.,
Scientific Instrument Makers,
406 & 457 STRAND,
LONDON, W.C.2.
ESTABLISHED [illegible]

"POSTLIP"
(No. 633 Mill)
ENGLISH FILTER PAPERS

Manufactured in
ANNUALLY INCREASING QUANTITIES
for upwards of 50 years.

White and Grey Plain, Antique, Crinkled, and Embossed.

PURE FILTERS POSTLIP MILLS

All sizes in Squares, Circles, and Folded Filters. Rolls made to order.

Pure Filterings for Laboratory Work and in quantities for all industrial purposes.

See Report of TESTS made by The National Physical Laboratory, a copy of which will be sent on application, together with free samples if required.

EVANS, ADLARD & CO., LTD.
POSTLIP MILLS,
WINCHCOMBE, CHELTENHAM, ENGLAND.

W. OTTWAY & Co. Ltd.
(Established 1640)
Actual Makers of Astronomical and Terrestrial Telescopes

STAINLESS STEEL MIRRORS AND FLATS

for Reflector Telescopes; no silvering required. A permanent highly polished surface guaranteed.

Surplus stock of 1¼" and 2", 90 degree **REFLECTING PRISMS** made from the best Optical glass flat surfaces; guaranteed highest quality. 1¼", **£1 5 0.** 2", **£1 15 0.**

All types of **Astronomical Telescopes, Eyepieces, Equatorial Mountings, etc.** Pamphlets post free on application.

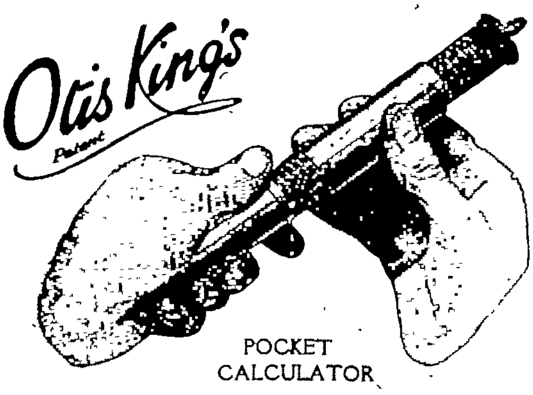
Orion Works, Ealing, London, W.5.

GAS SUPPLIES FOR LABORATORIES.

Mansfield Oil-Gas apparatus places in the hands of scientists whose laboratories are not supplied with town's gas, a means of securing a supply of gas which gives a perfect oxidising or reducing flame.

This plant has been supplied during the past 50 years to many of the important laboratories in the British Empire.

Write for particulars to
MANSFIELD & SONS, LTD.,
23 HAMILTON SQUARE, BIRKENHEAD.



"accuracy is about four times that of the ordinary ten-inch slide rule . . ."

writes a B.Sc., from Canada. This unsolicited letter goes on to state: "My estimate is that I have made about fifty thousand calculations with your product. About twenty-two thousand hydraulic calculations have been made in the last month with a probable error of any one calculation not greater than 5/100 of 1%."

Otis King Model K for multiplication, division, proportion, percentages. Model L gives, in addition, all powers and roots—fractional or otherwise—of all numbers without limit.

Price, packed in leather case, 21/- (special Black Cursor 1/6 extra), post free within U.K.

Write for illustrated and fully descriptive folder.

CARBIC LIMITED
(Dept. N), 51 Holborn Viaduct, London, E.C.1.
Agents in most Dominions and Foreign Countries.

LABORATORY EQUIPMENT

Those interested in the fitting of a **new laboratory** or the extension or rearrangement of existing labs., are invited to communicate with us. We are **specialists** in the making of **benches, fume cupboards,** and all types of furniture, and hold large stocks of laboratory **water and gas fittings, sinks, etc.** Plans and lay-outs submitted, or estimates given to clients' own prepared schemes.

BROWN & SON (ALEMBIC WORKS) LTD.
Laboratory Fitters
ALEMBIC WORKS, WEDMORE STREET
LONDON, N.19.

NOTICE.

NATURE for August 7, containing the Presidential Address of H.R.H. the Prince of Wales to the British Association, and Summaries of the Addresses of the Presidents of the Sections, can be sent to residents in the British Isles on receipt of 1s. 1½d., or to residents abroad on receipt of 1s. 2d.

St. Martin's Street, London, W.C.2

DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

Trustees: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Prof. A. C. Seward, Sc.D., F.R.S., Prof. R. S. Conway, Litt.D., F.B.A.

A *free* specimen copy of "Discovery" will be sent to anyone on request.

Contents of the October issue include:

HONG KONG UNIVERSITY. By Sir Arthur Shipley, G.B.E., F.R.S.
THE NEW GIBRALTAR SKULL. By E. N. Fallaize.
CRUSTACEAN LARVAE. By Robert Gurney.
SPECIAL PHOTOGRAPHS OF THE AMERICAN EXPEDITIONS TO THE GOBI DESERT, 1922–25.

Copies of the special July *Empire University Number*, and the August *British Association Number* to which Sir Oliver Lodge contributed his reminiscences of the 1894 meeting at Oxford, can still be obtained, each 1s. 2d. post free.

Illustrated. 1s. Monthly.
Annual Subscription 12s. 6d. post free.

BENN BROTHERS LTD.
154 Fleet Street, London, E.C.4

JOURNAL OF THE ROYAL STATISTICAL SOCIETY.

New Series.
Vol. LXXXIX. Part IV July 1926.
Price 7s. 6d.

CONTENTS.

"Some Observations on Trade Forecasting and Prices" By E. C. Snow, M.A., D.Sc. (With Discussion.)

Miscellanea.—

"Some Statistics concerning Occupational Invalidity—Economic, Mental and Moral" By D. Caradog Jones, M.A.

"The Contributions of Italy to Modern Statistical Methods." By Corrado Gini.

Annual Report of the Council.

Proceedings of the Ninety-Second Annual General Meeting.

Reviews of Books. Current Notes.

Royal Statistical Society, 9 Adelphi Terrace, W.C. 2.

ADLARD & SON

LIMITED

IT 66

A S

SCIENCE PRINTERS.

Home and Export.

23 Bartholomew Close, London, E.C.1.

Now ready. **Third Edition.**

A TEXT-BOOK OF EXPERIMENTAL PSYCHOLOGY

By CHARLES S. MYERS, M.A., M.D., Sc.D., F.R.S.,
and F. C. BARTLETT, M.A.

In two parts. **Price 16s net.**

The two parts are also sold separately:—Part I, Text-book, **10s 6d** net; Part II, Laboratory Exercises. With 40 Figures and Diagrams, **7s** net.

"The edition just issued is probably the most complete text-book of experimental psychology in this or any other language. Every page is loaded with trustworthy statements of verified fact, yet the argumentation is so well ordered, and the style so concise and clear, that the book can be read with ease and pleasure."

Nature on the Second Edition

Prospectus on application.

CAMBRIDGE UNIVERSITY PRESS
Fetter Lane, London, E.C.4

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals. General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A–R (pp. 112). Part V: Physics, Letters S–Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). **Just published:** Part VII: Chemistry and Chemical Technology (pp. 208). **In preparation:** Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."

NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

PATENTS AND CHEMICAL RESEARCH.

By HAROLD E. POTTS, M.Sc.,
CHARTERED PATENT AGENT.

Demy 8vo Cloth. 8/6 net.

"There can be no question of the Author's grasp of the fundamentals of patent law; the discrimination with which he has selected his leading cases when discussing the validity of patents demonstrates this."—*Nature*.

THE UNIVERSITY PRESS OF LIVERPOOL, LIMITED,
HODDER AND STOUGHTON, LIMITED, LONDON.

SCIENTIFIC BOOKS

AND PERIODICALS

Including the Publications of the Learned Societies,
ON SALE BY

WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

GERMAN BOOKS

AND PERIODICALS

supplied by

W. MULLER, Foreign Bookseller,
26 Hart Street, Bloomsbury, London, W.C.1
References in all countries.

NATURAL SCIENCE

BOOKS AND PERIODICALS

INCLUDING THE PUBLICATIONS
OF THE LEARNED SOCIETIES

CATALOGUES GRATIS LIBRARIES PURCHASED

BERNARD QUARITCH LTD.
11 Grafton Street, New Bond Street, London, W.1

THE

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE

No. 279. (Vol. 70. Part III.) Price 21s. net.

CONTENTS.—J. B. Gatenby and Vishwa Nath (The Oogenesis of Certain Invertebrata, with Special Reference to Lumbricus). C. M. Yonge (Protandry in Teredo norvegica). R. H. Bowen (Studies on the Golgi Apparatus in Gland-Cells. III. Lachrymal Glands and Glands of the male Reproductive System). R. H. Bowen (Studies on the Golgi Apparatus in Gland-Cells. IV. Topography, Structure, and Function of the Golgi Apparatus in Glandular Tissue). A. N. Sewertzoff (Studies on the Bony Skull of Fishes). R. Palmer (The Chromosome Complex of Gammarus chevreuxi. I. Spermatogenesis). Seana D. King (Note on the Oogenesis of Peripatopsis Capensis).

With 6 plates and 56 text-figures.

Subscription for four numbers of a volume post free on issue

£4:0:0

OXFORD UNIVERSITY PRESS
Amen House, London, E.C.4

SCIENCE PROGRESS

A QUARTERLY REVIEW OF SCIENTIFIC THOUGHT, WORK, AND AFFAIRS

Editor: Sir RONALD ROSS, K.C.B., F.R.S., &c.

No. 82 *OCTOBER 1926* *7s. 6d. net*

Recent Advances in Science: Pure Mathematics; Astronomy, Physics, Organic Chemistry, Geology, Prehistoric Archæology; Botany; Zoology; Entomology; Agricultural Physiology.

Articles: Host-Parasite Specificity among Human Protozoa. By R. W. Hegner. A Statistical Study of the Relationship between Mental or Athletic Activity and Physical or Respiratory Development. By D. Caradog Jones, M.A. The Scientific Renaissance. By Prof. Joseph Mayer, Ph D.

Popular Science: Methods of Making Maps. By H. Spencer Toy, B.Sc, and J. E. Coleclough, B A, F.R.G.S.

Essays: John Napier and the Invention of Logarithms. By Prof. G. A. Miller, M A, Ph D.

Notes: The Annual Meeting of the British Association; Reports of the Kala-Azar Commission in India, The Cure of Diseases; White Acclimatization in the Wet Tropics; The Ross Institute and Hospital for Tropical Diseases, Notes and News

Correspondence: On Artificial Functions and Non-Uniform Convergence, Statistical Methods for Research Workers; Elements of Physical Biology.

Reviews of 38 Books, etc.

Annual Subscription, post free, **51s. 2d.**

JOHN MURRAY, Albemarle St., LONDON, W.1.

METHUEN'S NEW SCIENCE BOOKS

Autumn 1926

THREE LECTURES ON ATOMIC PHYSICS

By Arnold Sommerfeld, Professor of Theoretical Physics at the University of Munich. Translated by Dr. Henry L. Brose. With 8 Diagrams. 2s. 6d. net.

HISTORY OF SCIENCES IN GRECO-ROMAN ANTIQUITY

By Professor Arnold Reymond, Lecturer on Philosophy at the University of Neuchâtel. Translated by Ruth Gheury de Bray. With 40 Diagrams. 7s. 6d. net.

COLLOID AND CAPILLARY CHEMISTRY.

By Professor Dr. Herbert Freundlich. Translated by H. Stafford Hatfield, Ph.D. With 157 Diagrams and 195 Tables. 50s. net.

NEW CONCEPTIONS IN COLLOIDAL CHEMISTRY

By Professor Dr. Herbert Freundlich. With 47 Diagrams and 20 Tables. 6s. net.

PRACTICAL COLLOID CHEMISTRY

By Wolfgang Ostwald, Ph.D., Professor of Colloidal Chemistry in the University of Leipzig, with the collaboration of W. P. Wolski and Dr. A. Kuhn. Translated by J. Newton Kugelmass, M.D., Ph.D., Sc.D., Yale University School of Medicine, and Theodore K. Cleveland, Ph.D. With 22 Illustrations. 7s. 6d. net.

THE THEORY OF THE BROWNIAN MOVEMENT

By Albert Einstein. Translated by A. D. Cowper, B Sc. (Lond.), M.Sc., A.I.C. With 3 Diagrams. 5s. net.

MAGNETISM AND ATOMIC STRUCTURE

By Edmund C. Stoner, Ph.D.(Cambridge), Lecturer in Physics at the University of Leeds. With 61 Diagrams. 18s. net.

THE NEW HEAT THEOREM, its Foundations in Theory and Experiment

By Professor W. Nernst, of Berlin University. Translated from the second German edition by Guy Barr, B.A., D.Sc. With 21 Diagrams. 12s. 6d. net.

FOURFOLD GEOMETRY: being the Elementary Geometry of the Four-dimensional World

By D. B. Mair. With 61 Diagrams. 8s. 6d. net.

THE DIVINING-ROD

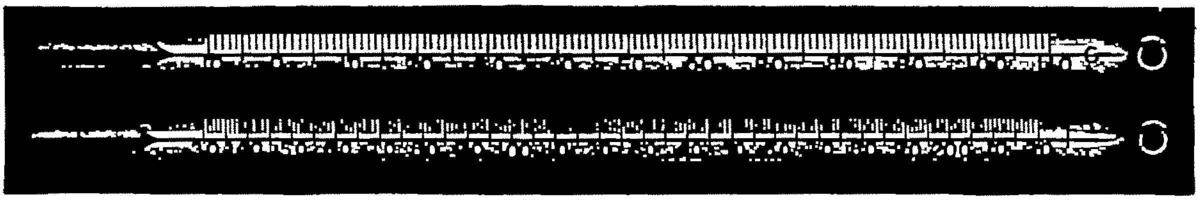
By the late Sir William Barrett, F.R.S., and Theodore Besterman. With 12 Plates and 70 Illustrations in the text. 18s net.

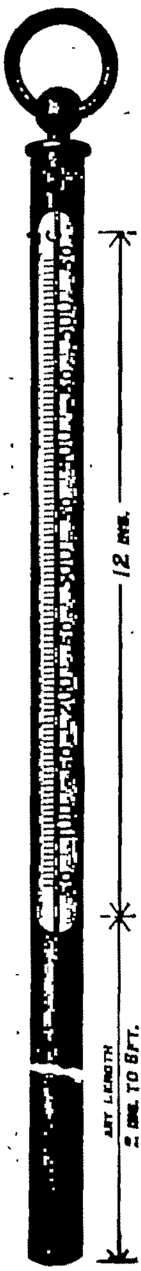
METHUEN & CO. LTD.
36 Essex Street, LONDON, W.C.2

THERMOMETERS FOR CHEMICAL LABORATORIES

With Normal Glass Bulbs.

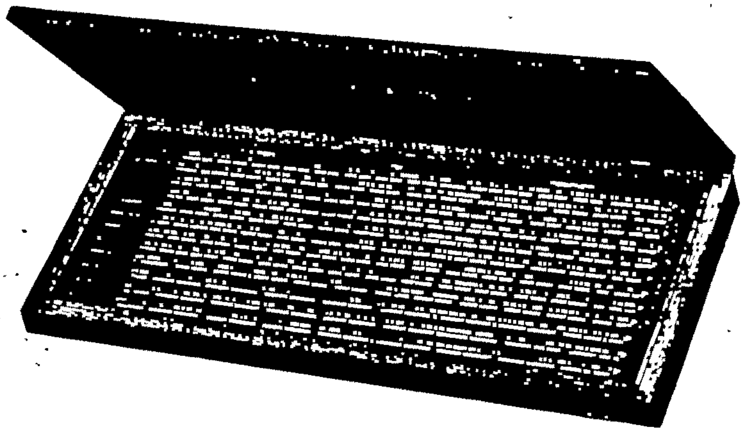
OUR OWN MANUFACTURE. BEST QUALITY (GUARANTEED ACCURATE) AT REASONABLE PRICES




12 ins.
ANY LENGTH
2 ins. TO 8 FT.

High Temperature Thermometers.

SETS OF STANDARD THERMOMETERS
divided to $\frac{1}{5}$° and $\frac{1}{10}$°
With National Physical Laboratory Certificates.



New Revised Catalogue of Chemical Laboratory Thermometers, showing Reduced Prices, post free on request.
☛ *See Editorial Notice, NATURE, April 21, 1923, page 545.*

Special Thermometers of any Length or Range made to order in a few days.

PASTORELLI & RAPKIN LTD.

Contractors to various Departments of H.M. Government

46 HATTON GARDEN, LONDON, E.C.1.

Actual Manufacturers of

THERMOMETERS FOR ALL INDUSTRIAL PURPOSES

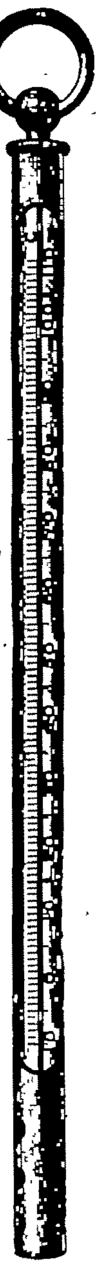
Barometers, Barographs, Thermographs, Hygrographs, Hydrometers, Standard Meteorological Instruments, Etc.

ILLUSTRATED PRICE LISTS ON APPLICATION

'Phone—Holborn 1881. ESTABLISHED 1750. Telegrams—Rapkin, London.

Any instrument sent on approval if desired.

Brass or Steel Protecting Sheaths.



Carriage paid and safe delivery guaranteed of all instruments within the British Isles.

EDWARD ARNOLD & CO.'S TEXTBOOKS

NEW BOOKS AND NEW EDITIONS

METAL-WORK. By H. M. Adam, Organiser and Instructor in Handicraft to the Eastbourne Education Committee, and J. H. Evans, A.M.I.Mech.E., Instructor in Metal-work, Stanley Central L.C.C. School. **Second Edition.** Revised and Enlarged. **6s. 6d.** [*October*

PHYSICO-CHEMICAL PERIODICITY. By J. E. Myers, O.B.E., D.Sc., Senior Lecturer in Chemistry in the University of Manchester, and E. S. Hedges, M.Sc., Ph.D., Bedford College, London. With Foreword by Professor S. G. Donnan, F.R.S. Demy 8vo. **7s. 6d.** net. [*October*

THE EVOLUTION AND DEVELOPMENT OF THE QUANTUM THEORY. By N. M. Bligh, A.R.C.S., A.I.C. With a Foreword by Professor Planck. Demy 8vo. **9s.** net [*November*

ELEMENTARY BOTANY. An Introduction to the Study of Plant Life. By W. Watson, D.Sc., Biology Master at Taunton School. 225 Illustrations. **6s. 6d.** [*November*

ANCIENT EGYPTIAN MATERIALS. By A. Lucas, F.I.C., Chemist in the Department of Antiquities, Cairo; author of "Forensic Chemistry," etc. Crown 8vo. **7s. 6d.** net. [*November*

NEW EDITION, REVISED AND ENLARGED

A HANDBOOK OF ORGANIC ANALYSIS: Qualitative and Quantitative. By H. T. Clarke, B.Sc., F.I.C., with an Introduction by Professor J. Norman Collie, F.R.S. xvi + 372 pages, 23 Figures, with classified Tables of Common Organic Compounds. **Fourth Edition.** Crown 8vo. **8s. 6d.** net. [*November*

A TEXTBOOK OF PHYSICS. By R. S. Willows, M.A. (Camb.), D.Sc. (Lond.) **Third Edition.** viii + 536 pages with 333 Diagrams. **8s.** net.

GENERAL ASTRONOMY. By H. Spencer Jones, M.A., B.Sc., M.B.E., H.M. Astronomer at the Cape of Good Hope. viii + 392 pages, with 102 Diagrams and 24 Plates. **21s.** net.

IONS, ELECTRONS, AND IONIZING RADIATIONS. By J. A. Crowther, M.A., Sc.D., Professor of Physics in the University of Reading. **Fourth Edition.** Thoroughly revised. xii + 328 pages. **12s. 6d.** net.

ISOTOPES. By F. W. Aston, D.Sc., M.A., F.R.S., Nobel Laureate, Fellow of Trinity College, Cambridge. **Second Edition.** With 21 Diagrams and 5 Plates. **10s. 6d.** net.

ORGANIC CHEMISTRY FOR ADVANCED STUDENTS. By Julius B. Cohen, Ph.D., F.R.S., Emeritus Professor of Organic Chemistry in the University of Leeds. **Fourth Edition.** Part I. Reactions. Part II. Structure. Part III. Synthesis. **18s.** net each volume.

INORGANIC CHEMISTRY. A Textbook for Colleges and Schools. By E. J. Holmyard, M.A., F.I.C., Head of the Science Department, Clifton College. **6s. 6d.**

"The very model of all that such a book should be."—*Chemistry and Industry.*

OUTLINES OF ORGANIC CHEMISTRY. By E. J. Holmyard, M.A. **7s. 6d.** net.

"The reviewer is of opinion that Mr. Holmyard's book is the best elementary textbook of Organic Chemistry which has appeared for many years in any language."—*Science Progress.*

PHYSICAL CHEMISTRY: its Bearing on Biology and Medicine. By J. C. Philip, M.A., F.R.S., D.Sc., Professor of Physical Chemistry in the Imperial College of Science and Technology. viii + 326 pages. **Third Edition.** **8s. 6d.** net.

ELEMENTARY PHYSICAL CHEMISTRY. By W. H. Barrett, M.A., Harrow School. A well-graduated course covering Higher Certificate and Scholarship work. **6s.**

OUTLINES OF PALÆONTOLOGY. By H. H. Swinnerton, D.Sc., F.Z.S., Professor of Geology, University College, Nottingham. 420 pages. 368 Illustrations. **30s.** net.

GEOLOGICAL AND TOPOGRAPHICAL MAPS: their Interpretation and Use. By A. R. Dwerryhouse, D.Sc., F.G.S., Lecturer in Geology at University College, Reading. **Second Edition. Second Impression.** viii + 133 pages, with 90 Illustrations. Cloth. **6s.** net.

A STUDY OF THE OCEANS. By J. Johnstone, D.Sc., Professor of Oceanography in the University of Liverpool. Illustrated. **10s. 6d.** net.

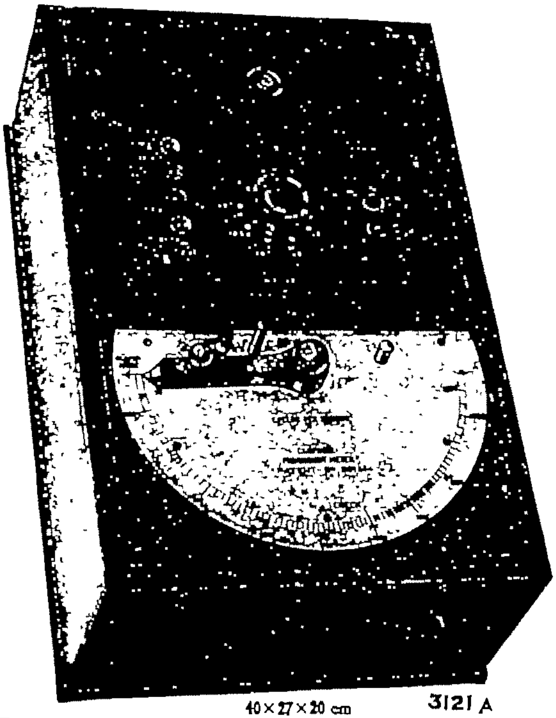
"This is an admirable book, and of its various qualities it is hard to say which one admires the most."—*Times Literary Supplement.*

MANUAL OF ENTOMOLOGY. With Special Reference to its Economic Aspects. By the late H. Maxwell Lefroy, M.A., Professor of Entomology, Imperial College of Science and Technology. Fully Illustrated. **35s.** net.

GROWTH. By G. A. de Beer, B.A., B.Sc., F.L.S., John Wilfred Jenkinson Lecturer on Embryology in the University of Oxford. With Plates and Diagrams. **7s. 6d.** net.

London: EDWARD ARNOLD & CO., 41 & 43 Maddox St., W.1.

—CAMPBELL FREQUENCY METER—



47 40 × 27 × 20 cm 3121 A

This instrument, designed by Mr. Albert Campbell, measures acoustic frequencies from about 18 to 4000 cycles, the accuracy being such that at 1000 cycles readings may be taken to within 0·1 per cent. The instrument is portable and convenient to use. Further particulars are given in List No. 170-N.

DELIVERY FROM STOCK.

CAMBRIDGE
INSTRUMENT Cº Lᵀᴰ

WORKS:-
LONDON, &
CAMBRIDGE

Head Office & Showrooms:- 45, GROSVENOR PLACE
LONDON, S.W.1

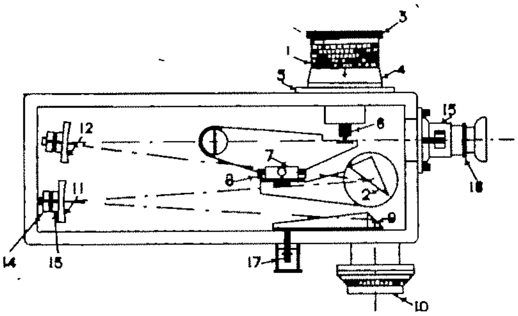
AMERICAN COMPANY
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

B-S
Spectrometer

for the

Visible, Ultra-violet or Infra-red Spectrum.

Reading directly in wavelengths.



Separate divided sleeves fitting over the drum of the micrometer screw can be supplied for use either with Quartz, Glass, or Rocksalt Prisms.

"British and Best"

Full particulars from the Makers:

BELLINGHAM & STANLEY LTD.
71 Hornsey Rise, London, N.19
Phone: Mountview 2270

MANUFACTURE OF SCIENTIFIC INSTRUMENTS

We have recently installed new machinery in our workshops, and are prepared to undertake the manufacture of new instruments to special design. We have a large selection of school microscopes suitable for educational purposes, workshop microscopes suitable for industrial use, microscope lamps, and special microscopical accessories, all of which are manufactured in our own workshops.

REPAIRS TO SCIENTIFIC INSTRUMENTS

Our facilities for carrying out all kinds of repairs to scientific instruments having been increased, we are now able to undertake additional work, and to carry out the repairs in a shorter time than hitherto. Our men are highly skilled mechanics, of long experience in this type of work, and produce results of the highest quality.

Catalogues and Estimates

Catalogues will be sent post free on request, and estimates are submitted free of cost.

Microscopes—Microtomes—Dark Ground Condensers—Photomicrographic Apparatus—Hæmatological Appliances—Dissecting Stands and Lenses—Microscopical, Medical and Dental Illuminating Apparatus—Micro-projection Apparatus—Epidiascopes—Colorimeters—Prismatic Field Glasses—Cameras, &c.

OGILVY & CO.
Optical Engineers
20 Mortimer Street, London, W.1

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

J. & A. CHURCHILL

42 Illustrations. 15s. net. Postage 6d.

THE PREPARATION AND ANALYSIS OF ORGANIC COMPOUNDS

By J. BERNARD COLEMAN, A R C.Sc., F.I.C., F.C.S., and FRANCIS ARNALL, Ph.D., M.Sc., F.I.C.,
Lecturer in Chemistry, Chelsea Polytechnic, London.

---

115 Experiments. 30 Illustrations. 10s. 6d. net. Postage 6d.

THEORETICAL ORGANIC CHEMISTRY—Part I

By FRANCIS ARNALL, Ph.D., M.Sc., F.I.C., Lecturer in Chemistry, Chelsea Polytechnic, London, and
F. W. HODGES, M.Sc., Senior Science Master, Coopers' Company School, London.

---

38 Illustrations. 12s. 6d. net. Postage 6d.

RECENT ADVANCES IN BIOCHEMISTRY

By J. PRYDE, B.Sc., M.Sc., Lecturer in Physiological Chemistry, Welsh National School of Medicine.
F.R.S. writes: "It is the best book of its kind I have ever seen."

New (Second) Edition. 70 Illustrations. 12s. 6d. net. Postage 6d.

RECENT ADVANCES IN PHYSIOLOGY

By C. LOVATT EVANS, D.Sc., M.R.C.S., L.R.C P., F.R.S., Jodrell Professor of Physiology,
University College, London.

THE PLANT ALKALOIDS. By T A. HENRY, D Sc., Director, Wellcome Chem. Research Laboratories. Second Ed 8 Plates. 28s. net Post 9d.

VOLUMETRIC ANALYSIS. By C H. HAMPSHIRE, B Sc., F.I.C. Third Ed. 7s. 6d. net. Post. 4d.

By FRANK CLOWES and J. B. COLEMAN.

QUANTITATIVE CHEMICAL ANALYSIS. Twelfth Ed. 133 Illus. 18s. net Post. 9d.

QUALITATIVE ANALYSIS. Ninth Ed. 84 Illus. 12s. 6d. net. Post. 9d.

ELEMENTARY PRACTICAL CHEMISTRY. 7th Ed. Part I.—GENERAL CHEMISTRY. 9th Ed. Part II.—ANALYTICAL CHEMISTRY. 95 Illus. 6s net each. Post. 4d.

INDUSTRIAL ORGANIC ANALYSIS. By PAUL S. ARUP, B.Sc., A.C.G.I. 2nd Ed. 14 Illus 12s 6d net. Post. 6d.

CORBIN AND STEWART'S PHYSICS AND CHEMISTRY. 5th Ed 200 Illus. 12s. 6d. net. Post. 6d.

GIUA'S CHEMICAL COMBINATION AMONG METALS. Translated by G. W. ROBINSON, Univ. Coll., Bangor 207 Diagrams. 21s. net. Post 9d.

ELEMENTARY PRACTICAL METALLURGY. By J. H. STANSBIE, B.Sc., F.I.C. 25 Illus. 5s. net. Post 4d.

THE CHEMISTRY OF THE CYANOGEN COMPOUNDS, AND THEIR MANUFACTURE AND ESTIMATION. By H. E. WILLIAMS 12s 6d net. Post. 8d.

---

2 Volumes. 72 Illustrations. £2 : 2s. net. Postage 1s.

THE ATMOSPHERIC NITROGEN INDUSTRY

WITH SPECIAL CONSIDERATION OF THE PRODUCTION OF AMMONIA AND NITRIC ACID

By DR. BRUNO WAESER. Translated by ERNEST FYLEMAN, B.Sc., Ph.D., F.I.C.
With a FOREWORD by J. F. CROWLEY, D.Sc., B.A., M.I.E.E.

55 Illustrations. 9s 6d. net. Postage 6d.

GASWORKS LABORATORY HANDBOOK

By W. I. INESON, Chief Chemist, Bradford Corporation Gas Department, Lecturer in Gas Engineering and Gas Supply, Technical College, Bradford.

---

50 Illustrations. 10s. 6d. net. Postage 6d.

CHEMISTRY OF THE PROTEINS AND ITS ECONOMIC APPLICATIONS

By DOROTHY JORDAN LLOYD, M.A., D.Sc., F.I.C. INTRODUCTION by SIR F. G. HOPKINS, F.R.S.

By PROF. H. GREENISH, F.I.C., F.L.S.
Fourth Edition. 270 Illustrations. 25s. net. Postage 9d.
A TEXT-BOOK OF MATERIA MEDICA

Third Edition. 209 Illustrations. 18s. net. Postage 6d.
MICROSCOPICAL EXAM. OF FOOD AND DRUGS

TOGNOLI'S REAGENTS AND REACTIONS. Translated by C. A. MITCHELL, M.A., F.I.C. 7s. 6d. net Post. 3d.

42 Illustrations. 12s. 6d. net. Postage 6d.
PREGL'S QUANT. ORGANIC MICRO-ANALYSIS
Translated by E. FYLEMAN, B.Sc., Ph.D, F.I.C.

Illustrated. 10s. 6d. net. Postage 6d.
QUALITATIVE AND VOLUMETRIC CHEMICAL ANALYSIS.
By W. CALDWELL, Professor of Chemistry, R.C.S.I
Introduction by C. S. GIBSON, Prof. Chem., Univ. Lond., at Guy's Medical School.

In One Volume 288 Illustrations 10s. 6d. net. Postage 6d.
STEAD'S PHYSICS
By G. STEAD, M.A., Univ. Lecturer in Physics as applied to Med. Radiology, Camb.
Also in Three Parts. 4s. net each

---

22 Illustrations. 15s. net. Postage 6d.

FOURNEAU'S ORGANIC MEDICAMENTS AND THEIR PREPARATION

Translated by W. A. SILVESTER, M.Sc. Prefaces by ÉMILE ROUX and G. BARGER, F.R.S.

London: J. & A. CHURCHILL, 7 Great Marlborough Street, W.1

SCIENCE PROGRESS

A QUARTERLY REVIEW OF SCIENTIFIC THOUGHT, WORK, AND AFFAIRS

Editor: Sir RONALD ROSS, K.C.B., F.R.S., &c.

No. 82 *OCTOBER 1926* *7s. 6d. net*

Recent Advances in Science: Pure Mathematics; Astronomy; Physics; Organic Chemistry; Geology; Prehistoric Archæology; Botany; Zoology; Entomology; Agricultural Physiology.

Articles: Host-Parasite Specificity among Human Protozoa. By R. W. Hegner. A Statistical Study of the Relationship between Mental or Athletic Activity and Physical or Respiratory Development. By D. Caradog Jones, M.A. The Scientific Renaissance. By Prof. Joseph Mayer, Ph.D.

Popular Science: Methods of Making Maps. By H. Spencer Toy, B.Sc., and J. E. Coleclough, B.A., F.R.G.S.

Essays: John Napier and the Invention of Logarithms. By Prof. G. A. Miller, M.A., Ph.D.

Notes: The Annual Meeting of the British Association; Reports of the Kala-Azar Commission in India; The Cure of Diseases; White Acclimatisation in the Wet Tropics; The Ross Institute and Hospital for Tropical Diseases; Notes and News.

Correspondence: On Artificial Functions and Non-Uniform Convergence; Statistical Methods for Research Workers; Elements of Physical Biology.

Reviews of 38 Books, etc.

Annual Subscription, post free, **31s. 2d.**

JOHN MURRAY, Albemarle St., LONDON, W.1.

HOPKIN & WILLIAMS, Ltd.

16 & 17 Cross St., Hatton Garden, London, E.C.1

Works: Ilford, Essex. Telegrams: "[illegible], [illegible], London." Telephone: Holborn [illegible] and [illegible]

The Leading British House for

CHEMICAL REAGENTS

PURE, FINE, AND RARE CHEMICALS

Manufacturers of Guaranteed

Chemical Reagents for Analysis and Research.

Made and supplied to standards and specifications described in the publication

"Analytical Reagents: Standards and Tests."

Compiled by
EDMUND WHITE, B.Sc. (Lond.), F.I.C.

Published by
HOPKIN & WILLIAMS, LTD.

NEW EDITION, 1925.
CLOTH BOUND. INTERLEAVED.

Price 1/6 post free from the Publishers.

J. POOLE & CO.

ESTABLISHED 1854

NEW & SECOND-HAND
SCIENTIFIC AND EDUCATIONAL
BOOKSELLERS

ENQUIRIES BY LETTER RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

¶ W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE, will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ CATALOGUE 269. Scientific Books and Publications of learned Societies.

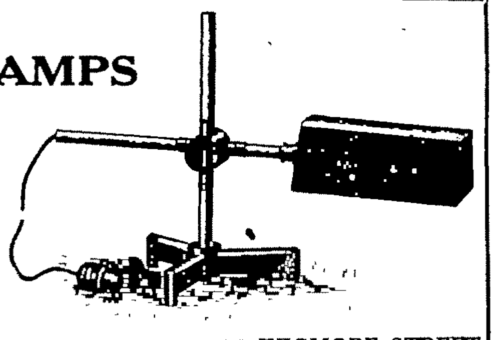
Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone: [illegible] (2 lines).

ELECTRIC MICROSCOPE LAMPS

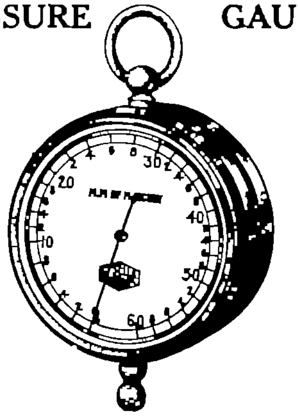
For { High Power Microscopy
Dark Ground Illumination
Dissecting, etc.

NEW DAYLIGHT LAMP
Particulars on request



HAWKSLEY & SONS, LTD. 83 WIGMORE STREET LONDON, W.1

CASELLA'S SENSITIVE
PRESSURE GAUGES



The illustration shows a gauge 55 mm. diam., reading to 60 mm. of mercury.
Price £2 17 6

C. F. CASELLA & CO. LTD.
Parliament Street, London, S.W.1

MAN An illustrated monthly record of Anthropological Science, 2s. net per part, 20s. a year, post free anywhere.

CONTENTS OF OCTOBER ISSUE.

ORIGINAL ARTICLES: Some Factors in Racial Immunity and Susceptibility to Disease. (*Illustrated*.)—Palæolithic Industries from the Beginning of the Rissian to the Beginning of the Wurmian Glaciation.—On the Probability that the Distribution of Illegitimacy in the British Isles depends upon Survival of Custom from Definite Racial Invasions. (*Illustrated*.)—Ancient History in Keane's "Man, Past and Present" (1920).—Obituary of Sir William Ridgeway. (*With Plate L.*)—A Small-Pox Edict Pillar at Lhasa (*Illustrated*.)—REVIEWS.—CORRESPONDENCE.

THE ROYAL ANTHROPOLOGICAL INSTITUTE,
52 Upper Bedford Place, Russell Square, London, W.C.1

Just Issued
from the Natural History Department of
DULAU & COMPANY LTD.
54–56 Margaret St., Cavendish Square, London, W.1
CATALOGUE No. 143:
PHYTO-PATHOLOGY AND HORTICULTURE.
Post free on request.

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

CHEMICAL AND TECHNICAL BOOKS
We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms
Write for Catalogue—
WILLIAM BRYCE, Scientific Bookseller,
54-54a Lothian Street, EDINBURGH.

B.D.H. CHEMICALS
FOR RESEARCH AND ANALYSIS

BRITISH MANUFACTURE

Over 3500 Substances for use in Research and Analysis are kept in stock, and we are continually adding to the list of our manufactures. The reliable quality of the B.D.H. Organic Chemicals and Analytical Reagents has led to their adoption by those who place the highest value on scientific accuracy.

A copy of our latest Catalogue will be supplied on application.

THE BRITISH DRUG HOUSES, LTD.
Makers of Fine Chemicals,
Graham St., City Road, London, N.1.
Chemical Works: Wharf Road, London, N.1.

ZENITH

NOTICE

We beg to inform our customers and suppliers that the business formerly carried on as THE ZENITH MANUFACTURING COMPANY has now been incorporated as a private company under the title of

THE ZENITH ELECTRIC COMPANY, LIMITED,

in order to provide additional capital and manufacturing facilities to cope with the increased demand for our well-known "ZENITH" electrical products.

Provision has been made for the collection by the new company of all accounts and the discharge by them of all liabilities in connection with the business, which will be continued without interruption under the same management, but the new title as above.

The directors trust that the happy relationship which has subsisted in the past will continue under the new proprietary.

THE ZENITH ELECTRIC CO. LTD.
Contractors to H.M. Admiralty, War Office, Air Ministry, Post Office, L.C.C., etc.
ZENITH WORKS, VILLIERS ROAD,
WILLESDEN GREEN, LONDON, N.W.2
Telephone: Willesden 4087-8. *Telegrams*: "Voltaohm, Willroad, London."

MACMILLAN'S NEW AND RECENT BOOKS.

IN UNKNOWN ARABIA. By MAJOR R. E. CHEESMAN, O.B.E., F.R.G.S., His Majesty's Consul in North-west Abyssinia. With a Foreword by MAJOR-GENERAL SIR PERCY Z. COX, G.C.M.G. With 32 pages of Illustrations in half-tone and 3 Maps and Plans Super Royal 8vo. 25s. net.

COTTON AND ITS PRODUCTION. By W. H. JOHNSON, lately Agricultural Adviser to the Australian Cotton Growing Association. With an Introduction by SIR WYNDHAM DUNSTAN, F.R.S., and a Foreword by SIR WILLIAM HIMBURY, Managing Director of the British Cotton Growing Association. With 26 Maps showing the Cotton Areas of the World. Med. 8vo. 30s. net.

Sir Wyndham Dunstan in his Introduction says, "Mr. Johnson explains the present position and prospects of cotton cultivation in every country in which there is any chance of success, and his book furnishes the most complete guide and encyclopædia which has yet appeared."

HOLISM AND EVOLUTION. By GENERAL THE RIGHT HON. J. C. SMUTS. 8vo. 18s. net.

The work deals with some of the problems which fall within the debateable borderland between Science and Philosophy; and may be expected to attract considerable attention in view of recent advances in physical and biological science.

RITUAL AND BELIEF IN MOROCCO. By EDWARD WESTERMARCK, Ph.D., author of "The History of Human Marriage," etc. Illustrated. 2 vols. 8vo. 50s. net.

This work is a systematic account of the popular religion and magic of the Muhammadan natives of Morocco based on seven years' experience among them.

THE AO NAGAS. By J. P. MILLS, I.C.S., author of "The Lhota Nagas." With a Foreword by HENRY BALFOUR, F.R.S., and Supplementary Notes and Bibliography by DR. J. H. HUTTON, C.I.E. With 34 pages of Illustrations in half-tone and line, and 2 Maps. 8vo. 30s. net.

ORIGINS OF EDUCATION AMONG PRIMITIVE PEOPLES. A Comparative Study in Racial Development By W. D. HAMBLY, B.Sc., Anthropologist for the Wellcome Expedition to the Sudan, Assistant Curator, African Ethnology, Field Museum, Chicago. With a Preface by DR. CHARLES HOSE (of Sarawak). With 74 pages of Illustrations in half-tone and line. 8vo. 25s. net.

CRYSTALLINE FORM AND CHEMICAL CONSTITUTION. By A. E. H. TUTTON, D.Sc., M.A.(Oxon), F.R.S., Past President of the Mineralogical Society, London; Author of "Crystallography and Practical Crystal Measurement." With 72 Illustrations. 8vo. 10s. 6d. net.

THE MINERALOGICAL MAGAZINE.—"The book is well printed and illustrated, and it gives a very clear and readable account of the subject. It should be seen by all students of chemistry as well as those of crystallography."

THE PHYSIOLOGY OF THE CONTINUITY OF LIFE. By D. NOËL PATON, M.D., B.Sc., LL.D., F.R.S., Regius Professor of Physiology, University of Glasgow. With Illustrations. 8vo. 12s. net.

JOURNAL OF EDUCATION.—"This is an important contribution to biological literature, and should be read and carefully considered by all interested in the current theory of heredity and in advanced cytological research."

⁂ ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

WHATMAN

FILTER PAPERS

The range of WHATMAN Filter Papers now manufactured is the most complete produced by any mill in the world, and covers practically all the requirements of modern high-grade technical work.

They are obtainable from all Laboratory Furnishers and are packed in sealed and labelled packages.

Manufactured by W. & R. BALSTON, LTD., Maidstone, KENT.

Samples and Price List on application.

In case of difficulty apply to Sole Mill Representatives:—

Telephone: CITY 7413 (3 lines). H. REEVE ANGEL & CO., LTD., 9 Bridewell Place, LONDON, E.C.4.

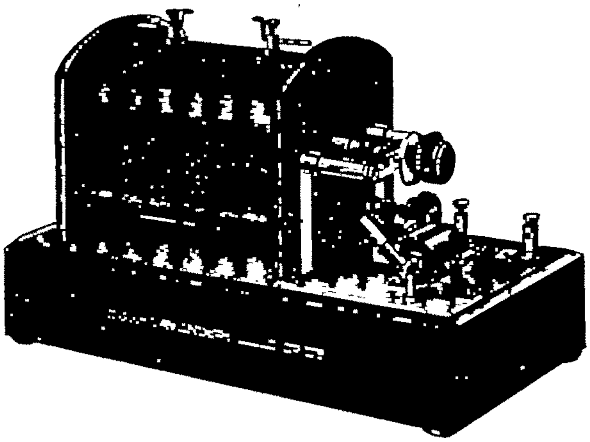
X-RAY APPARATUS

For Crystallography and Physical and Industrial Research

INDUCTION COILS AND TRANSFORMERS

Induction Coils from 1″ to 20″ spark.

Oil-immersed Transformers up to 10″ spark.



Coils up to 6″ spark length are complete with platinum or tungsten contacts.

Coils from 8″ upwards are arranged for use with motor mercury interrupters.

We specialise in X-Ray Apparatus (new and guaranteed second-hand) for Laboratories.

Please write for
1. Special List of New apparatus, including Coils, Transformers, Interrupters, X-Ray Tubes, etc.
2. Special List of guaranteed Second-hand apparatus.
Post free on request.

THE COX-CAVENDISH ELECTRICAL CO. (1924) LTD.

Telephone] 105 Great Portland Street, London, W.1 [Langham 1145

ANNOUNCEMENT OF THE CONTENTS
OF THE OCTOBER NUMBER
OF THE

PHILOSOPHICAL MAGAZINE
AND
JOURNAL OF SCIENCE

Published the First Day of every Month. Price 5s.

The Theory of the "Boys" Type of Double Resonator. By R. T. PARIS, D Sc., F Inst. P.
Regularities in the Spectrum of Ionized Silver. By C S. BEALS, M A., D I C (Plate XIV.)
A Simple Integraph By ALFRED A. ROBB, Sc D., F.R.S.
Secondary Radiations produced by Gamma Rays and their Effect upon Gamma-Ray Absorption Measurements. By L H. CLARK, Ph.D., M.Sc, A Inst P
The High Vacuum Arc in Hydrogen. By F H. NEWMAN, D Sc., A R C.S , Professor of Physics, University College of the South-West of England, Exeter. (Plate XV.)
On the Action in Parabolic Paths under Gravity. By W. B. MORTON, M.A., Queen's University, Belfast.
The Elastic Range of Friction. By JAMES S RANKIN, B.Sc., A.R.T.C., Lecturer, The Royal Technical College, Glasgow.
Latent Heats of Vaporization of Ethyl and Methyl Chlorides. By G. W. C YATES, B.Sc.
On the Parallel-Plate Condenser, and other Two-Dimensional Fields specified by Elliptic Functions. By W B. MORTON, M.A., Queen's University, Belfast.
The Stability of a Layer of Fluid heated below. By HAROLD JEFFREYS, M.A., D.Sc , F.R S.
Growth of Eddies in a Viscous Fluid. By Prof. H LEVY, M.A , D.Sc.
Orifice Flow as affected by Viscosity and Capillarity. By H. W. SWIFT, M.A., B.Sc.
Self-Reversal of the Red Hydrogen Line. By Prof. R. W WOOD.

130 *Pages with* 2 *Plates and numerous Illustrations in the Text.*

Subscription for 1926, £4, including six double numbers, post free to any part of the world Any double numbers issued beyond six charged extra.

TAYLOR & FRANCIS,
Red Lion Court, Fleet Street, London, E.C.4

JUST PUBLISHED

The Journal of the Royal Anthropological Institute

Vol. LVI. Part I. January to June, 1926.

CONTENTS:

MINUTES OF THE ANNUAL GENERAL MEETING, JANUARY 28.
THE RAINBOW-SERPENT MYTH OF AUSTRALIA. (With Plate I.) By A. R. RADCLIFFE-BROWN.
CERTAIN ASPECTS OF NAGA CULTURE. By J. P. MILLS, I.C S.
SOME NOTES ON THE WAHEHE OF MAHENGE DISTRICT, TANGANYIKA TERRITORY. By A G. O. HODGSON.
SOME NOTES ON THE HUNTING CUSTOMS OF THE WANDAMBA OF THE ULANGA VALLEY, TANGANYIKA TERRITORY, AND OTHER EAST AFRICAN TRIBES. By A. G. O. HODGSON
THE USE OF STONE IN THE NAGA HILLS (With Plates II.-VIII) By J. H. HUTTON.
PISHĀROTI RITUALS By K. RAMA PISHĀROTI, M.A , L.T.
SOCIAL ORGANIZATION OF THE MĀLAS—AN OUTCASTE INDIAN PEOPLE By SYDNEY NICHOLSON.
NOTE ON THE PHYSICAL ANTHROPOLOGY OF THE PAMIRS AND AMU-DARIA BASIN. (With Plates IX -XIII.) By T. A. JOYCE.
ANTILLEAN STONE COLLARS: SOME SUGGESTIONS OF INTERPRETATIVE VALUE By ADOLFO DE HOSTOS.
THE INHABITANTS OF INNER MONGOLIA. By L. H. DUDLEY BUXTON, M.A., F S.A.
THE KARÎN AND KARÎNEH. (With Plate XIV.) By WINIFRED S. BLACKMAN.
OBSERVATIONS ON SOME ASPECTS OF RELIGION AMONG THE AZANDE ("NIAM-NIAM") OF EQUATORIAL AFRICA. By CAPTAIN J. E. T PHILIPPS, M.C.
IRON SMELTING AMONG THE BA-USHI. (With Plate XV.) By THE REV. H. B BARNES.

208 pages, with 15 plates and many illustrations in the text

Price 15s. net.

THE ROYAL ANTHROPOLOGICAL INSTITUTE,
52 Upper Bedford Place, Russell Sq., London, W.C.1.

JUST PUBLISHED

Medium 8vo. Pp. ii+230, with 29 Illustrations in the Text. **12/6** *net.*

The Progress of Atomic Theory

By

ALBERT C. CREHORE, Ph.D.

TAYLOR & FRANCIS,
Red Lion Court, Fleet Street, London, E.C.4

THE JOURNAL OF GENERAL PHYSIOLOGY.

Edited by W. J. CROZIER, JOHN H. NORTHROP, W. J. V. OSTERHOUT.

CONTENTS OF VOL. X., No. 1, SEPTEMBER 20, 1926.

NOYES, HELEN MILLER, LORBERBLATT, I., and FALK, K GEORGE. Studies on enzyme action. XXXVIII. The ester-hydrolyzing actions of the whole cell.
REZNIKOFF, PAUL. Micrurgical studies in cell physiology II. The action of the chlorides of lead, mercury, copper, iron, and aluminium on the protoplasm of *Amoeba proteus*.
BRONFENBRENNER, JACQUES J A simple electro-ultrafilter.
GAINES, W. L. Interpretation of the lactation curve.
HOVER, J. MILTON, and GUSTAFSON, FELIX G. Rate of respiration as related to age.
MACHT, DAVID I Concerning the influence of polarized light on the growth of seedlings
CROZIER, W. J. On curves of growth, especially in relation to temperature.
IRWIN, MARIAN. Exit of dye from living cells of *Nitella* at different pH values.
HARVEY, E. NEWTON. Further studies on the inhibition of *Cypridina* luminescence by light, with some observations on methylene blue
BROWN, L. A. Temperature characteristics for duration of an instar in cladocerans.
HOAGLAND, D. R , HIBBARD, P. L , and DAVIS, A. R. The influence of light, temperature, and other conditions on the ability of *Nitella* cells to concentrate halogens in the cell sap.
EGGERTH, ARNOLD H. The effect of the pH on the germicidal action of soaps.
NORTHROP, JOHN H., and KUNITZ, M. The swelling pressure of gelatin and the mechanism of swelling in water and neutral salt solutions.
HITCHCOCK, DAVID I. The effect of pH on the permeability of collodion membranes coated with protein.

Subscription Price per Year (One Volume), $5.00.

Published bi-monthly by

THE ROCKEFELLER INSTITUTE for MEDICAL RESEARCH,
Avenue A and 66th Street • • New York, N.Y.

GURNEY & JACKSON'S
IMPORTANT NEW CHEMICAL BOOKS

A TEXT-BOOK OF ORGANIC CHEMISTRY. By Dr. JULIUS SCHMIDT, Professor of Chemistry, Stuttgart. English Edition by H. GORDON RULE, Ph.D (Munich), D.Sc. (Edin), Lecturer in Organic Chemistry, University of Edinburgh Extra royal 8vo 824 pages. Price **25s.** net.

A TEXT-BOOK OF INORGANIC CHEMISTRY. By Dr. FRITZ EPHRAIM, Professor of Chemistry, Berne. English Edition by P. C. L. THORNE, M.A. (Cantab), M.Sc. (Lond), Lecturer in Chemistry, Sir John Cass Technical Institute, London Extra royal 8vo. 818 pages. Price **28s.** net.

Extract from Prof. Partington's review of German Edition in the "Journal of the Society of Chemical Industry."

"The reviewer can recommend this book to all chemists as both interesting and useful Advanced students will find it of very great value; they will discover something new on nearly every page."

INTRODUCTION TO QUALITATIVE ORGANIC ANALYSIS. By HERMANN STAUDINGER, Ph.D (Halle a-S), Professor of Inorganic and Organic Chemistry, and Director of the Laboratory for General and Analytical Chemistry at the Federal Technical College, Zurich. Authorised Translation by WALTER T. K. BRAUNHOLTZ, M.A., Ph.D. (Cantab), F I C Medium 8vo. 128 pages Price **6s. 6d.** net.

COAL TAR AND AMMONIA. Fifth Edition. Greatly enlarged and thoroughly revised by Prof Dr GEORGE LUNGE 8vo. 1718 pages. In three parts. Not sold separately. Price **£3 : 15s.** net.

TECHNICAL CHEMISTS' HANDBOOK. Tables and Methods of Analysis for Manufacturers of Inorganic Chemical Products. By GEORGE LUNGE, Ph.D., Dr Ing. Second Edition, thoroughly revised. Pocket size. Bound in leather. Price **10s. 6d.** net.

A TEXT-BOOK OF QUANTITATIVE CHEMICAL ANALYSIS. By ALEXANDER CHARLES CUMMING, O B E, D Sc., F I C, Consulting Chemist, late Lecturer in Technical Chemistry in the University of Edinburgh; and SYDNEY ALEXANDER KAY, D.Sc., Lecturer in Chemistry in the University of Edinburgh Fourth Edition. Medium 8vo. 448 pages. Cloth Price **15s.** net.

ORGANIC CHEMISTRY FOR STUDENTS OF MEDICINE. By Sir JAMES WALKER, LL D., F.R.S., Professor of Chemistry, University of Edinburgh Second Edition Medium 8vo. 344 pages. Cloth. Price **10s. 6d.** net.

PRACTICAL CHEMISTRY FOR MEDICAL STUDENTS. By ALEXANDER CHARLES CUMMING, O.B E., D.Sc, F I C., Consulting Chemist; late Lecturer in Technical Chemistry in the University of Edinburgh Third Edition. Demy 8vo. 165 pages. Cloth Price **8s.** net.

ELEMENTARY CHEMICAL THEORY AND CALCULATION. By JOSEPH KNOX, D Sc., Lecturer in Chemistry in the University of Glasgow; author of "Physico-Chemical Calculations." Second Edition. Crown 8vo. vii + 104 pages. Cloth. Price **3s. 6d.** net.

A TEXT-BOOK OF QUALITATIVE ANALYSIS OF INORGANIC SUBSTANCES. By SYDNEY ALEXANDER KAY, D Sc, Lecturer in Chemistry, University of Edinburgh. Medium 8vo. Cloth Price **7s. 6d.** net.

LONDON: 33 Paternoster Row, E.C.4.
EDINBURGH: Tweeddale Court.

NOW READY

PHOTOGRAPHS OF EMINENT CHEMISTS

(Reproduced by a photolithographic process)

Published by the CHEMICAL SOCIETY.

R. W. BUNSEN.
EMIL FISCHER.
A. W. VON HOFMANN.
D. I. MENDELÉEFF.
L. PASTEUR.
Sir WILLIAM PERKIN.
Sir WILLIAM RAMSAY.
Sir HENRY ROSCOE.

Size of Photograph: 8 x 6 in., approximately.
Size of Mount: 15 x 11 in.

Price to the Public, **3s.** each, or **21s.** the set, post free.

MEMORIAL LECTURES ON EMINENT CHEMISTS

Delivered before the CHEMICAL SOCIETY.

Volume I. (Reproduced by a photolithographic process.) 592 pp. Illustrated. Price **10s. 6d.**, postage 9d extra.

CONTENTS

1. The Stas Memorial Lecture. By J. W. MALLET, F.R.S.
2. The Kopp Memorial Lecture. By Sir EDWARD THORPE, C.B., D.Sc., F.R.S.
3. The Marignac Memorial Lecture. By P. T. CLEVE.
4. The Hofmann Memorial Lecture. By the Rt. Hon. Lord PLAYFAIR, G.C.B., F.R.S.; Sir FREDERICK A. ABEL, Bt., K.C.B., G.C.V.O., F.R.S.; Sir WILLIAM PERKIN, LL.D., F.R S.; H. E. ARMSTRONG, LL.D., F.R.S.
5. The Helmholtz Memorial Lecture. By G. F. FITZGERALD, M.A., D.Sc., F.R.S.
6. The Lothar Meyer Memorial Lecture. By P. P. BEDSON, M.A., D.Sc.
7. The Pasteur Memorial Lecture. By PERCY F. FRANKLAND, C.B.E., LL.D., F.R.S.
8. The Kekulé Memorial Lecture. By F. R. JAPP, M.A., LL.D., F.R.S.
9. The Victor Meyer Memorial Lecture. By Sir EDWARD THORPE, C.B., D Sc., F.R.S.
10. The Bunsen Memorial Lecture. By the Rt. Hon. Sir HENRY E. ROSCOE, LL.D., D.Sc., F.R.S.
11. The Friedel Memorial Lecture. By J. M. CRAFTS.
12. The Nilson Memorial Lecture. By O. PETTERSSON.

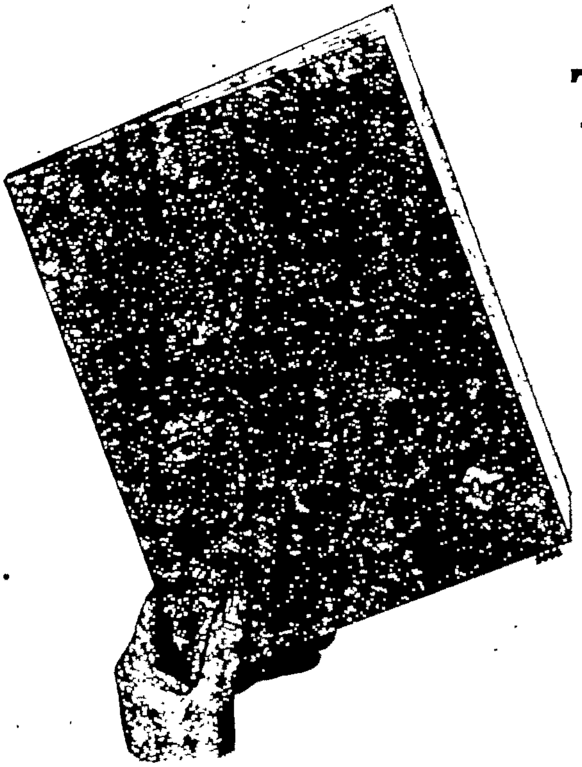
Volume II. 297 pp. Illustrated. Price **8s.**, postage extra. At Home 6d., Abroad 9d.

CONTENTS

13. The Rammelsberg Memorial Lecture. By Sir HENRY A. MIERS, D.Sc., LL.D., F.R.S.
14. The Raoult Memorial Lecture. By J. H VAN 'T HOFF, F.R.S.
15. The Wislicenus Memorial Lecture. By W. H. PERKIN, Sc.D., LL.D., F.R.S.
16. The Cleve Memorial Lecture. By Sir EDWARD THORPE, C.B., D.Sc., F.R.S.
17. The Wolcott Gibbs Memorial Lecture. By F. W. CLARKE, LL.D.
18. The Mendeléeff Memorial Lecture. By Sir WILLIAM A. TILDEN, D.Sc., F.R.S.
19. The Thomsen Memorial Lecture. By Sir EDWARD THORPE, C B., D.Sc., F.R.S.
20. The Berthelot Memorial Lecture. By H. B. DIXON, C.B.E., D.Sc., F.R.S.
21. The Moissan Memorial Lecture. By Sir WILLIAM RAMSAY, K.C.B., D.Sc, F.R S.
22. The Cannizzaro Memorial Lecture. By Sir WILLIAM A. TILDEN, D.Sc., F.R.S.
23. The Bequerel Memorial Lecture. By Sir OLIVER LODGE, D.Sc., F.R.S.
24. The Van 't Hoff Memorial Lecture. By Sir JAMES WALKER, D.Sc., F.R.S.
25. The Ladenburg Memorial Lecture. By F. S. KIPPING, D.Sc., F.R.S.

Note.—These volumes are eminently suitable for school prizes.

GURNEY & JACKSON, 33 Paternoster Row, E.C.4.



THIS NEW BOOK

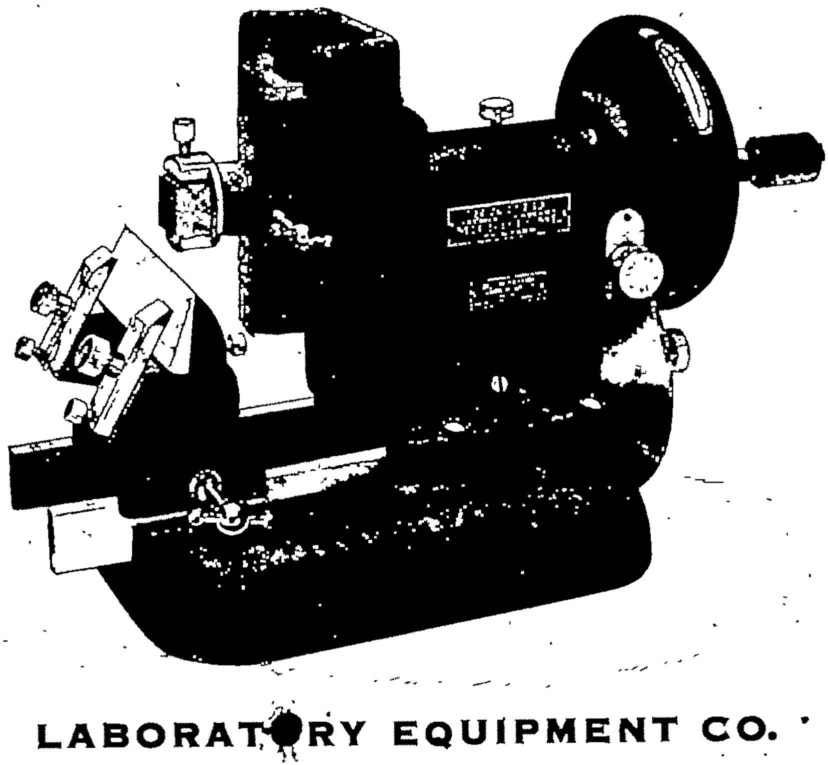
(List No. 169-N)

contains full particulars of various types of electrometers, and information concerning photo-electric cells. A bibliography is appended giving references to published papers on various applications of the instruments. May we send you a copy?

CAMBRIDGE
INSTRUMENT CO. LTD
WORKS - LONDON, & CAMBRIDGE
Head Office & Showrooms - 45, GROSVENOR PLACE LONDON, S.W.1
AMERICAN COMPANY.
Cambridge Instrument Co, Inc, Grand Central Terminal, New York

4a

No 3. AUTOMATIC ROTARY MICROTOME



NEW AND IMPROVED MODEL

HAVING —
UNIVERSAL OBJECT CLAMP, RIGID AND PRACTICAL
KNIFE HOLDER, INSTANTLY DETACHABLE AND WITH FINE ADJUSTMENT FOR KNIFE ANGLE
MECHANISM TOTALLY ENCLOSED
PERFECTLY BALANCED ACTION
HEAVY CONSTRUCTION (WEIGHT 28 lbs)
GUARANTEED PERFORMANCE WITH EVEN CUT ON ANY MATERIAL

PRICE £17 : 17 : 6

ALSO — MICROSCOPES:— RESEARCH, BACTERIOLOGICAL, STUDENTS', DISSECTING
LAMPS — POINTOLITE, ACETYLENE
MICROTOMES — TWO OTHER TYPES
PHOTOMICROGRAPHIC APPARATUS. — TWO TYPES
EMBEDDING APPARATUS, LIGHT FILTERS, TISSUE MINCERS, METAL BENCHING AND CHAIRS, SUPPLIES

Showroom:
310/12 Regent Street,
London, W.1
(Close Oxford Circus)
Telephone: Langham 3111

LABORATORY EQUIPMENT CO.

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

THE ASCENT OF MAN

By Means of Natural Selection

By ALFRED MACHIN

Crown 8vo. **7s. 6d.** net.

An effort at the solution of the greatest of all problems—that of the evolution of Man.

In a letter to the author **Sir ARTHUR KEITH, F.R.S.,** *says:*

"I have a very high opinion of your book on Man's evolution and it does deserve to be widely known and widely read. . . .

"Your book is not only reliable and interesting, but it puts old problems relating to man's evolution in a new way, and also in a way which the unskilled can understand."

Professor E. B. POULTON, F.R.S., *writes:*

"It is fortunate that Mr. Machin's volume should have been published at this period in the history of evolutionary thought—the period of the Tennessee proceedings and, here in England, of criticisms, which may be exemplified by the following passage printed in the *Spectator* for July 24, 1926: 'The theory of EVOLUTION BY NATURAL SELECTION, in its commonest expression—"the survival of the fittest"—adds nothing at all to our comprehension. The phrase, if it is analysed, means only "the survival of the survivors."' To this re-statement of an old objection, refuted more than fifty years ago and now revived, Mr. Machin's clearly written book supplies a convincing answer."

Professor SOLLAS, F.R.S., *writes:*

"In this interesting—and, indeed, fascinating work—we are shown that the picture of Nature 'red in tooth and claw' has been rather overdrawn.

"There is a brighter side, lit up by natural affection and even by a notable altruism.

"In insisting on this the author may be said to take the sting out of the doctrine of natural selection, and we are left to supply for ourselves, if we wish, the argument that unselfish instincts must exist, if only in germ, before they can be selected. Is it possible that we may find here a hint towards that basis for a system of ethics which many philosophers have sought after in vain?"

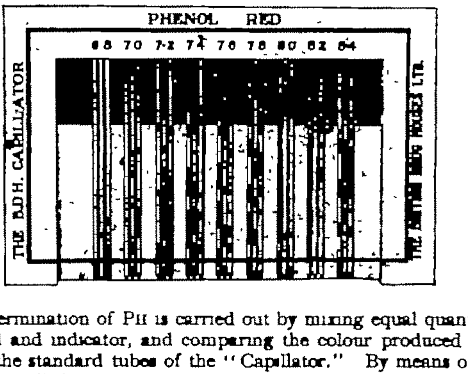
"It is a work which no student of man should omit to read"—Dr B. MALINOWSKI in *Nature*, Oct. 9, 1926.

LONGMANS, GREEN AND CO., LTD., 39 PATERNOSTER ROW, LONDON, E.C.4

B.D.H. CAPILLATOR

THE B.D.H. "Capillator" provides an improved method for the colorimetric determination of Hydrogen Ion Concentration.

The "Capillator" consists of a series of capillary tubes filled with buffer solutions containing an indicator. These tubes are mounted in threes on a white card, and form a series of coloured strips, each strip being marked with its exact PH value. Each card illustrates the complete colour change of the indicator.



A determination of PH is carried out by mixing equal quantities of liquid and indicator, and comparing the colour produced with that of the standard tubes of the "Capillator." By means of the "Capillator" determinations of PH are carried out expeditiously and accurately, and as little as one drop of the liquid will suffice for a test.

Prices and further particulars will be supplied on application.

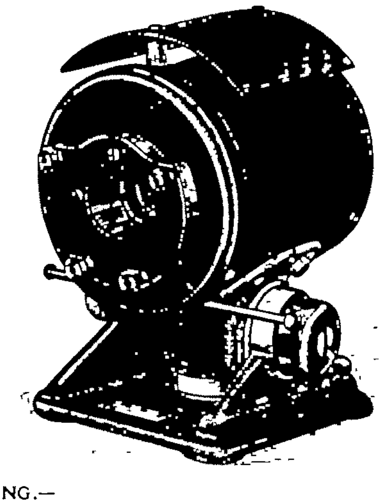
THE BRITISH DRUG HOUSES, LTD.

Makers of Fine Chemicals

Graham Street, LONDON, N.1

MICROSCOPE LAMP

NO. M.9.



HAVING.—
- CLOSE-UP DIAPHRAGM WITH ROD ADJUSTMENT.
- INCLINABLE BODY WITH FIRM CLAMP
- 2" SCREEN HOLDER
- PRACTICAL IN EVERY DETAIL AND ROBUST IN CONSTRUCTION

PRICE WITH 60-W. BULB, 6-ft FLEX AND PLUG·

£4:17:6

LABORATORY EQUIPMENT CO.

MICROSCOPES AND ACCESSORIES, MICROTOMES, PHOTOMICROGRAPHIC APPARATUS, BENCHES, Etc., Etc.

***Showroom:* 310/12 Regent Street, London, W.1**

Telephone [illegible]gham 3111

For Critical Work

SIRA

IMMERSION OIL

Refractive index 1·524. For use with modern immersion oil objectives, condensers and other optical instruments. Free from corrosive action on metal and glass. Prepared in accordance with the directions of The British Scientific Instrument Research Association, and positively the only oil that will give the best results in critical work. *Sole Manufacturers: Stafford Allen & Sons, Ltd. Established* 1833, 7 *Cowper St., London, E.C.2.*

Price 2/6 per bottle.

From all Scientific Instrument Makers and Dealers.

THE PRECIOUS METALS
GOLD, PLATINUM, SILVER.

SPINK & SON, LIMITED
(By Appointment)
17-18 PICCADILLY, LONDON, W.1.
Established 153 years.

VALUE, PURCHASE or ASSAY the above in any form.

Parcels can be safely sent by registered post.

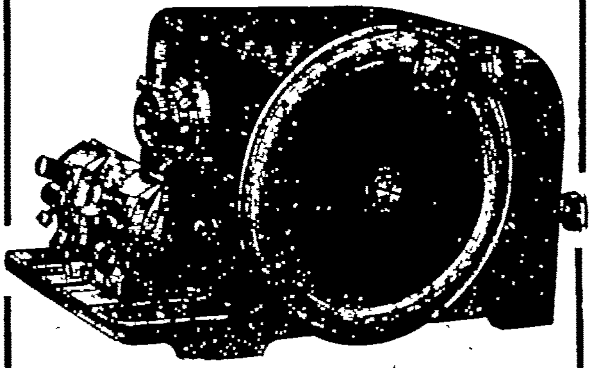
Estab.] STEVENS'S AUCTION ROOMS, LTD. [1760

A SALE by AUCTION is held EVERY FRIDAY, at 12.30, which affords first-class opportunities for the disposal or purchase of **SCIENTIFIC, OPTICAL, ELECTRICAL, and WIRELESS APPARATUS,** Microscopes and Accessories, Telescopes, Surveying Instruments, Photographic Cameras and Lenses, Cinematographs and Films, Lanterns and Slides, Lathes and Tools, Books and Miscellaneous Property.

Frequent Sales of Natural History and Ethnological Specimens, Curiosities, etc., are also held.

Catalogues and terms for selling will be forwarded on application to 38 King Street, Covent Garden, London, W.C.2.

MICROSCOPES, MICROTOMES AND ACCESSORY APPARATUS



Spencer Rotary Microtome No. 820

NEW
DAYLIGHT MICROSCOPE LAMP
Particulars on request

REPAIRS
to any make of Microscope or Objective and other Scientific Apparatus a Speciality

HAWKSLEY & SONS, LTD.
83 Wigmore Street, London, W.1

¶ **W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE,** will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ **CATALOGUE 269.** Scientific Books and Publications of learned Societies.

Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone [illegible] (2 lines).

J. POOLE & CO.
ESTABLISHED 1854
NEW & SECOND-HAND
SCIENTIFIC AND EDUCATIONAL
BOOKSELLERS

ENQUIRIES BY LETTER RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

ZENITH

NOTICE

We beg to inform our customers and suppliers that the business formerly carried on as THE ZENITH MANUFACTURING COMPANY has now been incorporated as a private company under the title of

THE ZENITH ELECTRIC COMPANY, LIMITED,

in order to provide additional capital and manufacturing facilities to cope with the increased demand for our well-known "ZENITH" electrical products.

Provision has been made for the collection by the new company of all accounts and the discharge by them of all liabilities in connection with the business, which will be continued without interruption under the same management, but the new title as above.

The directors trust that the happy relationship which has subsisted in the past will continue under the new proprietary.

THE ZENITH ELECTRIC CO. LTD.
Contractors to H.M. Admiralty, War Office, Air Ministry, Post Office, L.C.C., etc.
ZENITH WORKS, VILLIERS ROAD,
WILLESDEN GREEN, LONDON, N.W.2
Telephone: Willesden 4067-8. *Telegrams*: "Voltaohm, Willroad, London."

Chance's "Resistance"

Samples—Free of Cost.

We are prepared to send buyers of Chemical Glass a few samples of Chance's "Resistance" Laboratory Glassware, Free of Cost, to enable users to verify the following statement for themselves :—

For heat-resisting qualities combined with general resistance to chemical attack—CHANCE'S LABORATORY GLASSWARE is superior to any other make, whether British or Foreign.

Send us your Trade Card and ask for samples.

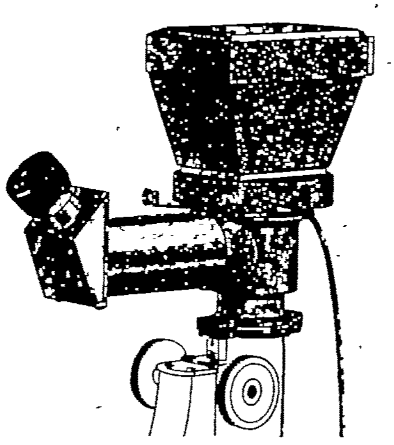
STOCKED BY ALL THE MOST IMPORTANT LABORATORY FURNISHERS.

CHANCE BROTHERS and Co. LIMITED
GLASS WORKS SMETHWICK BIRMINGHAM

Laboratory Glassware

BRITISH INDIA **ZEISS** BRITISH INDIA

ACCESSORIES
FOR YOUR
MICROSCOPE

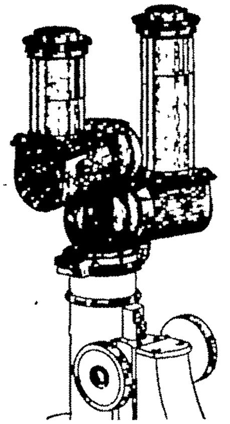


Attachable Photographic Eyepiece "Phoku," 4½ × 6 cms

CARL ZEISS JENA

Full descriptive lists and Rupee prices of these and other accessories upon request to the

SOLE DISTRIBUTORS FOR BRITISH INDIA :



Attachable Binocular Eyepiece "Bitumi."

ADAIR, DUTT & CO. LTD.
(Incorporated in England)

Stephen House, Dalhousie Square East, CALCUTTA
and
Exchange Building, Ballard Estate, BOMBAY

Head Office : 47 Victoria Street, London, S.W.1, where Government indents may be sent.

OLIVER AND BOYD'S

New and Recent Publications.

ANIMAL GENETICS

An Introduction to the Science of Animal Breeding.

By F. A. E. CREW, M D, D Sc., Ph.D., F.R.S.E., Lecturer in Genetics in the University of Edinburgh, and Director of the Animal Breeding Research Department. With one Coloured Plate, 66 Figures in the Text and a Bibliography of over 1500 References. Medium 8vo. 440 pp. 15s. net.

THE COMPARATIVE ANATOMY, HISTOLOGY, AND DEVELOPMENT OF THE PITUITARY BODY

By G. R. DE BEER, M A, B.Sc., F.L.S., Jenkinson Memorial Lecturer in Comparative and Experimental Embryology in the University of Oxford. With 11 Plates (one coloured) and 118 Figures in the Text. Medium 8vo 128 pp 12s. 6d. net.

REPRODUCTION IN THE RABBIT

By JOHN HAMMOND, M A.(Cantab.), School of Agriculture, Cambridge. With Foreword and Chapter on the Formation of the Corpus Luteum by F. H. A. MARSHALL, F R.S. With 20 full-page Illustrations Medium 8vo. 256 pp 15s. net.

STATISTICAL METHODS FOR RESEARCH WORKERS

By R. A. FISHER, M.A, Chief Statistician, Rothamsted Experiment Station. Medium 8vo. 252 pp. 15s. net.

THE PIGMENTARY EFFECTOR SYSTEM

A Review of the Physiology of Colour Response.

By LANCELOT T. HOGBEN, M.A (Cantab.), D Sc (Lond.), F.R.S (Edin.), McGill University, Montreal. Medium 8vo 164 pp. 10s 6d. net.

THE ERYTHROCYTE AND THE ACTION OF SIMPLE HÆMOLYSINS

By ERIC PONDER, Lecturer in Physiology in the University of Edinburgh. Medium 8vo. 204 pp 12s. 6d. net.

AGRICULTURE

The Science and Practice of British Farming.

By JAMES A. S. WATSON, M.C., B Sc., M.S.A.(Iowa), Professor of Agriculture, Oxford University, and JAMES A. MORE, B.Sc, N.D.A.(Hons.), N.D.D.(Hons.), Lecturer on Agriculture, University of Edinburgh; formerly Lecturer on Agriculture at the Midland Agricultural College. With 122 Illustrations. 8vo. 696 + xii pp. 15s. net.

FARM LIVE STOCK OF GREAT BRITAIN

By ROBERT WALLACE, M.A., Professor (Emeritus) of Agriculture and Rural Economy in the University of Edinburgh. Assisted by J. A. SCOTT WATSON, M.C, B Sc., Professor of Agriculture, Oxford University. Fifth Edition, Revised and Enlarged. With 442 Plates and 111 Figures in the Text. Medium 8vo 888 pp £1:10s net.

PRACTICAL BACTERIOLOGY

An Introductory Course for Students of Agriculture.

By ANDREW CUNNINGHAM, B.Sc (Agric.), Advisory Officer and Lecturer in Bacteriology, Edinburgh and East of Scotland College of Agriculture. With Illustrations. Crown 8vo. 196 pp. 7s. 6d. net.

A DICTIONARY OF SCIENTIFIC TERMS

Pronunciation, Derivation, and Definition of Terms in Biology, Botany, Zoology, Anatomy, Cytology, Embryology, Physiology.

By I. F. HENDERSON, M.A, and W. D. HENDERSON, M.A., B.Sc., Ph.D., F R.S.E. Medium 8vo. 18s. net.

FOSSIL MEN

Elements of Human Palæontology.

By MARCELLIN BOULE, Professor in the Museum National d'Histoire Naturelle, Paris; Director of L'Institut de Paléontologie Humaine. Translated from the French with an Introduction by JESSIE ELLIOT RITCHIE and JAMES RITCHIE, M.A., D.Sc, F.R.S E., Keeper of the Natural History Department, Royal Scottish Museum. Brought up-to-date with revised and enlarged Second French Edition (1923). With 250 Illustrations. Royal 8vo 532 pp. £1:16s. net.

LONDON: 33 Paternoster Row, E.C.4.
EDINBURGH: Tweeddale Court.

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals, General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

CHEMICAL AND TECHNICAL BOOKS

We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms.

Write for Catalogue.

WILLIAM BRYCE, Scientific Bookseller,
64-64a Lothian Street, EDINBURGH.

RHEINBERG MICROMETERS and other GRATICULES by the processes of Grainless and of Filmless Photography. Stock list of standard articles on request. RHEINBERG & Co., 57-60 Holborn Viaduct, London, E C.1.

MICRO-TELESCOPE
AND
SUPER-MICROSCOPE

apparatus, shop soiled and returned from various exhibitions, for sale at 33⅓ per cent discount off list prices List on request.

F. DAVIDSON & CO.
29 Great Portland Street, London, W.1

NOTICE.

NATURE for May 29 and July 3, containing, respectively, Supplements by Prof. T. M. Lowry (on "Electrons, Atoms and Molecules") and Dr. G. E. Hale (on "Some New Possibilities in Solar Research"), can still be supplied at published price, plus postage.

The issue for August 7, containing the Presidential Address of H.R.H. the Prince of Wales to the British Association, and Summaries of the Addresses of the Presidents of the Sections, can be sent to residents in the British Isles on receipt of 1s. 1½d., or to residents abroad on receipt of 1s. 2d.

St. Martin's Street, London, W.C.2.

X-Ray Apparatus

For Crystallography and Physical Research

In choosing apparatus for the application of X-rays to physical and industrial science, reliability is the factor of prime importance. Watson & Sons have a world-wide reputation for absolute reliability in connection with the manufacture of every class of X-ray apparatus, and the "Watson" housemark is accepted by discriminating experts as sufficient guarantee of superlative quality. Special attention has been given by Watson & Sons to the production of X-ray equipment for physical research work, and the Firm is prepared to give advice and to supply suitable equipment of the finest quality for this purpose.

Write us your requirements,
and let us submit an estimate.

WATSON & SONS
(ELECTRO-MEDICAL) LTD.
SUNIC HOUSE, PARKER ST.,
KINGSWAY, LONDON, W.C.2.

Telephone: Regent 1227. *Telegrams: "Skiagram, Westcent, London."*

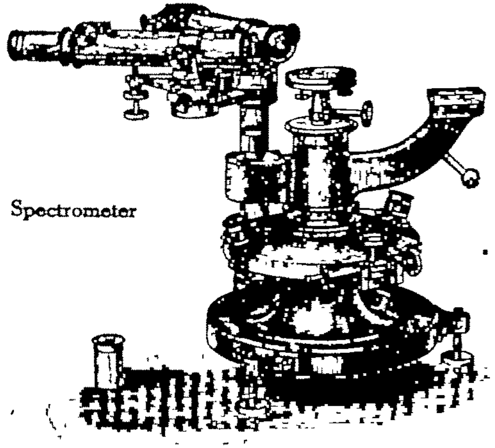
Max Kohl A.G.

Chemnitz A1 (Germany)

Manufacturers of

Physical Apparatus

Laboratory Furniture
Induction Coils · Oil Air Pumps
Experimental Switchboards
Projection Apparatus

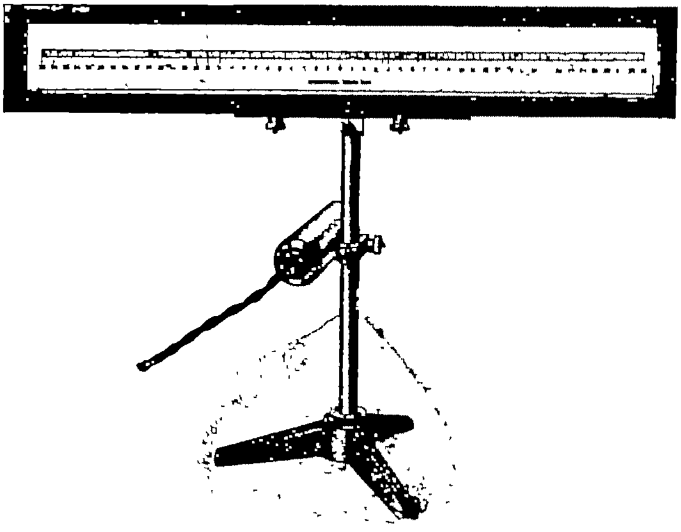


Spectrometer

Special Lists on request

GAMBRELL BROS. LTD.

Established 1898.



Lamp and Scale, Pattern No. 1000.

The following are some of our standard lines:

Please send for Lists in which you are interested.

LIST	
"G"	Galvanometers, moving coil, pointer and reflecting.
"OG"	Galvanometers, "Onwood" pattern.
"GA"	Galvanometer Accessories, including Lamps, Scales, Universal Shunts, etc.
"K.S"	Keys and Switches.
"IR"	Gambrell's "Independent" Plug Contact Resistance Boxes and Wheatstone Bridges.
"HR"	Megohms and High Resistances.
"SR"	Switch Pattern Resistance Boxes and Wheatstone Bridges, all grades, including Direct Reading.
"P.K"	Potentiometers, Kelvin Low Resistance Bridges, Kelvin Double Ratio Boxes, Volt Ratio Boxes, Standard Cells, Low Resistance Shunts.
"RR"	Rheostats and Single Resistances.
"C"	Condensers, Standard and Secondary.
"V.A"	Voltmeters, Ammeters, Milliameters.
"T.A"	Apparatus for Electro-Titration.

MERTON ROAD, SOUTHFIELDS,

London, S.W.18.

Phones: PUTNEY 3641-2 (Instrument).
VICTORIA 9938 (Wireless).

Radio Sales Dept. for Wireless Apparatus 76 VICTORIA ST.,
LONDON, S.W.1.

"In years to come the publication of this monumental work will rank as one of the milestones in British applied science."—*Nature.*

Sir Richard Glazebrook's
DICTIONARY
OF
APPLIED PHYSICS
Can NOW be purchased
on the Convenient System of
DIVIDED PAYMENTS

CONTENTS

Vol. I. Mechanics—Engineering—Heat.
" II. Electricity.
" III. Meteorology, Metrology, and Measuring Apparatus.
" IV. Light—Sound—Radiology.
" V. Aeronautics—Metallurgy—General Index.

THE COMPLETE WORK
IN 5 VOLUMES
Delivered
at once
FOR A FIRST PAYMENT OF
21/-
AND 14 FURTHER MONTHLY PAYMENTS OF 21/- THUS COMPLETING THE SUBSCRIPTION
PRICE - £15 15 0

Authoritative Reviews:

"This encyclopædic work differs from many that have preceded it in that it is produced by those who have worked strenuously and successfully to promote knowledge. Originality of treatment and masterly handling are everywhere exhibited."—*Engineering.* (Vol. 1.)

"A book which every electrical engineer ought to possess. . . . A mass of information in a field which, at present, is not adequately covered by any one work."—*The Electrician.* (Vol. 2.)

"As a summary of our present knowledge of certain aspects of meteorology, the work is of great value. It will perhaps be regarded in future as a milestone showing the stage reached by the science at the end of the great war."—*The Meteorological Magazine.* (Vol. 3.)

SINGLE VOLUMES
ALSO SUPPLIED ON DIVIDED MONTHLY PAYMENTS AS FOLLOWS:
Immediate
Delivery
AGAINST A FIRST PAYMENT OF
2/6
AND 13 FURTHER MONTHLY PAYMENTS OF 5/- THUS COMPLETING THE SUBSCRIPTION PRICE
£3 7 6

7 DAYS
FREE ☞
EXAMINATION

To the GLOBE PUBLISHING COMPANY, LIMITED,
Gloucester House, 19 Charing Cross Road, London, W.C.2.

Please send me for 7 days free examination
A complete copy of the "Dictionary of Applied Physics" in 5 volumes.
Volume.....................of the "Dictionary of Applied Physics."
(Strike out lines not applicable)

It is understood that I can examine the $\frac{\text{work}}{\text{volume}}$ for seven days after I receive it, and that I can return it to you on the eighth day if I decide not to keep it. Should I decide to retain the volume(s) I undertake to send you a first payment of $\frac{\text{21/- for the complete work}}{\text{2/6 for Volume. ......only}}$ on the eighth day and to complete the purchase of the $\frac{\text{complete work}}{\text{Volume}}$ by remitting $\frac{14}{13}$ further monthly payments of $\frac{\text{21/-}}{\text{5/-}}$ until the full price $\frac{\text{£15 : 15 : 0}}{\text{£3 : 7 : 6}}$ is paid. (I am not under 21 years of age.)

NAME ....

ADDRESS ....

N.100 ....

MACMILLAN'S NEW AND RECENT BOOKS.

PEOPLE OF THE VEIL. Being an Account of the Habits, Organisation, and History of the Wandering Tuareg Tribes which inhabit the mountains of Air or Asben in the Central Sahara. By FRANCIS RENNELL RODD. With 51 pages of Illustrations and 6 Maps and Plans. Super Royal 8vo. 30s. net.

Mr. Francis Rodd, son of Sir Rennell Rodd, gives in this book the record of a remarkable voyage of exploration in Africa among a people whose history and customs are very little known and of great anthropological and general interest.

IN UNKNOWN ARABIA. By MAJOR R. E. CHEESMAN, O.B.E., F.R.G.S., H.M. Consul in North-west Abyssinia. With a Foreword by SIR PERCY COX, G.C.M.G. With Illustrations and Maps. Super Royal 8vo. 25s. net.

SUNDAY TIMES.—"The illustrations are of unusual interest, and with its appendices of technical information and its maps, the book must take its place amongst the most valuable of recent exploratory works."

RITUAL AND BELIEF IN MOROCCO. By EDWARD WESTERMARCK, Ph.D., author of "The History of Human Marriage," etc. Illustrated. 2 vols. 8vo. 50s. net.

SUNDAY TIMES.—"It would be impossible to summarise this encyclopædia of fascinating information. But no one interested in the foundations of belief is likely to neglect this storehouse of evidence and scholarly elucidation."

ORIGINS OF EDUCATION AMONG PRIMITIVE PEOPLES. A Comparative Study in Racial Development. By W. D. HAMBLY, B.Sc., Anthropologist for the Wellcome Expedition to the Sudan, Assistant Curator, African Ethnology, Field Museum, Chicago. With a Preface by DR. CHARLES HOSE (of Sarawak). With 74 pages of Illustrations in half-tone and line. 8vo. 25s. net.

SUNDAY TIMES.—"It is not necessary to be an anthropologist to appreciate and enjoy Mr. Hambly's most entertaining book, for it is written as much for the layman as for the student."

THE PHYSIOLOGY OF THE CONTINUITY OF LIFE. By D. NOËL PATON, M.D., B.Sc., LL.D., F.R.S., Regius Professor of Physiology, University of Glasgow. With Illustrations. 8vo. 12s. net.

BRITISH MEDICAL JOURNAL.—"These pleasantly written lectures contain not only much information but much stimulating food for thought."

COTTON AND ITS PRODUCTION. By W. H. JOHNSON, lately Agricultural Adviser to the Australian Cotton Growing Association. With an Introduction by SIR WYNDHAM DUNSTAN, F.R.S., and a Foreword by SIR WILLIAM HIMBURY, Managing Director of the British Cotton Growing Association. With 26 Maps showing the Cotton Areas of the World. Med. 8vo. 30s. net.

INTERNATIONAL COTTON BULLETIN.—"The book is 'sound' and can be confidently recommended to those engaged in cotton growing, but seeing that spinners the world over are consuming more and more 'outside growth' of cotton, they ought to study this book as well, for it deals extensively with these kinds of cotton."

THE CULTIVATION OF CITRUS FRUITS. By HAROLD HUME. With 237 Illustrations. 8vo. 21s. net. (The Rural Science Series.)

AN OUTLINE OF PLANT GEOGRAPHY. By DOUGLAS H. CAMPBELL, Professor of Botany, Stanford University, California; author of "The Structure and Development of Mosses and Ferns." With 52 page Plates and 101 Figures in the Text. 8vo. 17s. net.

HOLISM AND EVOLUTION. By GENERAL THE RIGHT HON. J. C. SMUTS. 8vo. 18s. net.

THE DAILY TELEGRAPH.—"This presentment of his attitude towards the scheme of things is in many ways extraordinarily interesting. Even those who disagree with his conclusions will find his exposition of them very stimulating, and in the course of reading his volume they will learn a great deal probably new to them about the recent theories of science in many departments."

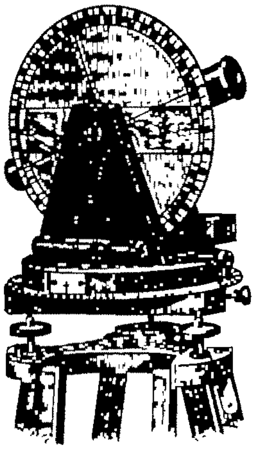
PROJECTIVE GEOMETRY. By CLEMENT V. DURELL, M.A., Senior Mathematical Master at Winchester College. Crown 8vo. 7s. 6d. net.

ANSWERS, HINTS AND SOLUTIONS OF THE EXERCISES IN SAME. Crown 8vo. Limp Cloth. 2s. 6d.

⁂ ***Send for Macmillan's Classified Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

Student's Theodolite



Write for leaflet describing this instrument, which has many advantages over others on the market. It has been designed by a teacher of geography and is made by a firm of theodolite makers.

Price £3 10 0
or with Plane Table
£4 0 0

Sent on approval to any teacher

*** *Although this instrument has only recently been introduced, the demand has already been very large.*

C. F. CASELLA & CO. LTD.
49-50 Parliament Street, London, S.W.1

HOPKIN & WILLIAMS, Ltd.
16 & 17 Cross St., Hatton Garden, London, E.C.1
Works : Ilford, Essex. Telegrams : "Cerium, Smith, London." Telephone : Holborn 6084 and [illegible]

The Leading British House for
CHEMICAL REAGENTS
PURE, FINE, AND RARE CHEMICALS

Manufacturers of Guaranteed
Chemical Reagents for Analysis and Research.

Made and supplied to standards and specifications described in the publication

" Analytical Reagents : Standards and Tests."

Compiled by
EDMUND WHITE, B.Sc. (Lond.), F.I.C.
Published by
HOPKIN & WILLIAMS, LTD.

NEW EDITION, 1925.
CLOTH BOUND. INTERLEAVED.

Price 1/6 post free from the Publishers.

Oertling

NEW TYPE
EÖTVÖS TORSION BALANCE
FOR LOCATING DEPOSITS OF OIL AND MINERALS

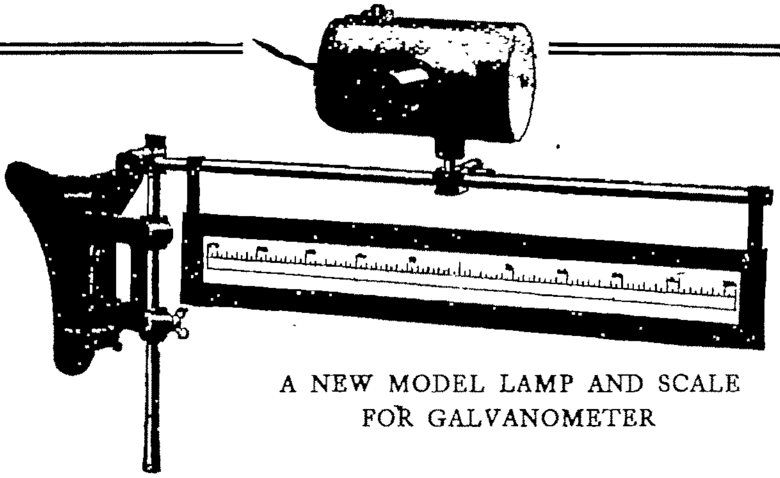
¶ See article, "The Eötvös Torsion Balance and its Use in the Field," by Capt. H. Shaw and E. Lancaster Jones, NATURE, June 23, 1923, page 849 *et seq.*

Government and Prospecting Geologists. Mining and Oil Companies should be in possession of our Manual of Instruction, price £1 : 1s. prepaid (see review in NATURE, September 18, 1926, page 406). Booklet describing the Instrument will be sent post free.

EXPLORATION WORK CARRIED OUT
Correspondence Invited

MANUFACTURERS :
L. OERTLING LTD. (ESTAB 1849), **88-90 Turnmill Street, LONDON, E.C.1**

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.



THE MICROID SERIES

This and other electrical instruments of new design are fully described in List No. 2M, which will be sent on application. The accuracy and sensitiveness of the new instruments are characteristic of the highest class of apparatus, and the cost is remarkably moderate.

WRITE FOR LIST 2M

A NEW MODEL LAMP AND SCALE FOR GALVANOMETER

This newly designed lamp and scale is intended to give first-class service at a comparatively low cost. Designed and used in our own test-rooms, it is provided with every useful adjustment. A clear image is obtained in bright sunlight with a 60-watt gas-filled lamp. It is made in three styles—with wall bracket, as here illustrated, clamp for shelf, and on heavy foot.

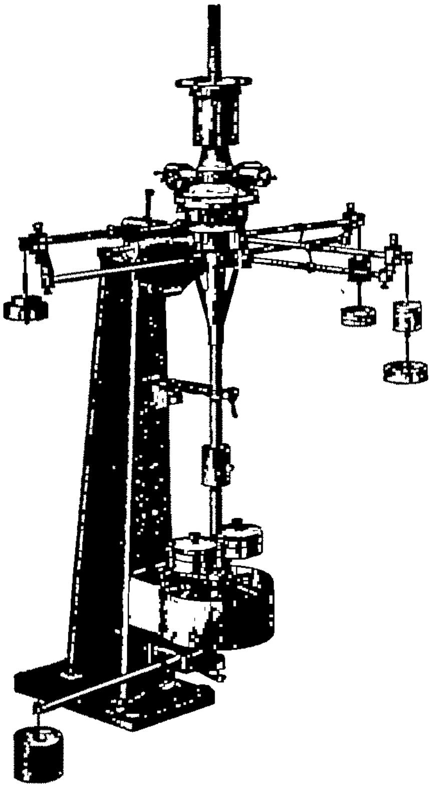
Price £4 10s.

JOHN J. GRIFFIN & SONS LTD

Kemble Str
Kingsway
LONDON
W.C. 2

BAIRD & TATLOCK LTD

GLASGOW
45 Renfrew St
EDINBURGH
7 Teviot Place
MICROID
MANCHESTER
34 Gt Ducie St
LIVERPOOL
64 Brownlow Hill



AERONAUTICAL INSTRUMENTS

❧ ❧ ❧

C. F. CASELLA & CO.
LIMITED

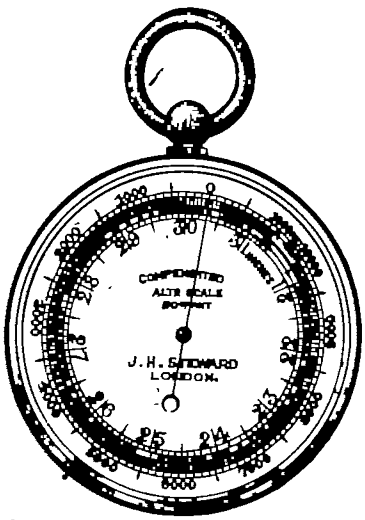
have considerable experience in making instruments for use in the teaching of aeronautics and in aeronautical research, and will be glad to quote for any apparatus which may be required. The figure illustrates a WIND BALANCE as supplied to various laboratories.

Address:

49 & 50 Parliament Street, London, S.W.1

ANEROID BAROMETERS

FOR MEASURING THE ALTITUDE OF MOUNTAINS OR AIRCRAFT.



Best Quality Movements compensated for Temperature.

With Altitude Scale reading up to 10,000 feet and divided to every 50 feet.

£5 0 0

With Altitude Scale to 15,000 feet and divided to 100 feet.

£5 10 0

With Altitude Scale to 20,000 feet and divided to 100 feet.

£6 15 0

J. H. STEWARD, Ltd.

Opticians and Scientific Instrument Makers to the British and Foreign Governments,

406 and 457 Strand, London, W.C.2.

Established 1852.

A feature of NATURE is its Supplements—the monthly one on "Recent Scientific and Technical Books" and those published occasionally on specific pieces of scientific research. In the latter class are "Electrons, Atoms and Molecules," by Prof. T. M. Lowry (May 29), and "Some New Possibilities in Solar Research," by Dr. G. E. Hale (July 3). The numbers can be sent to any address by the publishers on receipt of the published price, plus postage.

OXYGEN

And other Gases.

The British Oxygen Co. have works for the production of Oxygen, Nitrogen, Carbonic Acid, Nitrous Oxide, Hydrogen, and Argon in all chief industrial centres. The Company's Plants are capable of an aggregate output of **about four million cubic feet per day.**

Special Terms quoted to the Trade

Catalogue and full particulars on application to the Head Offices of the Company—

THE BRITISH OXYGEN CO., Ltd.,
ANGEL ROAD, UPPER EDMONTON,
LONDON, N.18.

THE PRECIOUS METALS
GOLD, PLATINUM, SILVER.

SPINK & SON, LIMITED
(By Appointment)
17-18 PICCADILLY, LONDON, W.1.
Established 153 years.

VALUE, PURCHASE or ASSAY the above in any form.

Parcels can be safely sent by registered post.

SCIENTIFIC BOOKS

AND PERIODICALS

Including the Publications of the Learned Societies,

ON SALE BY

WHELDON & WESLEY Ltd.

2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2

Classified Catalogues sent post free. Books Purchased.

GERMAN BOOKS

AND PERIODICALS

supplied by

W. MULLER, Foreign Bookseller,
26 Hart Street, Bloomsbury, London, W.C.1

References in all countries.

TO KEEP IN TOUCH WITH SCIENTIFIC MATTERS
IT IS NECESSARY TO SEE "**NATURE**" REGULARLY

Subscription rates

Inland		*Foreign*
£2 12 0	*Year*	£2 17 0
£1 6 0	*Half-year*	£1 10 0
13 0	*Quarter*	16 0

All Subscriptions are payable in advance.

Cheques and Postal Orders should be made payable to Macmillan & Co., Ltd

Please send me "NATURE" for . . . months, for which I enclose remittance value

Name

Address

Date

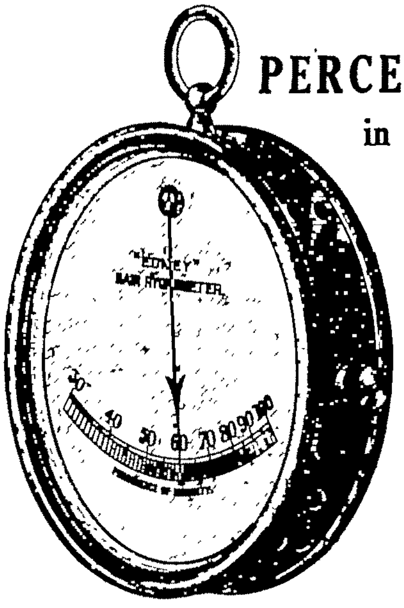
THIS FORM MAY BE HANDED TO A BOOKSELLER OR NEWSAGENT, OR SENT DIRECT TO MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.

"Edney" Hair Hygrometers

showing directly the

PERCENTAGE of MOISTURE

in the room or other position where placed

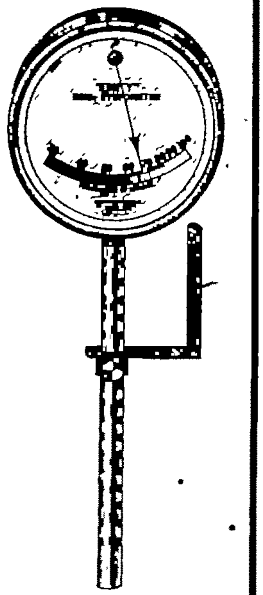


No. 1

THESE instruments are strongly made, and mounted in stout polished and lacquered brass cases, with 5-inch engraved and silvered metal dials which give a very open range, allowing the variations in humidity to be easily observed.

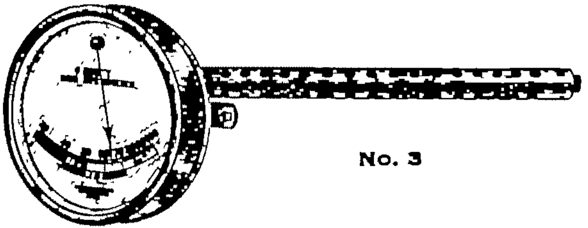
The action is by the contraction or expansion of a strand of 50 specially treated human hairs, which alters in length according to the percentage of moisture in the atmosphere.

This movement is conveyed by simple mechanism to a pulley on which the indicating hand is fixed.



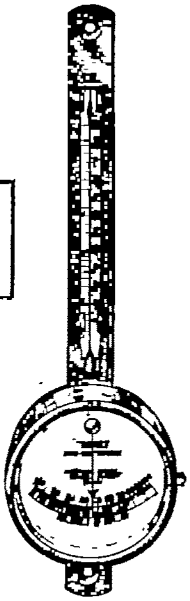
No. 2

Each instrument is tested against Standard Wet and Dry Bulb thermometers, and is guaranteed to give accurate readings.
A small adjusting screw is provided so that at any time the hand can (if required) be set to a standard.



No. 3

GUARANTEED ACCURATE



Nos. 6 and 7

PRICES

No. 1 pattern, for hanging in a room	**£2 . 2 . 0**
No. 2 pattern, for fixing to wall, with bracket, 12-inch stem	**£2 . 15 . 0**
No. 3 pattern, for passing through a door or wall, to show humidity of room without opening the door, 12-inch stem	**£2 . 15 . 0**
No. 6, 2-in. dial Hygrometer mounted with 4-in. Thermometer	**£2 . 5 . 0**
No. 7, 5-in. dial Hygrometer mounted with 6-in. Thermometer	**£2 . 10 . 0**

SAFE DELIVERY FREE

Illustrated Descriptive List of above and other patterns of Hygrometers, also Hygrographs and Thermographs, post free from the Sole Manufacturers:

PASTORELLI & RAPKIN LTD.

Established 1750. Contractors to various Departments of H.M. Government.

Actual Makers also of Thermometers, Barometers, Barographs, Hydrometers, and Standard Meteorological Instruments.

46 HATTON GARDEN, LONDON, E.C.1.

Telephone: Holborn 1981] ***Any instrument sent on approval if desired*** [*Telegrams:* Rapkin, London

Carriage paid and safe delivery guaranteed of all instruments within the British Isles.

H. K.
LEWIS
& CO. LTD.
BOOKSELLERS & PUBLISHERS,
136 GOWER ST.,
AND
24 & 28 Gower Place,
LONDON, W.C. 1.
District Railway. Euston Square Station.
All Tube Railways. Warren Street.
Telephone Museum 1072.

SCIENTIFIC BOOKS

Complete Stock of Works and Text-books in all branches of General, Technical, and Medical Science.

Classified List of Scientific, Technical, and Industrial Books, post free. All books in General Literature also supplied. Periodicals at subscription rates.

SPECIAL FACILITIES FOR EXECUTION OF ORDERS FROM ABROAD, which can be forwarded under the V.P.P. (C.O.D.) system when desired.

Effectually protective packing used without charge.

LARGE STOCK OF SECOND-HAND BOOKS, 140 GOWER STREET. 'Phone: Museum 4031.

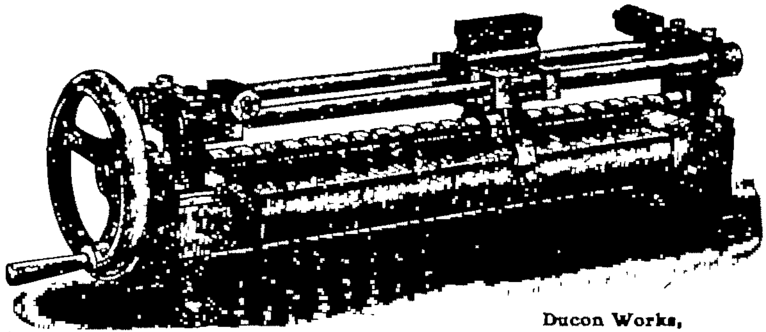
SLIDING RESISTANCES

In a VARIETY OF PATTERNS for

ALL REQUIREMENTS

Quality up. Prices down.

List free on request.



ISENTHAL & CO., LTD.,

Contractors to the Admiralty, War Office, Air Ministry, Postmaster-General, &c.

Ducon Works,
Victoria Road, North Acton,
LONDON, W.3.

LABORATORIES
WITHOUT A SUPPLY OF GAS

should write for particulars of the Mansfield Oil-Gas plant which produces gas in a simple manner from heavy oil, such as paraffin.

The gas produced has a calorific power of about 1300 B.T.U.'s per cubic foot and gives perfect oxidising and reducing flames.

The Mansfield plant may be seen in operation in many of the principal laboratories in the British Empire which are out of the reach of a supply of town's gas.

Write for particulars to

MANSFIELD & SONS, LTD.,
23 HAMILTON SQUARE, BIRKENHEAD.

ULTRA VIOLET RAYS

WHICH ARE STOPPED BY GLASS PASS THROUGH

WINDOLITE,

The Practical Glass Substitute

for windows in FACTORIES, SCHOOLS, and HOSPITALS;
for POULTRY HOUSES, BROODERS, and CATTLE SHEDS;
for all GARDEN USES.

Light. Flexible. Unbreakable.
Easy to cut and fix
Particulars post free, or Sample 3 ft. by 2 ft. for 4/6.

WINDOLITE (Dept. M), 179/185 Great Portland St.,
LONDON, W. 1.

SIR HOWARD GRUBB, PARSONS AND COMPANY

ENGINEERS & ASTRONOMICAL INSTRUMENT MAKERS.

OPTICAL WORKS:
WALKER GATE,
NEWCASTLE-
ON-TYNE.

The illustration shows a crown glass disc of 45" diameter, for an optical plane, being ground.

Recent Scientific and Technical Books.

Volumes marked with an asterisk have been received at "NATURE" *Office.*

Mathematics: Mechanics: Physics

Borchardt, W. G. Elementary Arithmetic. Part 1. Cr. 8vo. Pp 128. (London: Rivingtons, 1926.) Without answers, 2*s*; with answers, 2*s* 6*d*.

Cranz, C. Lehrbuch der Ballistik Zweiter Band. Innere Ballistik; die Bewegung des Geschosses durch das Rohr und ihre Begleiterscheinungen. Herausgegeben von C Cranz unter Mitwirkung von O Poppenberg und O. von Eberhard 8vo Pp. 464 (Berlin: Julius Springer, 1926) 39 gold marks.

Cushman, Frank. Mathematics and the Machinist's Job: Practical Mathematics of the Machinist's Trade Cr. 8vo (London: Chapman and Hall, Ltd, 1926) 8*s*. 6*d* net.

Dunk, John L. Tonality: its Rational Basis and Elementary Development. Cr. 8vo Pp. vii + 72 (London: J. M. Dent and Sons, Ltd., 1926.) 3*s*. 6*d*. net.*

Geiger, H., und **Scheel, Karl**, Herausgegeben von Handbuch der Physik. Band 1: Geschichte der Physik: Vorlesungstechnik. Redigiert von Karl Scheel Sup. Roy. 8vo. Pp. vi + 404. 31.50 gold marks Band 2: Elementare Einheiten und ihre Messung. Redigiert von Karl Scheel. Sup Roy. 8vo Pp. viii + 522. 39 60 gold marks. (Berlin: Julius Springer, 1926) *

Haas, Arthur. Die Welt der Atome: Zehn gemeinverstandliche Vortrage. Med. 8vo. Pp. xii + 130 + 3 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1926) 4.80 gold marks.*

Hofmann, J. V. Grundzuge der Korperlehre: eine Wissenschaft über die innere Beschaffenheit der (irdischen) Körper und die Vorgange in denselben als Ursachen aller Erscheinungen der Aussenwelt. Posthum herausgegeben von seinen Söhnen Pp. 70. (Dresden. Emil Pahl, 1926.) 4.50 gold marks

Hood, George J. Geometry of Engineering Drawing. (New York McGraw-Hill Book Co, Inc, London: McGraw Hill Publishing Co, Ltd., 1926.) 12*s*. 6*d*. net

Hutchinson, Robert W. Intermediate Text Book of Magnetism and Electricity. Second edition. Cr. 8vo. Pp viii + 630. (London: University Tutorial Press, Ltd., 1926) 9*s*. 6*d*

Jones, D. Caradog, and **Daniels, G. W.** Elements of Mathematics: for Students of Economics and Statistics. Cr. 8vo. Pp. viii + 240. (Liverpool: University Press of Liverpool, Ltd; London: Hodder and Stoughton, Ltd., 1926) 8*s*. 6*d*. net *

Lecat, M. Coup d'œil sur la théorie des déterminants supérieurs dans son état actuel Première partie. 8vo. Pp. 60. (Louvain: E Ceuterik, 1926)

Lohr, E. Atomismus und Kontinuitatstheorie in der neuzeitlichen Physik (Wissenschaftliche Grundfragen, Heft 6) Roy. 8vo. Pp 82 (Leipzig und Berlin: B. G. Teubner, 1926.) 4 gold marks.

Müller, Erich. Die elektrometrische (potentiometrische) Massanalyse. Vierte verbesserte und vermehrte Auflage. Pp. vi + 246. (Dresden und Leipzig: Theodor Steinkopff, 1926) 12 gold marks.

Parcel, John Ira, and **Maney, George Alfred.** An Elementary Treatise on Statically Indeterminate Stresses Demy 8vo. Pp. 368 (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926) 25*s*. net.

Paterson, W. E. Test Papers in Geometry: for Candidates preparing for School Certificate, Matriculation and similar Examinations. Demy 8vo Pp. 104. (London: Sir Isaac Pitman and Sons, Ltd, 1926.) 2*s* net.

Protheroe, Ernest. A Book about Mechanical Marvels (Book About Series.) Cr 8vo. Pp. 144. (London: The Epworth Press, 1926.) 2*s* net.

Salpeter, J. Einführung in die hohere Mathematik: fur Naturforscher und Ärzte Dritte Auflage Roy. 8vo Pp xi + 383. (Jena: Gustav Fischer, 1926.) 16 gold marks

Small, Lloyd C. Plane Trigonometry Pp 246. (New York. McGraw-Hill Book Co, Inc, London: McGraw Hill Publishing Co., Ltd, 1926) 11*s* 3*d*. net.

Smekal, A. Allgemeine Grundlagen der Quantenstatistik und Quantentheorie. (Sonderausgabe aus der Encyklopadie der mathematischen Wissenschaften.) Roy. 8vo. Pp. vi + 366. (Leipzig und Berlin: B. G Teubner, 1926) 16 gold marks.

Smith, P. J. Lancelot. Text Papers in Physics (Heat, Light and Sound, Magnetism and Electricity) Demy 8vo. Pp v + 106. (London: Sir Isaac Pitman and Sons, Ltd., 1926) 2*s*.

Taylor, Lloyd W., Watson, William W., and **Howe, Carl E.** General Physics for the Laboratory Med. 8vo. Pp vi + 247. (Boston, New York and London: Ginn and Co., 1926) 2.40 dollars *

Engineering

Andreae, C. Der Bau langer tiefliegender Gebirgstunnel. 8vo Pp. vi + 151. (Berlin: Julius Springer, 1926.) 13.50 gold marks.

Anmund, H. Hebe- und Forderanlagen: ein Lehrbuch für Studierende und Ingenieure Band 2: Anordnung und Verwendung fur Sonderzwecke. Zweite Auflage. (Berlin: Julius Springer, 1926) 42 gold marks

d'Anselme, J. La T. S F. et les phénomènes radioélectriques expliqués sans formules Pp. 146. (Paris: Étienne Chiron, 1926) 12 francs.

Bagnasco, Adriano. Cemento armato: teoria e pratica Seconda edizione. (Brescia: Giulio Vannini, 1926.) 25 lire.

Baxter, L. H. Electro-Craft in Theory and Practice. Pp. 168. (London: B T Batsford, Ltd, 1926) 7*s* 6*d* net

Bennett, Alfred Rosling. History of the States of Guernsey Telephone System, 1895–1925. Cr. 8vo. Pp. 139. (London: Leonard Parsons, Ltd, 1926.) 5*s*. net.

Bie, Charles de. Chaudières à vapeur Roy. 8vo. Pp. 562. (Paris: Libr. Dunod, 1926) 60 francs.

Bleich, Fr., und **Melan, J.**, Herausgegeben von Taschenbuch für Ingenieure und Architekten. (Berlin und Wien: Julius Springer, 1926.) 22 50 gold marks.

British Engineering Standards Association. British Standard Glossary of Terms used in Electrical Engineering (Publication No. 205—1926) Demy 8vo. Pp 263. (London: British Engineering Standards Association; Crosby Lockwood and Son, 1926.) 5*s* net.*

Brutzkus, Markus. Theorie der Brennkraftmaschinen und deren Brennstoffe vom Standpunkte der chemischen Gleichgewichtslehre. (Halle a. Saale: Wilhelm Knapp, 1926.) 3.80 gold marks.

Bültemann, August. Dielektrisches Material: Beeinflussung durch das elektrische Feld, Eigenschaften, Prufung, Herstellung Pp 160 (Berlin: Julius Springer, 1926.) 10 50 gold marks.

Bundschu, F. Druckrohrleitungen. (Berlin: Julius Springer, 1926.) 6 gold marks.

Concrete Floor Treatment: Specifications for Hardening, Dustproofing and Waterproofing. (Cleveland, Ohio: The Master Builders' Co, 1926)

Dacremont, Édouard. Électricité. Deuxième partie: Applications industrielles Deuxième édition mise à jour par Léon Grininger Deux vols Gl 8vo Tome 1. Pp viii + 632. Tome 2. Pp. iv + 584. (Paris: Libr Dunod, 1926.) 84 francs.

Dettmar, Georg. Erlauterungen zu den Regeln fur die Bewertung und Prüfung von elektrischen Maschinen (R. E. M) und von Transformatoren (R. E. T), zu den Regeln fur die Bewertung und Prufung von elektrischen Bahn-Motoren, Maschinen und Transformatoren (R. E B.) sowie zu den normalen Anschlussbedingungen und den normalen Klemmenbezeichnungen. Im Auftrage des Verbandes Deutscher Elektrotechniker herausgegeben. Sechste Auflage, unveranderter Nachdruck. 8vo. Pp. vii + 320. (Berlin: Julius Springer, 1926.) 12 gold marks.

Emperger, F., Herausgegeben von Handbuch fur Eisenbetonbau. Band 4. Wasserbau und verwandte Anwendungen. Dritte Auflage (Berlin: Wilhelm Ernst und Sohn, 1926) 36 gold marks.

Gesteschi, Theodor. Der Holzbau: Grundlagen der Berechnung und Ausbildung von Holzkonstruktionen des Hoch- und Ingenieurbaues. (Berlin: Julius Springer, 1926.) 45 gold marks.

Hetzel, Frederic V. Belt Conveyors and Belt Elevators. Second edition, revised. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 25*s*. net.

Hœhn, E. Rivure et soudère des chaudières à vapeur (Zurich: E. Hœhn, 1926)

Hutchinson, Robert W. A First Course in Wireless Cr. 8vo. Pp. viii + 262. (London: University Tutorial Press, Ltd., 1926) 3*s* 6*d*.

Ibbetson, W. S. Accumulator Charging, Maintenance and Repair: Intended for the Use of all interested in the Charging and Upkeep of Accumulators for Wireless Work, Motor-car Lighting and Starting Equipment, and Country House Lighting Plant. Cr 8vo Pp. x + 118. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 3*s* 6*d*. net.

Kearton, W. J., Edited by. Pitman's Engineering Educator. Complete in 30 fortnightly Parts. Part 1 Cr. 4to. Pp. ii + 56. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 1*s*. 3*d*. net each part *

Kersten, C. Freitragende Holzbauten. Zweite Auflage. (Berlin: Julius Springer, 1926) 36 gold marks.

Kirsopp, John. The Use of Power in Colliery Working: a Treatise on Mining Costs and Machinery Designs and Management. Roy. 8vo. Pp. xxviii + 580. (London: H. F. and G. Witherby, 1926.) 40*s*. net *

Korn, A., und Nesper, E. Bildrundfunk Pp 106. (Berlin: Julius Springer, 1926.) 5 40 gold marks.

Kummer, Hans. Zeitstudien bei Einzelfertigung (Berlin: Julius Springer, 1926.) 9.60 gold marks.

Lindley, A. L. G. The Design of Direct-Acting Steam Winders. (London: The Association of Engineering and Shipbuilding Draughtsmen, 1926) 2*s*

Liwschitz, M. Die elektrischen Maschinen Pp viii + 337. (Berlin und Leipzig: B G Teubner, 1926.) 14 gold marks.

Lubberger, F. Die Fernsprechanlagen mit Wahlerbetrieb. Pp. xiii + 277. (München: R Oldenbourg, 1926.) 11 gold marks

Melan, Herbert. Die Schaltungarten der Haus- und Hilfsturbinen: ein Beitrag zur Warmewirtschaft der Kraftwerksbetriebe. (Berlin: Julius Springer, 1926.) 10.50 gold marks

Michenfelder, C. Kran- und Transportanlagen: fur Hutten-, Hafen-, Werft- und Werkstatt-betriebe. Zweite umgearbeitete und erweiterte Auflage (Berlin: Julius Springer, 1926.) 67 50 gold marks.

Mills, A. P. Materials of Construction: their Manufacture and Properties Third edition, edited by H W. Hayward. (London: Chapman and Hall, Ltd., 1926) 20*s*. net.

Prévost, Pierre. Le chauffeur au garage: organisation de l'atelier du garage privé, entretien de la voiture, sa mise au point, recherche des pannes. Tome 1. Cr. 8vo Pp. viii + 284 (Paris: Libr. Dunod, 1926) 19.20 francs.

Schonberg, A., und Glunk, E. Landeselektrizitatswerke. (München: R. Oldenbourg, 1926.) 26 gold marks

Staus, A. Der Genauigkeitsgrad von Flugelmessungen bei Wasserkraftanlangen. (Berlin: Julius Springer, 1926.) 2 40 gold marks.

Stein, Th. Regelung und Ausgleich in Dampfanlagen (Berlin: Julius Springer, 1926.) 30 gold marks

Vieweger, H. Recueil de problèmes avec solutions sur l'électricité et ses applications pratiques. Traduction française de G. Capart. Cinquième édition, revue et augmentée. Roy. 8vo. Pp. xviii + 441 + 11 planches. (Paris: Libr. Dunod, 1926)

Waterproofing and Damp-proofing Specifications. (Cleveland, Ohio: The Master Builders' Co., 1926)

Watkins, J. H. Five Simple Wireless Sets Described and Explained 12mo Pp. 46 (London: Radio News Bureau, Ltd., 1926) 1*s*. net.

Weber, C. L. Erlauterungen zu den Vorschriften fur die Errichtung und den Betrieb elektrischer Starkstromanlagen einschliesslich Bergwerksvorschriften und zu den Bestimmungen fur Starkstromanlagen in der Landwirtschaft. Im Auftrage des Verbandes Deutscher Elektrotechniker herausgegeben. Funfzehnte, vermehrte und verbesserte Auflage. Berichtigter Neudruck. 8vo. Pp. ix + 330 (Berlin: Julius Springer, 1926.) 6 gold marks.

Chemistry: Chemical Industry

Arnall, Francis, and Hodges, Francis W. Theoretical Organic Chemistry. Part 1 Ex. Cr 8vo. Pp xi + 372. (London: J. and A. Churchill, 1926) 10*s*. 6*d* net *

Barral, E. Précis d'analyse chimique quantitative. Tome 1: Méthodes générales et métaux (cations) Deuxième édition, entièrement refondue. Cr. 8vo. Pp. vii + 576 (Paris: J -B Baillière et fils, 1926.) 34 francs.

Bied, J. Recherches industrielles sur les chaux, ciments et mortiers. Roy. 8vo. Pp vi + 227. (Paris: Libr. Dunod, 1926.)

Blüchers Auskunftsbuch fur die chemische Industrie. Dreizehnte vollig umgearbeitete Auflage. Besorgt von Otto Lange Halbbände 1 und 2. Pp. 1400. (Berlin und Leipzig: Walter de Gruyter und Co, 1926.) 70 gold marks.

Brunswig, H. Das rauchlose Pulver. (Die Explosivstoffe, Heft 8.) Pp. 499. (Berlin und Leipzig: Walter de Gruyter und Co., 1926.) 22 gold marks.

Crehore, Albert C. The Progress of Atomic Theory. Med 8vo. Pp. ii + 230. (London: Taylor and Francis, 1926.) 12*s*. 6*d*. net.*

Danneel, Heinrich. Electrochemie und ihre physikalisch-chemischen Grundlagen. Band 3: Energie. (Berlin und Leipzig: Walter de Gruyter und Co., 1926.) 1.50 gold marks.

Emich, Friedrich. Lehrbuch der Mikrochemie. Zweite gänzlich umgearbeitete Auflage. Pp. 273. (München: J. F. Bergmann, 1926.) 16.50 gold marks.

Franck-Jordan. Anregung von Quantenspringen durch Stosse. Pp. 312. (Berlin: Julius Springer, 1926.) 19 50 gold marks.

Fuchs, Walter. Die Chemie des Lignins. Roy. 8vo. Pp. xi + 327. (Berlin: Julius Springer, 1926.) 18 gold marks.*

Gibson, Charles R. How Photography came About. (Rambles in Science Series.) Cr. 8vo. Pp. 80 + 8 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1926.) 1*s*. 3*d*.

Hägglund, E. Technik und Praxis der Papierfabrikation. Band 2, Teil 2: Natronzellstoff. Pp 359. (Berlin: Otto Elsner, 1926.) 30 gold marks

Hertel, E. Stillings pseudo-isochromatische Tafeln zur Prufung des Farbensinnes, sowie Wolfflin, Tafeln mit Umschlagfarben zum Nachweis von relativer Rot- und Grünsichtigkeit. (Leipzig: Georg Thieme, 1926.) 5.70 gold marks.

Houben, J. Fortschritte der Heilstoffchemie. Erste Abteilung: Das deutsche Patentschriftwesen. Band 1: 1877–1900. Pp 922. (Berlin und Leipzig: Walter de Gruyter und Co., 1926.) 70 gold marks

Kehrmann, F. Gesammelte Abhandlungen Band 4: Untersuchungen uber Beziehungen zwischen Konstitution und Farbe von Kohlenstoffverbindungen. Von F. Kehrmann und Maurice Sandoz. Pp 266 (Leipzig: Georg Thieme, 1926) 24 gold marks

Liénard-Flévet, Ch. Manuel de blanchiment-teinture Tome 1: Chimie tinctoriale. (Bibliothèque professionnelle) Pott 8vo. Pp. 460. (Paris: J.-B. Baillière et fils, 1926) 18 francs.

Litinsky, L. Über die Wahl eines Gaswerksofensystems. (Halle a. Saale: Wilhelm Knapp, 1926.) 1.50 gold marks.

Litinsky, L. Feuerfeste Baustoffe fur Kammern der Kokerei- und Gaswerksöfen. (Halle a. Saale: Wilhelm Knapp, 1926) 2.80 gold marks.

Mines Department Safety in Mines Research Board. Paper No. 26: Pyritic Oxidation in relation to the Spontaneous Combustion of Coal. By H. Macpherson, N. Simpkin and S. V. Wild. Roy. 8vo. Pp. 15 + 10 plates (London: H.M. Stationery Office, 1926.) 1*s*. net *

Rau, Dr. Allgemeines deutsches Gebührenverzeichnis fur Chemiker. Dritte Auflage. Pp. 67. (Leipzig: Verlag Chemie, G m.b.H, 1926.) 5 gold marks.

Schimpf, J. Handelsbezeichnungen fur Kalk. Pp. 14. (Berlin: Kalkverlag, G.m b H, 1926.) 1 gold mark.

Schlickums Ausbildung des jungen Pharmazeuten und seine Vorbereitung zur pharm. Vorprufung. Vierzehnte vollstandig umgearbeitete und bedeutend vermehrte Auflage des Apothekerlehrlings. Unter Redaktion von K. H. Bauer. Pp. 1002. (Leipzig: Johann Ambrosius Barth, 1926.) 42 gold marks.

Stone, Willard J. Blood Chemistry Colorimetric Methods. Second edition, revised. Med. 8vo. Pp. x + 129. (New York: Paul B. Hoeber, Inc., 1926.) 3.25 dollars.

Thoms, Hermann. Handbuch der praktischen und wissenschaftlichen Pharmazie. Lieferung 15. Band 5. Pp. 288. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 10 gold marks

Thon, Nathaniel. Die Chlorknallgasreaktion. (Fortschritte der Chemie, Physik und physikalischen Chemie, Band 18, Heft 11.) Pp 88. (Berlin: Gebrüder Borntraeger, 1926.) 4 gold marks.

Trillich, Heinrich. Das deutsche Farbenbuch. Teil 3: Die Anstrichfarben und Lacke. Pp. 192 + 7 Tafeln. (München: B. Heller, 1926.) 6 gold marks.

Vogt, Ernst. Die chemischen Pflanzenschutzmittel: ihre Anwendung und Wirkung. (Sammlung Göschen, Nr. 923.) Pp. 134. (Berlin und Leipzig: Walter de Gruyter und Co., 1926.)

Weissberger, Arnold. Grundriss der organischen Chemie. (Breitensteins Repetitorien, Nr. 8.) Pp. 156 (Leipzig: Johann Ambrosius Barth, 1926.) 5.70 gold marks.

Wilson, John-Arthur. La chimie de la fabrication du cuir. Traduction française par André Deforge. Roy. 8vo. Pp. xii + 468. (Paris: Libr. Dunod, 1926.) 68 francs.

Wilson, John-Arthur. Die moderne Chemie in ihrer Anwendung in der Lederfabrikation. Übersetzt von Hermann Loewe. Pp. 400. (Leipzig: Paul Schulze, 1926.) 30 gold marks.

Zsigmondy, R. Traité de chimie colloïdale. Traduit sur la troisième édition allemande par G. Lejeune. Roy. 8vo. Pp. x + 536 + 8 planches. (Paris: Libr. Dunod, 1926.) 78 francs.

Technology

Baker, Walter Davis, and Strawn, Ida. Batik and other Pattern Dyeing. Cr. 8vo. (London: B T. Batsford, Ltd., 1926.) 9*s.* net.

Cornelle, A. Manuel de fabrication des briques, tuiles et produits réfractaires Pp. 400. (Paris: J.-B. Baillière et fils, 1926.)

Curtis, Harry P. The Testing of Yarns and Fabrics: for Manufacturers, Warehousemen and Operatives, Drapers, Laundrymen and Clothiers Cr. 8vo. Pp. xii + 168. (London: Sir Isaac Pitman and Sons, Ltd, 1926.) 5*s.* net.

Eggert, Hans. Die Herstellung und Verarbeitung der Viskose unter besonderer Berucksichtigung der Kunstseidenfabrikation. 8vo. Pp. vi + 92. (Berlin: Julius Springer, 1926.) 6 gold marks.

Fornet, A. Die Theorie der prakt. Brot- und Mehlbereitung. Dritte Auflage. Pp. 287. (Berlin: F. A Günther und Sohn, 1926) 6.30 gold marks.

Gates, Philip. Gears and Gear Cutting. Revised and brought up to date. Cr. 8vo. Pp. 149. (London: Crosby Lockwood and Son, 1926.) 5*s.* net.

Greenwood, Henry. Handbook of Weaving and Manufacturing. Cr. 8vo. Pp. 136. (London: Sir Isaac Pitman and Sons, Ltd, 1926.) 5*s.* net.

Hiscox, W. J. Engineering Factory Supplies: the Purchase, Receipt, Storage and Distribution of Factory Materials. Demy 8vo. Pp. 184. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 5*s.* net.

Hobbs, Edward W. House Repairs: a Practical Guide for the Householder and Amateur Craftsman (Little Things that Matter Series.) Demy 8vo. Pp. xii + 79. (London: Architectural Press, Ltd., 1926.) 5*s.* net.

Hœhn, E. Résistance des récipients soudés à l'électricité. (Zurich: E. Hœhn, 1926.)

Laurie, A. P. The Painter's Methods and Materials: the Handling of Pigments in Oil, Tempera, Water-Colour, and in Mural Painting, the Preparation of Grounds and Canvas, and the Prevention of Discoloration, together with the Theories of Light and Colour applied to the Making of Pictures; all described in a Practical and Non-technical Manner. (New Art Library.) Ex. Cr. 8vo. Pp. 250. (London: Seeley, Service and Co., Ltd., 1926) 21*s.* net.

Ministry of Agriculture and Fisheries. Investigations into the Desiccation (De Vecchis) Process for producing Sugar from Sugar Beet; Progress Report. By B. J. Owen. Roy 8vo. Pp. 20 (London: H M. Stationery Office, 1926) 4*d.* net.*

Norrenberg, Hch. Die Organisation der chemisch-technischen Klein- und Nebenbetriebe und die Herstellung der wichtigsten Handverkaufsartikel des täglichen Bedarfs. Pp. 764. (Berlin: R. Müller, m.b.H., 1926) 15 gold marks

Palmer, R. H. Foundry Practice Third edition. (London: Chapman and Hall, Ltd., 1926.) 15*s.* net

Picoux, M., et Werquin, M. Manuel de brasserie. Pp. 320. (Paris: J.-B Baillière et fils, 1926)

Regelsberger, Friedrich. Chemische Technologie der Leichtmetalle und ihrer Legierungen. (Sammlung Chemische Technologie in Einzeldarstellungen.) Pp. 385. (Leipzig: Otto Spamer, 1926.) 26 gold marks.

Roux, Ch. Pour le relieur, amateur ou professionnel: procédés, formules, recettes, tours de main et 'trucs' de toutes sortes pour le brochage, la reliure, la marbrure, la réparation du livre. Cr. 8vo. Pp. viii + 162 (Paris: Libr. Dunod, 1926.) 12 francs

Smithells, Colin J. Tungsten: a Treatise on its Metallurgy, Properties and Applications. Roy. 8vo. Pp. viii + 167 + 33 plates. (London: Chapman and Hall, Ltd, 1926.) 21*s.* net.*

Thompson, Mervyn, Edited by. The Camera Book. Cr. 8vo. Pp. 182. (London: Philip Allan and Co, Ltd., 1926.) 3*s.* 6*d.* net.

Trinks, W. Industrial Furnaces. Vol. 1. Second edition. (New York: John Wiley and Sons, Inc; London: Chapman and Hall, Ltd., 1926.) 22*s.* 6*d* net.

Winship, George Parker. Gutenberg to Plantin: an Outline of the Early History of Printing. Demy 8vo. Pp. xii + 86. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1926) 12*s.* 6*d.* net.

Astronomy

Colson, F. H. The Week: an Essay on the Origin and Development of the Seven-day Cycle. Cr 8vo Pp. viii + 126. (Cambridge: At the University Press, 1926.) 5*s.* net.*

Dreyer, I. L. E., Edidit. Tychonis Brahe Dani opera omnia. Tomus 13. Med. 4to. Pp. iv + 398. (Hauniæ: Libraria Gyldendaliana, 1926.) *

Fath, Edward Arthur. The Elements of Astronomy: a Non-Mathematical Textbook for Use as an Introduction to the Subject in Colleges, Universities, etc., and for the General Reader. Med. 8vo. Pp. viii + 307. (New York: McGraw-Hill Book Co, Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15*s.* net.*

Meteorology: Geophysics

Air Ministry: Meteorological Office Professional Notes, No. 45: The Comparison of Sunshine Recorders of the Campbell-Stokes Type; Report prepared in the Meteorological Office, London, at the request of the International Meteorological Committee. Roy. 8vo. Pp. 14. (London: H.M. Stationery Office, 1926.) 6*d.* net.*

Defant, Albert. Wetter und Wettervorhersage (Synoptische Meteorologie). Zweite, vollständig umgearbeitete Auflage. Sup. Roy. 8vo. Pp. vii + 346. (Leipzig und Wien: Franz Deuticke, 1926.) 18 gold marks.*

Geology: Mineralogy

Anderson, J. W. The Prospector's Handbook: a Guide for the Prospector and Traveller in search of Metal-bearing or other Valuable Minerals. Cr. 8vo. Pp 210. (London: Crosby Lockwood and Son, 1926.) 5*s.* net.

Bubnoff, Serge von. Geologie von Europa. (Geologie der Erde.) Band 1: Einführung, Osteuropa, Baltischer Schild Sup. Roy. 8vo. Pp viii + 322 + 8 Tafeln. (Berlin: Gebrüder Borntraeger, 1926) 22.50 gold marks *

Cahen, J., et Druet, E. Carrières, plâtrières, ardoisières. Pp. 283. (Paris: J.-B. Baillière et fils, 1926) 18 francs

Daly, Reginald Aldworth. Our Mobile Earth. Med 8vo. Pp. xxii + 342 (15 plates). (New York and London: Charles Scribner's Sons, 1926.) 21*s.* net *

Frebold, Georg. Grundriss der Bodenkunde. Roy. 8vo. Pp. viii + 94 + 2 Tafeln. (Berlin und Leipzig. Walter de Gruyter und Co., 1926.) 7.50 gold marks

Geological Survey, England, Memoirs of the. Wells and Springs of Dorset. By W. Whitaker and Wilfrid Edwards Roy. 8vo Pp. vi + 119. (London: H.M Stationery Office, Southampton · Ordnance Survey Office, 1926.) 3s. 6d. net *

Stuart, Murray. The Geology of Oil, Oil-Shale and Coal. Cr. 8vo. Pp ix + 104 (London: Mining Publications, Ltd., 1926) 7s. 6d. net.*

Suess, Franz Ed. Intrusionstektonik und Wandertektonik im variszischen Grundgebirge. Roy 8vo. Pp. vii + 268 + 2 Tafeln. (Berlin · Gebruder Borntraeger, 1926.) 21 gold marks *

Twenhofel, William H., and Collaborators Treatise on Sedimentation. Prepared under the Auspices of the Committee on Sedimentation, Division of Geology and Geography, National Research Council of the National Academy of Sciences. Med 8vo Pp. xxv + 661 + 38 plates. (Baltimore, Md · Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926) 34s. net.*

Wilser, J., Herausgegeben von Die Kriegsschauplatze 1914–1918 geologisch dargestellt In 14 Heften. Heft 14: Die Isthmuswuste und Palastina Von Paul Range. Mit einem Beitrage von Walter Hoppe. Palaeontologie und Palaeogeographie der Jura- und Kriedeschichten der Isthmuswuste. Roy. 8vo. Pp. vi + 82. (Berlin. Gebruder Borntraeger, 1926) 11 40 gold marks *

Geography: Travel

Andrews, Roy Chapman. On the Trail of Ancient Man: a Narrative of the Field Work of the Central Asiatic Expeditions. With an Introduction and a Chapter by Henry Fairfield Osborn. Roy 8vo. Pp xxiv + 375 + 61 plates. (New York and London. G. P Putnam's Sons, Ltd., 1926) 25s net *

Blache, P. Vidal de la. Principles of Human Geography. Edited by Emmanuel de Martonne Authorised translation from the French by Millicent Todd Bingham Demy 8vo Pp. xv + 511 + 6 plates. (London: Constable and Co, Ltd, 1926.) 18s. net.*

Black, Harman. The Real North America Pocket Guide Book. From official sources (Black's Blue Books.) Fcap. 8vo. Pp. 447. (London: Simpkin, Marshall and Co., Ltd, 1926.) 15s. net.

Brouwer, H. A., Edited by. Practical Hints to Scientific Travellers. Vol. 4. Ex Cr 8vo. Pp v + 171 + 11 plates. (The Hague: Martinus Nijhoff, 1926) 5 guilders.*

Brown, W. C., and **Johnson, P. H.** How People Live. Part 1: The British Isles, Part 2: Outside the British Isles (The New Outlook Geography, Book 1.) Revised edition. Cr. 8vo. Pp. 252. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd, 1926) 2s 6d

Cox, J. Charles. Surrey. (Little Guides) Revised by Philip M. Johnston. 18mo. Pp. 242. (London: Methuen and Co, Ltd, 1926.) 5s. net.

Dahl, Knut. In Savage Australia: an Account of a Hunting and Collecting Expedition to Arnhem Land and Dampier Land. Roy. 8vo. Pp. 338. (London: Philip Allan and Co., Ltd, 1926) 21s net.

Eden, Anthony. Places in the Sun Ex. Cr 8vo. Pp. xiii + 143. (London: John Murray, 1926) 5s. net

Elston, Roy, Edited by The Traveller's Handbook to Florence. Fcap. 8vo. Pp 118 (London: Simpkin, Marshall and Co., Ltd., 1926.) 2s. 6d. net

English and Welsh Homelands, The. (Life and Progress of the World Series) Pp 208. (London and Edinburgh: McDougall's Educational Co, Ltd., 1926) 2s. 4d.

Foord, Edward, Edited by. Black's Guide to London and Environs Fcap. 8vo Pp. 124. (London: A and C. Black, Ltd., 1926.) 2s. net.

Fox, Frank. Finland To-day Med 8vo. Pp. x + 188 (London: A. and C. Black, Ltd., 1926.) 7s. 6d. net.

Fraser, Douglas C. Impressions—Nigeria 1925. Demy 8vo. Pp. 188. (London: Herbert Jenkins, Ltd., 1926.) 10s. 6d. net

Geography through Map-Reading No 3: The British Empire Large Cr. 8vo Pp. 96. (London: Oxford University Press, 1926.) 1s.

Gosling, Cecil. Travel and Adventure in Many Lands Demy 8vo Pp. 306 (London: Methuen and Co., Ltd, 1926.) 10s. 6d net.

Grigaut, Maurice. Géographie générale et économique: section industrielle des écoles techniques Ex. Cr. 8vo. Pp vi + 338. (Paris: Libr Dunod, 1926) 18 francs.

Hammer, S. C. Things Seen in Norway. (Things Seen Series.) 18mo Pp. 154. (London Seeley, Service and Co., Ltd., 1926) 3s 6d net.

Hastings, A. C. G. The Voyage of the *Dayspring*. Being the Journal of the late Sir John Hawley Glover, R N., G C.M.G, together with some account of the Expedition up the Niger River in 1857. Med. 8vo. Pp xiii + 230 (London: John Lane, The Bodley Head, Ltd., 1926.) 12s. 6d. net.

Heber, A. Reeve, and **Heber, Kathleen M.** In Himalayan Tibet: a Record of Twelve Years spent in the Topsy-turvy Land of Lesser Tibet, with a Description of its Cheery Folk, their Ways and Religion, of the Rigours of the Climate and Beauties of the Country, its Fauna and Flora. Demy 8vo Pp 283. (London: Seeley, Service and Co, Ltd, 1926) 21s. net.

Herriot, Edouard. Amid the Forests of Normandy. Translated by John Heron Lepper. Med. 8vo. Pp. 275. (London: Cassell and Co, Ltd., 1926.) 10s 6d net.

Hurley, F. Perlen und Wilde (Neuguinea). 8vo. Pp. 276. (Leipzig: F. A. Brockhaus, 1926) 16 gold marks.

Iggleeden, Charles. A Saunter through Kent with Pen and Pencil. Cr. 4to. Pp. 79. (Ashford, Kent: *Kentish Express*, 1926) 3s 6d. net.

Kermack, W. R. W. and A K. Johnston's Commercial and Economic Atlas of the World. Roy. 8vo. Pp. ii + 32. (Edinburgh and London. W. and A K Johnston, Ltd., 1926.) 1s 6d

Kohl, L. Zur grossen Eismauer des Sudpols. 8vo. Pp. xv + 203. (Stuttgart: Strecker und Schroder, 1926.) 6 gold marks.

Laughlin, Clara E. So You're going to England! Fcap. 8vo. Pp. xiii + 571. (London: Methuen and Co, Ltd., 1926) 10s 6d net.

Lewis, Frederick. Sixty-four Years in Ceylon: Reminiscences of Life and Adventure. Demy 8vo. Pp. vii + 506. (Ceylon. Colombo Apothecaries' Co; London: Simpkin, Marshall and Co, Ltd, 1926) 15s net

Lucas, E. V. A Wanderer in Rome. Cr. 8vo. Pp. xv + 246. (London: Methuen and Co., Ltd, 1926.) 10s. 6d. net

Lyde, Lionel W., and **Butterworth, E. M.** The Overseas Empire (The Where and Why Geographies.) Gl. 8vo. Pp 160. (London, Glasgow and Bombay: Blackie and Son, Ltd, 1926.) 2s 6d.

McKay, Herbert. The Oxford Picture Geographies. Cr. 8vo Text Book 4: Communications. 2s. 6d. net Pupil's Book 4. 6d Text Book 5: Climate. 2s. 6d. net. Pupil's Book 5. 6d. Text Book 6: Towns and Industries. 2s. 6d. net. Pupil's Book 6 6d. (London: Oxford University Press, 1926)

MacKinnon, Albert G. Things Seen in Rome: a Description of the Modern Life of this Wonderful City and of the Relics of the Glorious Past, its Street Life, Churches, its People, their Amusements and Manner of Living. (Things Seen Series) 18mo Pp. 158. (London: Seeley, Service and Co, Ltd., 1926) 3s. 6d. net.

McMahon, Thomas J. The Orient I Found. Med. 8vo Pp 223. (London: Gerald Duckworth and Co., Ltd., 1926) 15s. net.

Muirhead, James F. A Wayfarer in Switzerland Cr 8vo Pp x + 236. (London: Methuen and Co., Ltd, 1926.) 7s. 6d. net.

Philip, George, Edited by Philips' Elementary Atlas of Comparative Geography. New edition, showing the Territorial Changes effected by the Peace Treaties Hertfordshire edition. Demy 4to. Pp. 8 + 4 + 40 + 12. (London · George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1926) 2s

Philip, George, Edited by. Philips' New Handy General Atlas and Gazetteer. a Geographical Survey of the New Era, its Territorial Changes, World Relations and Commercial Communications; with a Gazetteer-Index of over 100,000 Names Third edition, revised to show the latest Territorial Changes. Imp 4to. (London: George Philip and Son, Ltd., Liverpool: Philip, Son and Nephew, Ltd, 1926.) 63s. net.

Philips' Visual Contour Atlas. Berks and Reading edition. Cr 4to Pp. 6+40+12. Warwickshire edition. Cr. 4to. Pp. 4+40+12. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1926) 1*s.* 4*d.* each

Protheroe, Ernest. From Ceylon to Hong Kong. (Story of Empire Series) Cr. 8vo. Pp 112. (London. The Epworth Press, 1926.) 1*s* 6*d.* net.

Protheroe, Ernest. In Australia and New Zealand. (Story of Empire Series.) Cr 8vo. Pp. 112. (London· The Epworth Press, 1926) 1*s.* 6*d.* net.

Sheldon-Williams, Inglis. A Dawdle in France. Demy 8vo. Pp. viii+264+16 plates. (London· A. and C Black, Ltd., 1926.) 7*s.* 6*d.* net.

Soane, E. B. To Mesopotamia and Kurdistan in Disguise. Second edition, with a Memoir of the Author by Sir Arnold T. Wilson. Demy 8vo Pp xxi+410 (London: John Murray, 1926) 18*s.* net

Sweeting, H. R. Europe and the Mediterranean Lands. Cr. 8vo. Pp. 266. (London Nisbet and Co., Ltd., 1926.) 2*s.* 9*d*

Sydney, R. J. H. Malay Land, "Tanah Malayu"· some Phases of Life in Modern British Malaya. Med. 8vo. Pp 300. (London: Cecil Palmer, 1926.) 15*s* net

Terry, Michael. Across Unknown Australia. Demy 8vo. Pp. 311. (London· Herbert Jenkins, Ltd, 1926.) 7*s.* 6*d.* net.

Thomas, Lowell, Written by. The First World Flight: being the Personal Narratives of Lowell Smith, Erik Nelson, Leigh Wade, Leslie Arnold, Henry Ogden and John Harding. Roy. 8vo. Pp. 303. (London: Hutchinson and Co., Ltd., 1926.) 24*s.* net.

Tuckermann, W. Die Philippinen: ein kulturgeographischer Ruck- und Ausblick. (Geographische Schriften, Heft 2.) Roy. 8vo. Pp. v+128. (Leipzig und Berlin. B. G. Teubner, 1926.) 6 gold marks.

Weston, Rev. Walter. Japan. Large Cr. 8vo. Pp. x+240+32 plates (London: A. and C. Black, Ltd., 1926) 7*s.* 6*d.* net

Wethey, E. R. Test Papers in Geography: for the Use of Candidates preparing for School Certificate, Matriculation and similar Examinations, with Points essential to Answers. (Test Papers Series.) Demy 8vo. Pp: v+114+98a. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 4*s.* 6*d.*

Whyte, Frederic. A Wayfarer in Sweden. Cr. 8vo. Pp. 223. (London: Methuen and Co., Ltd, 1926.) 7*s.* 6*d* net.

Wynne, Kenyon. A Book about the Romance of Travel. (Book About Series.) Cr. 8vo. Pp. 144 (London: The Epworth Press, 1926.) 2*s* net

General Biology: Natural History: Zoology: Botany

Abel, O. Amerikafahrt: Eindrücke, Beobachtungen und Studien eines Naturforschers auf einer Reise nach Nordamerika und Westindien. Roy. 8vo. Pp. viii+437. (Jena: Gustav Fischer, 1926) 22 gold marks.

Bose, Sir Jagadis Chunder. Réactions de la matière vivante et non vivante. Traduit par Ed. Monod-Herzen. 8vo. Pp. 188. (Paris: Gauthier-Villars et Cie, 1926.) 30 francs.

Boulenger, E. G. A Naturalist at the Zoo. Demy 8vo. Pp. 206+32 plates. (London: Gerald Duckworth and Co., Ltd., 1926) 10*s.* 6*d.* net *

Brown, W. Campbell. The Story of Life. (Elementary Science Primers.) Fcap. 8vo. Pp. 108. (London: Selwyn and Blount, Ltd., 1926.) 1*s.* net

Clodd, Edward. The Story of Creation: a Plain Account of Evolution. New edition, revised. 8vo. Pp. 128 (London: Watts and Co., 1926.) 1*s.* net.

Fishery Board for Scotland. Scientific Investigations, 1926, No. 1: Rays and Skates; a Revision of the European Species By Robert S Clark. Imp. 8vo. Pp 66+15 plates 8*s* net. Plates. Imp. 8vo. Pp. iii+36 plates 5*s.* net. (Edinburgh and London: H.M. Stationery Office, 1926.)*

Hannig, E., und **Winkler, H.,** Herausgegeben von. Die Pflanzenareale: Sammlung kartographischer Darstellungen von Verbreitungsbezirken der lebenden und fossilen Pflanzen-Familien, -Gattungen und -Arten. Reihe 1, Heft 2. Large 4to. Pp. ii+19-34+Karten 11-20. (Jena: Gustav Fischer, 1926) 7 50 gold marks.*

Holmer, M. R. N. Bird Study in India Second edition. Cr 8vo. Pp. 148. (London. Oxford University Press, 1926.) 4*s.* 6*d* net.*

Hyman, Libbie H. A Laboratory Manual of Elementary Zoology. Revised edition. Roy 8vo. (Cambridge: At the University Press, 1926.) 12*s.* 6*d* net

Johannsen, W. Elemente der exakten Erblichkeitslehre: mit Grundzugen der biologischen Variationsstatistik. Dritte deutsche, neubearbeitete Auflage in dreissig Vorlesungen. Roy 8vo Pp. xi+736. (Jena. Gustav Fischer, 1926.) 32 gold marks.*

Kammerer, P. Der Artenwandel auf Inseln und seine Ursachen, ermittelt durch Vergleich und Versuch an den Eidechsen der dalmatinischen Eilande. Nebst einem Anhang: Zur Systematik der adriatischen Insel-Eidechsen, von O. Wettstein. Sup. Roy. 8vo. Pp. xiv+324+8 Tafeln. (Leipzig und Wien: Franz Deuticke, 1926.) 30 gold marks

Karsten, G., und **Schenck, H.,** Herausgegeben von. Vegetationsbilder. Reihe 17, Heft 3-4· Kustenvegetation der süddalmatinischen Eilande Von A. Ginzberger. 8 gold marks. Reihe 17, Heft 5-6: Die ägyptisch-arabische Wuste. Von Otto Stocker 8 gold marks (Jena· Gustav Fischer, 1926.)

Linsbauer, K., Herausgegeben von. Handbuch der Pflanzenanatomie. Abteilung 1, Teil 2: Histologie Band 4: Meristeme. Von Otto Schüepp. Sup Roy 8vo Pp. vi+115 8.70 gold marks Lieferung 17 Abteilung 2, Teil 1: Thallophyten Band 6: Anatomie der Flechten. Von Wilhelm Nienburg. Sup Roy. 8vo. Pp. iv+137 14 gold marks. (Berlin: Gebrüder Borntraeger, 1926.)*

Lotsy, J. P. Evolution im Lichte der Bastardierung betrachtet. Aus dem Englischen ubersetzt von H. N. Kooiman. (Separat Abdruck aus *Genetica*, 7.) Roy. 8vo. Pp. iii+365-470. (Haag: Martinus Nijhoff, 1926) 4 guilders.*

Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol. 9, No 4, 1926: Distribution of the Food Fishes in the North Sea during 1923 and 1924, by J. O. Borley; with Notes on the Natural History of the Food Fishes of the North Sea, by D E Thursby-Pelham. Imp. 8vo. Pp 14+45 charts (London. H.M. Stationery Office, 1926.) 4*s.* 6*d* net.*

Morse, Richard. Wild Plants and Seeds for Birds: an Illustrated Dictionary of the best Foods for Use in the Aviary. 12mo. Pp. 116. (London: *Cage Birds and Bird World*, 1926.) 1*s.* 6*d* net.

Nichols, J. C. M. Birds of Marsh and Mere and How to Shoot Them. Demy 8vo. Pp. 287 (London: A. M. Philpot, Ltd, 1926.) 15*s.* net.

Osborn, Henry Fairfield. Evolution and Religion in Education. Polemics of the Fundamentalist Controversy of 1922 to 1926. Cr 8vo. Pp. xiv+240 (New York and London: Charles Scribner's Sons, 1926) 7*s.* 6*d.* net *

Patten, C. J. The Memory Factor in Biology: a Sketch of the Unity of Life. Fcap. 8vo. Pp. xiii+175. (London: Baillière, Tindall and Cox, 1926.) 5*s.* net *

Pauli, Wolfgang. Eiweisskorper und Kolloide: zwei Vortrage für Biologen und Chemiker. Pp. 32 (Wien und Berlin: Julius Springer, 1926) 2 40 gold marks.

Pax, Ferdinand, Ausgefuhrt von Wirbeltierfauna von Schlesien: faunistische und tiergeographische Untersuchungen im Odergebiet. Pp. xvi+558. (Berlin: Gebruder Borntraeger, 1926) 39.60 gold marks.

Przibram, Hans. Tierpfropfung: die Transportation der Korperabschnitte, Organe und Kieme. (Die Wissenschaft: Sammlung von Einzeldarstellungen aus den Gebieten der Naturwissenschaften und der Technik, Band 75.) Demy 8vo. Pp. viii+303. (Braunschweig: Friedr. Vieweg und Sohn A-G, 1926.) 17.50 gold marks.*

Przibram, Hans. Die anorganischen Grenzgebiete der Biologie (insbesondere der Kristallvergleich). (Sammlung Borntraeger, Band 10.) Med. 8vo. Pp. 240 (Berlin: Gebruder Borntraeger, 1926.) 7.50 gold marks.*

Radcliffe, William. Fishing from the Earliest Times. Second edition. Med. 8vo. Pp. xxi+494+22 plates. (London: John Murray, 1926) 21*s.* net.*

Schiffner, Victor. Der Neo-Darwinismus, metaphysisch begrundet durch das allgemeine Zweckmassigkeitsgesetz. (Jena: Gustav Fischer, 1926.) 2.50 gold marks.

Shelford, Victor E., Assembled and edited by. Naturalist's Guide to the Americas. Prepared by the Committee on the Preservation of Natural Conditions of the Ecological Society of America, with Assistance from Numerous Organizations and Individuals. Publication Editor: Forrest Shreve; Associates and special Editors: E. Lucy Braun, Lee R. Dice, Lynds Jones, Clarence F Korstian, Robert B. Miller, Helen T. Gaige, Frank C Baker. Med. 8vo. Pp. xv + 761 + 16 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 45*s*. net *

Snoop, Fabius Zachary. Reproduction and Sexual Evolution, from the Protozoa to the Primates: a Popular Explanation. Cr. 8vo. Pp. vii + 99. (London: John Bale, Sons and Danielsson, Ltd., 1926.) 4*s*. net.*

Tansley, A. G., and **Chipp, T. F.,** Edited by. Aims and Methods in the Study of Vegetation. (Published by the British Empire Vegetation Committee.) Demy 8vo. Pp. xvi + 383 + 19 plates. (London: The Crown Agents for the Colonies, 1926.) 12*s*. 6*d*.*

Thom, Charles, and **Church, Margaret B.** The Aspergilli. Photomicrographs by G. L. Keenan. Med. 8vo. Pp. ix + 272 + 4 plates (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 22*s*. 6*d*. net.*

Wilder, Harris Hawthorne. The Pedigree of the Human Race. Demy 8vo. Pp. xiv + 368. (London, Calcutta and Sydney: George G. Harrap and Co, Ltd., 1926) 12*s*. 6*d*. net.*

Williamson, Henry. The Old Stag: Stories. Cr 8vo. Pp. vi + 298. (New York and London: G. P. Putnam's Sons, Ltd., 1926.) 7*s*. 6*d*. net *

Horticulture: Forestry: Agriculture

Blunt, H. S. Gum Arabic: with Special Reference to its Production in the Sudan. Imp. 8vo. Pp. 47 + 22 plates. (London: Oxford University Press, 1926.) 10*s*. 6*d*. net *

Cane, Florence Du. The Flowers and Gardens of Madeira. Second edition. Large Cr. 8vo Pp. 158 + 16 plates. (London: A. and C. Black, Ltd., 1926.) 6*s*. net.

Darnell, A. W., Alphabetically arranged by. Winter Blossoms from the Outdoor Garden: a Descriptive List of Exotic Trees, Shrubs and Herbaceous Plants that Flower in the Outdoor Garden in the British Isles during the Months of December, January and February: for the Use of Amateur Gardeners. Demy 8vo. Pp xxiv + 335 + 24 plates. (London: L. Reeve and Co, Ltd., 1926.) 21*s*.*

Frankel, Herbert. Co-operation and Competition in the Marketing of Maize in South Africa. Demy 8vo. Pp 164. (London: P. S. King and Son, Ltd, 1926.) 8*s*. 6*d*. net.

Grabham, Michael Comport. The Garden Interests of Madeira. Cr. 8vo. Pp. xii + 100 + 3 plates. (London: Printed by William Clowes and Sons, Ltd, 1926.) 5*s*. net *

Imperial Economic Committee. Report on Marketing and Preparing for Market of Foodstuffs produced within the Empire. Fourth Report: Dairy Produce (London: H.M. Stationery Office, 1926.) 1*s*. net.

Institute of Agricultural Engineering: University of Oxford. Bulletin No. 2: Preliminary Report of an Investigation into the Artificial Drying of Crops in the Stack. Roy. 8vo. Pp. 104 + 7 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 2*s*. 6*d*.*

Johnson, W. H. Cotton and its Production. Med 8vo. Pp. xxvii + 536 + 16 plates. (London: Macmillan and Co., Ltd., 1926.) 30*s*. net.*

Law, Ernest. Hampton Court Gardens, Old and New: a Survey, Historical, Descriptive and Horticultural, including the Lay-out, the full schemes of all the Bedding in the Herbaceous and Mixed Borders and the Flower Beds, and showing the position of every Flower and Shrub in the Gardens. Fcap 4to. Pp. 80. (London: G. Bell and Sons, Ltd., 1926.) 3*s*. 6*d*. net

MacInnes, C. M. The Early English Tobacco Trade. Cr. 8vo. Pp. xi + 195 + 8 plates. (London: Kegan Paul and Co., Ltd., 1926.) 7*s*. 6*d*. net.

Maiden, J. H. A Critical Revision of the Genus Eucalyptus. (Published by authority of the Government of the State of New South Wales) Vol. 7, Part 6 (Part 66 of the complete Work). Roy. 4to. Pp. v + 239-314 + plates 268-271. (Sydney, N.S.W.: Alfred James Kent, 1926.) 3*s*. 6*d* *

Notcutt, R. C. A Handbook of Flowering Trees and Shrubs: for Gardeners. Edited by the late W. R. Dykes Med. 8vo. Pp. 246. (London: Martin Hopkinson and Co, Ltd, 1926.) 12*s*. 6*d*. net.

Rohde, Eleanour Sinclair. A Garden of Herbs Revised and enlarged edition. Demy 8vo Pp. xv + 300 (London: Herbert Jenkins, Ltd, 1926.) 10*s*. 6*d*. net.

Salaman, Redcliffe N. Potato Varieties. Sup. Roy. 8vo. Pp xxii + 378 + 10 plates. (Cambridge: At the University Press, 1926.) 25*s*. net.*

Stapf, O., Edited by Curtis's Botanical Magazine (Published for the Royal Horticultural Society, London.) Vol 151 (1925), Part 4 Roy. 8vo Pp. iv + 34 + plates 9105-9115. (London: Bernard Quaritch, Ltd, 1926) 17*s*. 6*d*. net.*

Wiessmann, H. Agrikulturchemisches Praktikum: Quantitative Analyse Med. 8vo Pp. ix + 329. (Berlin: Paul Parey, 1926.) 18 gold marks

Anatomy: Physiology

Aschoff, L., Borst, M., Pick, L., und **Schmidt, M. B.,** Herausgegeben von. Veroffentlichungen aus der Kriegs- und Konstitutionspathologie. Geleitet von W. Koch. Heft 16 (Band 4, Heft 2): Anatomische und histologische Untersuchungen uber Weite und Wand der Hohlvenen unter physiologischen und pathologischen Kreislaufbedingungen. Von Karl Husten. Roy. 8vo. Pp. iv + 84. (Jena: Gustav Fischer, 1926.) 6 gold marks.

Choay, André. La sécrétion interne du pancréas et l'insuline. Roy. 8vo. Pp. xx + 570. (Paris: Masson et Cie, 1926.) 8*s*. 4*d*.

Gray, Henry. Anatomy: Descriptive and Applied Twenty-third edition, edited by Robert Howden. Notes on Applied Anatomy revised by John Clay and James Dunlop Lickley. Roy. 8vo. Pp. xvi + 1400. (London: Longmans, Green and Co, Ltd., 1926) 42*s*. net.*

Kawamura, R. Neue Beitrage zur Morphologie und Physiologie der Cholesterinsteatose Roy. 8vo. Pp. xiv + 260. (Jena: Gustav Fischer, 1926.) 12 gold marks.

Latimer, Caroline Wormeley. Girl and Woman: a Book for Mothers and Daughters. Revised edition. Ex. Cr. 8vo. Pp. xviii + 331. (New York and London: D. Appleton and Co, 1926) 7*s*. 6*d*. net.

Warburg, Otto, Herausgegeben von. Über den Stoffwechsel der Tumoren Arbeiten aus dem Kaiser Wilhelm-Institut fur Biologie, Berlin-Dahlem. Pp. 267. (Berlin: Julius Springer, 1926) 16 50 gold marks.

Wydler, Albert. Die Histologie der Kretinenstruma: mit Berucksichtigung der Klinik des Kretinismus und der funktionellen Untersuchung. (Erweiterter Abdruck aus "Mitteilungen aus den Grenzgebieten der Medizin und Chirurgie," Band 39, Heft 4-5.) (Jena: Gustav Fischer, 1926.) 7 gold marks.

Anthropology: Archæology

Estabrook, Arthur H., and **McDougle, Ivan E.** Mongrel Virginians The Win Tribe. Cr. 8vo. Pp. 205 + 2 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 13*s*. 6*d*. net.*

Green, Arthur Robert. Sundials: Incised Dials or Mass-clocks. Med. 8vo. Pp. xx + 203. (London: Society for Promoting Christian Knowledge, 1926.) 10*s*. 6*d*. net.

Hambly, W. D. Origins of Education among Primitive Peoples: a Comparative Study in Racial Development. Med. 8vo. Pp. xx + 432 + 79 plates. (London: Macmillan and Co., Ltd., 1926.) 25*s*. net.*

Hurry, Jamieson B. Imhotep: the Vizier and Physician of King Zoser and afterwards the Egyptian God of Medicine. Demy 8vo. Pp. xvi + 118 + 13 plates. (London: Oxford University Press, 1926) 7*s*. 6*d*. net.*

Jones, Neville. The Stone Age in Rhodesia Demy 8vo. Pp xiv + 120 + 22 plates. (London: Oxford University Press, 1926.) 12*s*. 6*d*. net.*

Salzman, L. F. English Life in the Middle Ages. Ex. Cr. 8vo. Pp. 287. (London: Oxford University Press, 1926.) 7*s* 6*d* net *

Westermarck, Edward. Ritual and Belief in Morocco. In 2 vols Demy 8vo. Vol 1. Pp. xxxii + 608. Vol. 2. Pp. xvii + 629. (London: Macmillan and Co., Ltd, 1926) 50*s*. net.*

Wheeler, Gerald Camden. Mono-Alu Folklore (Bougainville Strait, Western Solomon Islands). Thesis approved for the Degree of Doctor of Science (Economics) in the University of London. Med. 8vo. Pp. xv + 396 (London: George Routledge and Sons, Ltd, 1926.) 21*s* net.*

Philosophy: Psychology

Coué, Émile. Self Mastery through Conscious Auto-Suggestion. 12mo. Pp. 92. (London: George Allen and Unwin, Ltd., 1926.) 1*s*. net.

Durant, Will. The Story of Philosophy: the Lives and Opinions of the Greater Philosophers. Roy. 8vo. Pp. 600. (London: Ernest Benn, Ltd., 1926.) 25*s*. net.

Hollingworth, H. L. The Psychology of Thought: approached through Studies of Sleeping and Dreaming. Demy 8vo. Pp. 347. (New York and London: D. Appleton and Co, 1926) 10*s*. 6*d*. net.

Leahy, M. P. The Mind in Disease: some Conditions cured by Suggestion. Cr. 8vo. Pp. 178. (London: William Heinemann, Ltd., 1926) 6*s* net

Lewin, Kurt. Vorsatz, Wille und Bedurfnis: mit Vorbemerkungen uber die psychischen Krafte und Energien und die Struktur der Seele (Sonderabdruck aus "Psychologische Forschung," Band 7, Heft 4) Roy. 8vo. Pp. 92. (Berlin: Julius Springer, 1926) 4.50 gold marks.

McBride, P. The Riddle of Personality (Mechanism or Mystery?) Cr. 8vo Pp. viii + 190. (London: William Heinemann, Ltd., 1926) 6*s*. net.

Martin, Everett Dean. Psychology: What it has to Teach You about Yourself and the World You Live In. Cr. 8vo Pp. 380 (London: Jonathan Cape, Ltd, 1926.) 7*s* 6*d*. net.

Russell, Bertrand. Unser Wissen von der Aussenwelt. (Our Knowledge of the External World) Übersetzt von Walther Rothstock. Med 8vo Pp. viii + 331. (Leipzig: Felix Meiner, 1926) 10 gold marks.

Russell, Bertrand. Our Knowledge of the External World, as a Field for Scientific Method in Philosophy. New edition, revised and reset Demy 8vo. Pp. 251. (London: George Allen and Unwin, Ltd, 1926) 7*s*. 6*d* net

Smuts, Gen. the Rt. Hon. J. C. Holism and Evolution. Demy 8vo Pp ix + 361. (London: Macmillan and Co, Ltd, 1926) 18*s*. net *

Sturt, Mary, and **Oakden, E. C.** Modern Psychology and Education: a Text-Book of Psychology for Students in Training Colleges and Adult Evening Classes. Cr 8vo. Pp. xxiv + 320 (London: Kegan Paul and Co, Ltd., 1926.) 7*s*. 6*d*. net *

Thalbitzer, S. Emotion and Insanity. Med. 8vo Pp. x + 128. (London: Kegan Paul and Co, Ltd., 1926.) 7*s* 6*d* net.

Wolf, A. Key to Exercises in Logic and Scientific Method. Cr. 8vo. Pp. 154 (London: George Allen and Unwin, Ltd, 1926) 5*s* net *

Bacteriology: Hygiene

Blake, E. H. Drainage and Sanitation. Third edition, revised Demy 8vo. Pp. 527 (London: B. T. Batsford, Ltd., 1926.) 15*s* net

Flood, G. M. Sewage Treatment and Disposal: a Manual for Municipal and Sanitary Engineers, and Managers of Sewage Disposal Works Large Demy 8vo. Pp. viii + 164 (London, Glasgow and Bombay: Blackie and Son, Ltd., 1926.) 10*s* net.

White, C. F. Aids to Sanitary Science and Law. Fcap. 8vo. Pp 325 (London: Baillière, Tindall and Cox, Ltd, 1926) 4*s* 6*d* net

Medical Sciences

Alexander, G., und **Marburg, O.,** Herausgegeben von. Handbuch der Neurologie des Ohres. Band 3. Pp. 825. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 60 gold marks.

Balzeat, Ray M. Hay-fever and Asthma: a Practical Handbook for Hay-fever and Asthma Patients. Pp 198. (Philadelphia: F. A. Davis Co., 1926.) 2 dollars.

Bang-Krüger. Lehrbuch der Harnanalyse. Zweite verbesserte und erganzte Auflage. Pp. 146. (Munchen: J. F. Bergmann, 1926) 8 70 gold marks.

Barclay, H. Clifford, Edited by. Baillière's Nurses' Complete Medical Dictionary. 32mo. Pp. 256. (London: Baillière, Tindall and Cox, Ltd, 1926.) 3*s*. 6*d*. net.

Bernhard, O. Light Treatment in Surgery. Translated by R. King Brown Med. 8vo. Pp. xii + 317. (London: Edward Arnold and Co, 1926.) 21*s* net.*

Bland-Sutton, Sir John, and **Giles, Arthur E.** The Diseases of Women: a Handbook for Students and Practitioners. Eighth edition. Demy 8vo. Pp. xv + 595. (London: W. Heinemann (Medical Books), Ltd, 1926) 15*s*. net.

Brunet, Pierre. Les physiciens hollandais et la méthode expérimentale en France au XVIIIe siècle. Roy. 8vo. Pp ii + 153. (Paris: Albert Blanchard, 1926.) 14 francs.*

Cameron, Samuel J., and **Hewitt, John.** Uterine Hæmorrhage Pp. 208. (London: Edward Arnold and Co., 1926.) 8*s*. 6*d*. net.

Campbell, Walter R., and **Potter, Mame T.** A Guide for Diabetics. 8vo. (London: Baillière, Tindall and Cox, 1926) 11*s*. 6*d*. net.

Cathcart, George C. The Treatment of Chronic Deafness by the Electrophonoide Method of Zund-Burguet. (Oxford Medical Publications.) Cr. 8vo. Pp. viii + 88. (London: Oxford University Press, 1926) 4*s*. 6*d*. net.

Chandler, Asa C. Animal Parasites and Human Disease Third edition, revised. Med 8vo. Pp. xiii + 573. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 22*s*. 6*d*. net *

Craig, Charles F. A Manual of the Parasitic Protozoa of Man. Med. 8vo. Pp. viii + 569 (Philadelphia and London: J. P. Lippincott Co., Ltd., 1926.) 35*s* net

Dana, Charles L. The Peaks of Medical History: an Outline of the Evolution of Medicine for the Use of Medical Students and Practitioners. Med. 8vo Pp. 105 + 40 plates. (New York: Paul B. Hoeber, Inc., 1926.) 3 dollars

Emanuel, J. G. Auricular Fibrillation. Pp 31. (Birmingham: Cornish Brothers, Ltd, 1926.)

Fairbairn, John S. Obstetrics. (Oxford Medical Publications) Fcap. 8vo. Pp. x + 221. (London: Oxford University Press, 1926.) 5*s*. net

Feer, E., Herausgegeben von. Lehrbuch der Kinderheilkunde. Neunte, verbesserte Auflage Roy. 8vo. Pp. ix + 794. (Jena: Gustav Fischer, 1926) 27 gold marks.

Ferguson, J. Bell. The Quartz Mercury Vapour Lamp: its Possibilities and Uses in Public Health and General Practice. Demy 8vo Pp xii + 106 + 13 plates. (London: H. K. Lewis and Co, Ltd, 1926.) 6*s*. net.*

Gibson, Alexander George. The Heart. (Oxford Medical Handbooks) Pp. 108. (London: Oxford University Press, 1926) 5*s*. net.

Gibson, Alexander George. The Radcliffe Infirmary. Demy 8vo. Pp. xi + 316 (London: Oxford University Press, 1926.) 18*s*. net.*

Gould, George M. Gould's Medical Dictionary. Edited by R. J. E. Scott. Imp. 8vo. Pp. xi + 1398. (London: H. K. Lewis and Co, Ltd, 1926.) 30*s*. net.

Guleke, N., Penzoldt, F., und **Stintzing, R.,** Herausgegeben von. Handbuch der gesamten Therapie. In sieben Banden. Sechste, umgearbeitete Auflage. Band 2: Behandlung der Erkrankungen der Verdauungswerkzeuge. Roy. 8vo Pp. vi + 942. (Jena: Gustav Fischer, 1926) 36 gold marks

Hajek, M. Pathology and Treatment of the Inflammatory Diseases of the Nasal Accessory Sinuses. Translated and edited by Joseph D Heitger and French K Hansel. Fifth edition, completely revised and enlarged. 2 vols. Roy. 8vo. Pp. 670. (London: Henry Kimpton, 1926.) 75*s*. net.

Holmes, George W., and **Ruggles, Howard E.** Roentgen Interpretation: a Manual for Students and Practitioners Third edition, revised. Roy. 8vo Pp. 326 (London: Henry Kimpton, 1926.) 21*s*. net

Kerr, James. The Fundamentals of School Health. Roy. 8vo. Pp xvi + 859. (London: George Allen and Unwin, Ltd., 1926.) 35*s*. net.*

Kirchberg, Franz. Handbuch der Massage und Heilgymnastik Sup. Roy 8vo. Pp. viii + 279 + 19 Tafeln (Leipzig · Georg Thieme, 1926) 14 40 gold marks

Kirchberg, Franz. Massage und Gymnastik im Dienste der Kosmetik. Post 8vo Pp. v + 99 (Leipzig: Georg Thieme, 1926.) 3 90 gold marks

Kisch, Eugen. Besonnung und Beluftung Gesunder, Gelenk- und Lungentuberkuloser. Small 8vo Pp iii + 16 (Berlin: Julius Springer, 1926.) 1.80 gold marks

Knaggs, R. Lawford. The Inflammatory and Toxic Diseases of Bone: a Textbook for Senior Students Demy 8vo Pp. 424. (Bristol: John Wright and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd, 1926) 20*s*. net

Küster-Giessen, Ernst. Über die Zeichnungen der Blatter und Blüten (Fortschritte der naturwissenschaftlichen Forschung, Band 12, Heft 2.) Sup Roy 8vo Pp. iv + 71-153. (Berlin und Wien · Urban und Schwarzenberg, 1926.) 7.20 gold marks *

Loughnane, F. McG. A Handbook of Renal Surgery. Demy 8vo. Pp. xiv + 210. (London: Longmans, Green and Co, Ltd., 1926) 10*s* 6*d*. net.*

McClaw, Emma J. The Dental Assistant. Small 8vo. Pp. 118 (London: Henry Kimpton, 1926) 7*s* 6*d*. net.

Mackenzie, Sir James, and **Orr, James.** Principles of Diagnosis and Treatment in Heart Affections (Oxford Medical Publications) Third edition, revised. Med. 8vo. Pp. viii + 242. (London · Oxford University Press, 1926) 10*s* 6*d* net.

Ministry of Health. Preventive Medicine · Outline of the Practice. (London: H.M Stationery Office, 1926.) 2*s*. 6*d* net.

Montague, Joseph Franklin. The Modern Treatment of Hemorrhoids Roy 8vo. (Philadelphia and London: J B. Lippincott Co, Ltd, 1926) 21*s*. net.

Morgan, J. Douglas. Electrothermic Methods (Desiccation and Coagulation) in the Treatment of Neoplastic Diseases. Ex. Cr 8vo. Pp. 172. (Philadelphia: F A. Davis Co, 1926) 2.50 dollars.

Nassau, Erich. Die Klinik der Sauglingspneumonie (Sonderdruck aus *Zeitschrift fur Kinderheilkunde*, Band 41.) Roy. 8vo Pp. 53. (Berlin · Julius Springer, 1926) 5 gold marks.

Neil, James Hardie. Ear, Nose and Throat Nursing Second edition. Ex Post 8vo. Pp 106 + 13 plates (Auckland, N.Z.: Clark and Matheson, Ltd, London: H. K. Lewis and Co, Ltd., 1926) 7*s* 6*d* net

Popenoe, Paul. The Conservation of the Family Cr. 8vo (London: Baillière, Tindall and Cox, 1926.) 13*s* 6*d* net

Roesle, E. Medizinalstatistik und Gesundheitsstatistik Mit einem Anhang: Bibliographie der amtlichen Reichs-Medizinalstatistik, 1876–1926. (Sonderabdruck aus dem Festband der "Arbeiten aus dem Reichsgesundheitsamte," Band 57) 4to. Pp. 22 (Berlin · Julius Springer, 1926) 2 gold marks

Sampson, C. M. A Practice of Physiotherapy. Roy. 8vo Pp. 620. (London: Henry Kimpton, 1926) 45*s*. net

Schröder, Robert. Lehrbuch der Gynakologie fur Studierende und Ärzte Zweite neubearbeitete Auflage Sup. Roy 8vo Pp xvii + 725 + 3 Tafeln (Leipzig F. C W. Vogel, 1926) 35 gold marks

Stoddart, W. H. B. Mind and its Disorders: a Text-Book for Students and Practitioners of Medicine (Lewis's Practical Series.) Fifth edition. Demy 8vo. Pp. xx + 593 + 12 plates (London: H. K. Lewis and Co., Ltd, 1926) 21*s*. net.*

Taylor, H. Dennis. The Vaccination Controversy Reviewed on partly Novel Lines. Demy 8vo. Pp. 144. (London: The C. W. Daniel Co., 1926) 2*s* 6*d*. net

Wigg, Harold. Sunlight and Artificial Light. 32mo Pp. 96. (London: Faber and Gwyer, Ltd., 1926.) 1*s*. 6*d*. net.

Williams, Leonard. Obesity. (Oxford Medical Publications) Demy 8vo. Pp. 181. (London: Oxford University Press, 1926) 10*s*. 6*d*. net.

Miscellany

Ashley, Sir William. Business Economics. Cr. 8vo. Pp. viii + 71. (London: Longmans, Green and Co, Ltd, 1926.) 2*s*. 6*d* net *

Bethea, Jack. The Deep Seam. Cr 8vo Pp. iv + 316 (London: Hodder and Stoughton, Ltd., 1926) 7*s* 6*d*. net *

Buer, M. C. Health, Wealth and Population in the Early Days of the Industrial Revolution Demy 8vo. Pp xi + 290. (London. George Routledge and Sons, Ltd, 1926) 10*s*. 6*d* net.*

Fay, Erica. A Road to Fairyland Cr. 8vo. Pp. vii + 219. (London and New York · G P Putnam's Sons, Ltd., 1926) 5*s* net *

Frewin, J. G. A New Experimental Science. Cr. 8vo. Pp. 92. (Oxford: Clarendon Press; London: Oxford University Press, 1926) 1*s*. 6*d*. net.

Freytagh-Loringhoven, Frhrn. v. Die Satzung des Volkerbundes. Mit Einleitung und Erläuterungen. (Stilke's Rechtsbibliothek, Nr. 51) Cr. 8vo. Pp xxiv + 379 (Berlin · Georg Stilke, 1926) 8 gold marks.*

Kipling, Rudyard. Debits and Credits. Ex. Cr 8vo. Pp vi + 416 (London: Macmillan and Co., Ltd., 1926.) 7*s* 6*d*. net *

Liveing, Susan. A Nineteenth-Century Teacher: John Henry Bridges, M B., F.R C S, sometime Fellow of Oriel College, Oxford, and late Medical Inspector to the Local Government Board By his Niece. Cr. 8vo. Pp. xv + 262. (London: Kegan Paul and Co, Ltd., 1926) 7*s*. 6*d*. net *

Patrick, David, and **Geddie, William**, Edited by. Chambers's Encyclopædia a Dictionary of Universal Knowledge. New edition. Vol. 8: Penobscot to Saco. Imp. 8vo. Pp iii + 871. (London and Edinburgh: W. and R. Chambers, Ltd; Philadelphia: J B Lippincott Co., 1926) 20*s*. net.*

Pink, M. Alderton. Procrustes: or, The Future of English Education (To-day and To-morrow Series) Pott 8vo. Pp. 95 (London: Kegan Paul and Co, Ltd; New York: E P Dutton and Co., 1926) 2*s* 6*d* net *

Roe, Joseph Wickham. English and American Tool Builders (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co, Ltd., 1926) 20*s*. net

Shaw, Daphne, Arranged by. A Catalogue of British Scientific and Technical Books. Supplement, 1925 Demy 8vo Pp. viii + 166. (London: British Science Guild, 1926) 2*s* 6*d*. net.*

Sonnenschein, William Swan. The Best Books: a Reader's Guide to the Choice of the best available Books in every Department of Science, Art and Literature, with the Dates of the first and last Editions, and the Price, Size and Publisher's Name (both English and American) of each Book; a Contribution towards Systematic Bibliography. With Complete Authors and Subjects Index. Third edition, entirely rewritten Part 4 Cr 4to. Pp. 1681-2510. (London: George Routledge and Sons, Ltd., 1926.) 36*s* net.*

Unwin, Stanley. The Truth about Publishing Ex. Cr 8vo. Pp. 360. (London: George Allen and Unwin, Ltd, 1926.) 7*s*. 6*d*. net.*

Webb, Beatrice. My Apprenticeship. Gl. 4to. Pp. xiv + 459 + 12 plates (London: Longmans, Green and Co., Ltd, 1926) 21*s*. net *

Wells, H. G. The World of William Clissold: a Novel at a New Angle In 3 vols. Cr. 8vo. Vol. 1. Book the First: The Frame of the Picture; Book the Second. The Story of the Clissolds—My Father and the Flow of Things. Pp. 245 Vol 2 Book the Third: The Story of the Clissolds—Essence of Dickon; Book the Fourth: The Story of the Clissolds—Tangle of Desires Pp. 247-601. Vol. 3. Book the Fifth: The Story of the Clissolds—The Next Phase; Book the Sixth: The Story of the Clissolds—Venus as Evening Star, The Epilogue. Note by Sir Richard Clissold. Pp. 603-885. (London: Ernest Benn, Ltd, 1926) 7*s*. 6*d*. net each vol.*

NOW READY **Price 3s. 6d.**

A First Course in Wireless

By R. W. HUTCHINSON, M.Sc., A.M.I.E.E.

This is a scientific introduction to Wireless Telegraphy and Telephony. No previous knowledge of the subject is assumed, the theory underlying the production, propagation and detection of electromagnetic waves is treated in a simple yet scientific way, the construction and action of all essential apparatus is briefly dealt with, whilst several receiving circuits are explained and illustrated in detail. The book is specially intended for the use of technical students and wireless constructors and experimenters.

"It is one of the best works on the subject we have so far seen."—*Electricity and Electrical Engineering.*

"This is one of the most usefully comprehensive radio text-books published at a popular price we have seen."—*Popular Wireless and Wireless Review.*

Descriptive Prospectus of the above and Complete Catalogue of Educational Publications post free.

UNIVERSITY TUTORIAL PRESS LTD.,
25 HIGH STREET, NEW OXFORD STREET, LONDON, W.C.2

Transactions of the Optical Society

PRICE PER NUMBER, 10s. SUBSCRIPTION PER VOLUME, 50s.

Vol. XXVII. **CONTENTS** No. 3.

"The Annealing and Re-annealing of Glass." Parts III. and IV. By W. M. HAMPTON, B.Sc., A.I.C.
"The Nature of the Polishing Operation." By F. W. PRESTON.
"Notes on the Significance and Detection of Low Errors of Refraction." By O. AYRES.
"Vertex Power and its Measurement." By W. H. A. FINCHAM.
"Notes on Some Physical and Optical Characteristics of the Stylus-on-Celluloid Method of Recording." By W. G. COLLINS.
REVIEWS.

PUBLISHED BY
THE OPTICAL SOCIETY
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY
SOUTH KENSINGTON : : : : LONDON, S.W.

ADLARD & SON
LIMITED

SCIENCE PRINTERS.

Home and Export.

23 Bartholomew Close, London, E.C.1.

FROM CONSTABLE'S LIST

PRINCIPLES OF HUMAN GEOGRAPHY. By P. VIDAL DE LA BLACHE. Edited by EMMANUEL DE MARTONNE. Demy 8vo. Illustrated. 18s. net.

NOMOGENESIS or EVOLUTION DETERMINED BY LAW. L. S. BERG, D.Sc. With an Introduction by D'ARCY WENTWORTH THOMPSON. Demy 8vo. Illustrated. 28s. net.

OUTLINES OF EVOLUTIONARY BIOLOGY. ARTHUR DENDY, D.Sc., F.R.S. Fourth Edition. Demy 8vo. Illustrated. 16s. net.

SOCIAL LIFE AMONG THE INSECTS. WILLIAM MORTON WHEELER, Ph.D., Sc.D. Medium 8vo. 116 Illustrations. 16s. net.

INTRODUCTION TO THEORETICAL PHYSICS. ARTHUR HAAS, Ph.D. Translated by T. VERSCHOYLE. 2 volumes. Demy 8vo. Illustrated. Vol. I., 21s. net. Vol. II., 21s. net.

HYDRAULICS AND ITS APPLICATIONS. By A. H. GIBSON, D.Sc., A.M.Inst.C.E., M.Inst.Mech.E., F.R.S.E. Third Revised Edition. Demy 8vo. Illustrated. 24s. net.

PHOTOMETRY. JOHN W. T. WALSH, M.A., M.Sc., A.M.I.E.E., F.Inst.P. Royal 8vo. Illustrated. 40s. net.

SYSTEMATIC ORGANIC CHEMISTRY. A complete laboratory guide to the preparations and estimations of Organic Chemistry. W. M. CUMMING, D.Sc., F.I.C.; I. V. HOPPER, Ph.D., B.Sc., A.R.C.Sc.I., F.I.C.; and T. S. WHEELER, Ph.D., B.Sc., F.R.C.Sc.I., F.I.C. Demy 8vo. Illustrated. 25s. net.

THE STATES OF AGGREGATION: The Changes in the State of Matter in their Dependence upon Pressure and Temperature. GUSTAV TAMMANN, Director of the Institute of Physical Chemistry at the University of Gottingen. Authorised translation from the 2nd German Edition by R. F. MEHL, Ph.D. Demy 8vo. 308 pages. Illustrated. 24s. net.

HIGH TENSION LINE PRACTICE: Materials and Methods. By ERNEST V. PANNELL, M.Inst E.E., M.Am.Inst.E.E. Demy 8vo. Fully Illustrated 22s. 6d. net.

THE THEORY OF ELECTRIC CABLES AND NETWORKS. By ALEXANDER RUSSELL, M.A., D.Sc., LL.D., F.R.S. Third Edition. Demy 8vo. Illustrated. 24s. net.

A TEXT-BOOK OF GLASS TECHNOLOGY. By F. W. HODKIN, B.Sc., A.I.C., and ARNOLD COUSEN, M.Sc., A.R.C.Sc., A.I.C. With an Introduction by Professor W. E. S. TURNER, D.Sc., M.Sc. Demy 8vo. Fully Illustrated. 42s. net.

THE SCIENCE OF SOILS AND MANURES. J. ALAN MURRAY, B.Sc., Lecturer in Agricultural Chemistry at University College, Reading. Third Edition. Demy 8vo. Illustrated. 12s. 6d. net.

Complete Lists of Scientific Books sent Post Free on Request.

10 & 12 ORANGE ST., LONDON, W.C.2

MACMILLAN'S NEW AND RECENT BOOKS.

PEOPLE OF THE VEIL. Being an Account of the Habits, Organisation, and History of the Wandering Tuareg Tribes which inhabit the mountains of Air or Asben in the Central Sahara. By FRANCIS RENNELL RODD. With 51 pages of Illustrations and 6 Maps and Plans. Super Royal 8vo. 30s. net.

Mr. Francis Rodd, son of Sir Rennell Rodd, gives in this book the record of a remarkable voyage of exploration in Africa among a people whose history and customs are very little known and of great anthropological and general interest.

IN UNKNOWN ARABIA. By MAJOR R. E. CHEESMAN, O.B.E., F.R.G.S., H.M. Consul in North-west Abyssinia. With a Foreword by SIR PERCY COX, G.C.M.G. With Illustrations and Maps. Super Royal 8vo. 25s. net.

SUNDAY TIMES.—"The illustrations are of unusual interest, and with its appendices of technical information and its maps, the book must take its place amongst the most valuable of recent exploratory works."

HOLISM AND EVOLUTION. By GENERAL THE RIGHT HON. J. C. SMUTS. 8vo. 18s. net.

THE TIMES.—"With this volume General Smuts takes a high place in the small but distinguished company of British statesmen-philosophers."

A SHORT HISTORY OF MARRIAGE. By EDWARD WESTERMARCK, Ph.D. 8vo. 10s. 6d net.

RITUAL AND BELIEF IN MOROCCO. By EDWARD WESTERMARCK, Ph.D. Illustrated. 2 vols. 8vo. 50s. net.

SUNDAY TIMES.—"It would be impossible to summarise this encyclopædia of fascinating information. But no one interested in the foundations of belief is likely to neglect this storehouse of evidence and scholarly elucidation."

ORIGINS OF EDUCATION AMONG PRIMITIVE PEOPLES. A Comparative Study in Racial Development. By W. D. HAMBLY, B.Sc., Anthropologist for the Wellcome Expedition to the Sudan, Assistant Curator, African Ethnology, Field Museum, Chicago. With a Preface by DR. CHARLES HOSE (of Sarawak). With 74 pages of Illustrations in half-tone and line. 8vo. 25s. net.

SUNDAY TIMES.—"It is not necessary to be an anthropologist to appreciate and enjoy Mr. Hambly's most entertaining book, for it is written as much for the layman as for the student."

COTTON AND ITS PRODUCTION. By W. H. JOHNSON, lately Agricultural Adviser to the Australian-Cotton Growing Association. With an Introduction by SIR WYNDHAM DUNSTAN, F.R.S., and a Foreword by SIR WILLIAM HIMBURY, Managing Director of the British Cotton Growing Association. With 26 Maps showing the Cotton Areas of the World. Med. 8vo. 30s. net.

INTERNATIONAL COTTON BULLETIN.—"The book is 'sound' and can be confidently recommended to those engaged in cotton growing, but seeing that spinners the world over are consuming more and more 'outside growth' of cotton, they ought to study this book as well, for it deals extensively with these kinds of cotton."

THE CULTIVATION OF CITRUS FRUITS. By HAROLD HUME. With 237 Illustrations. 8vo. 21s. net. (The Rural Science Series.)

AN OUTLINE OF PLANT GEOGRAPHY. By DOUGLAS H. CAMPBELL, Professor of Botany, Stanford University, California; author of "The Structure and Development of Mosses and Ferns." With 52 page Plates and 101 Figures in the Text. 8vo. 17s. net.

PROJECTIVE GEOMETRY. By CLEMENT V. DURELL, M.A., Senior Mathematical Master at Winchester College. Crown 8vo. 7s. 6d.

THE MATHEMATICAL GAZETTE, in a review of the volume of which this is an abridged form, says: "The author possesses a thorough grasp of his subject, and the power of presenting it in an eminently attractive manner. . . . The book is a notable and most attractive addition to the literature of the subject."

ANSWERS, HINTS AND SOLUTIONS OF THE EXERCISES IN SAME. Crown 8vo. Limp Cloth. 2s. 6d.

MODERN GEOMETRY—THE STRAIGHT LINE AND CIRCLE. By CLEMENT V. DURELL. Crown 8vo. 5s.

MATHEMATICAL GAZETTE.—"We hope that it will become generally adopted, for it is a good book. . . . It forces the reader to think, although it is seldom hard to understand. It is also remarkably complete, nothing essential being omitted, and very little that is unessential being admitted."

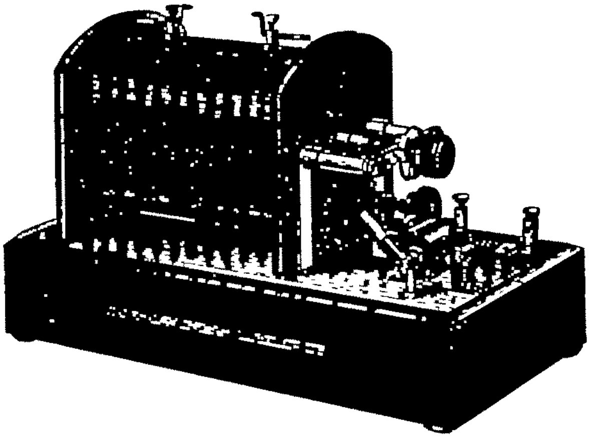
⁂ Send for Macmillan's Classified Catalogue, post free on application.

MACMILLAN & CO., LTD., LONDON, W.C.2.

X-RAY APPARATUS

For Crystallography and Physical and Industrial Research

INDUCTION COILS AND TRANSFORMERS



Induction Coils from 1″ to 20″ spark.

Oil-immersed Transformers up to 10″ spark.

Coils up to 6″ spark length are complete with platinum or tungsten contacts.

Coils from 8″ upwards are arranged for use with motor mercury interrupters.

We specialise in X-Ray Apparatus (new and guaranteed second-hand) for Laboratories.

Please write for 1. Special List of New apparatus, including Coils, Transformers, Interrupters, X-Ray Tubes, etc. 2. Special List of guaranteed Second-hand apparatus. *Post free on request.*

THE COX-CAVENDISH ELECTRICAL CO. (1924) LTD.
Telephone] 105 Great Portland Street, London, W.1 [Langham 1145

PRIOR'S ULTRA-SENSITIVE SELENIUM CELLS

These Cells are the outcome of 25 years' research in selenium, and stand in a class entirely by themselves. The inertia so pronounced in all other types of selenium cells has been reduced to almost infinity, and they will remain constant for a long period.

They can be supplied in any resistance, and with a ratio up to 100 to 1 with 60-watt lamp 3″ away. We are also able to supply special Cells having a zero reading in the dark.

Scientists and research workers have described Prior's Ultra-Sensitive Selenium Cells as a wonderful scientific development, producing results hitherto considered impossible with selenium.

Recent experiments carried out with speaking film prove these Cells invaluable—tone being purer than that obtained by the use of the photo-electric cell.

All Ultra-Sensitive Selenium Cells are guaranteed for a period of six months from date of purchase.

The following represents a reading of a Cell selected at random :—

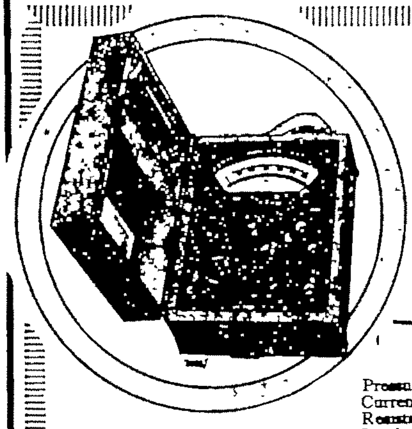
Size of active surface : 1″ × 1″.
Resistance of Cell in the dark : 350,000 ohms.
Current passed in dark at 50 volts : ·2 mA.
Distance of Cell from lamps : 12 inches.

	8 c.p. 50,000	16 c.p. 30,000	25 c.p. 25,000	32 c.p. 20,000 ohms
Current passed in mA.	1	1·5	1·8	2·25

2 mA. at 20 volts with 60-watt lamp 3″ from Cell.
The above Cell has been tested to 60 volts.

LIST AND GRAPH POST FREE ON REQUEST.

PRIORSELLS LIMITED
65/70 CANNON STREET HOUSE—110 CANNON STREET, LONDON, E.C.4
Telephone CITY 2186-7 Telegrams PRIORSELLS, CANNON, LONDON

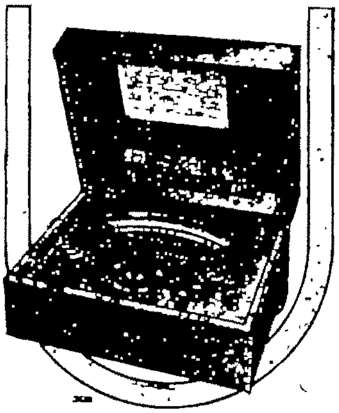


CAMBRIDGE TESTING SETS

FOR
ELECTRICAL
MEASUREMENTS

PATTERN "O"

Pressures (0·0001 to 600 volts).
Currents (1 microamp. to 150 amps.)
Resistances (10 microhms to 10 ohms).
Insulations (0·02 to 500 megohms at 500 volts).

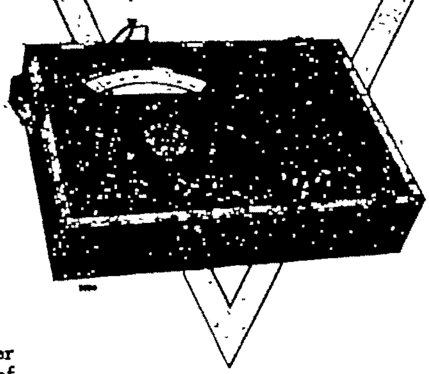


PATTERN "U"

as pattern "O," but of higher sensitivity, measures currents to 150 amps. and insulations to 1000 megohms.

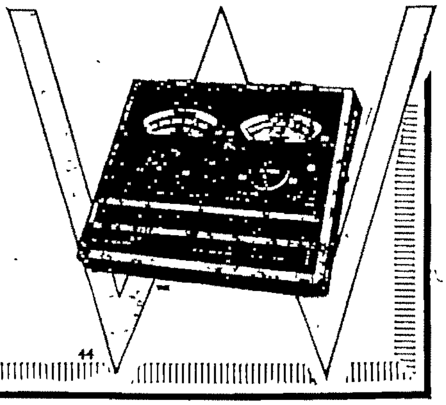
PATTERN "V"

as pattern "U," but measures resistances to 10 megohms, and capacities from 0·01 to 100 mfds.



PATTERN "W"

for stray underground electric currents up to 5000 milliamperes. Adopted by the G.P.O. for cable testing, etc.



Although these testing sets cover an exceptionally wide range of measurements, they are compact, portable, and simple to operate. They are fully described in our new 27-page List, No. 160-N. May we send you a copy?

CAMBRIDGE
INSTRUMENT Cº Lᵀᴰ

WORKS - LONDON, & CAMBRIDGE
Head Office & Showrooms - 45, GROSVENOR PLACE LONDON, S.W.1

AMERICAN COMPANY
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

ANNOUNCEMENT OF THE CONTENTS OF THE NOVEMBER NUMBER OF THE

PHILOSOPHICAL MAGAZINE AND JOURNAL OF SCIENCE

Conducted by Sir OLIVER JOSEPH LODGE, D.Sc., LL.D., F.R.S.; Sir JOSEPH JOHN THOMSON, O.M., M.A., Sc.D., F.R.S.; JOHN JOLY, M.A., D.Sc., F.R.S., F.G.S.; RICHARD TAUNTON FRANCIS, F.R.S.E.; and WILLIAM FRANCIS, F.L.S.

DOUBLE NUMBER. (272 *pages.*) *Price* ***10s. 6d.***

The Theory of the Vane Anemometer. By E. Owen, A.C.G.I., B.Sc.
On Irrotational Flow past Two Intersecting Planes. By W. B. Morton, M.A.
Alternative Currents in Rarefied Oxygen in the same Circuit. By Rev. P. J. Kirkby, D Sc.
An Application of Diffraction Halos to Elasticity. By Jas. P. Andrews, B.Sc.
The Striated Distribution of Space Charge By B M. Cassen.
Sound Changes analysed by Records.—II. Voice and Violin. By H M. Browning, M.Sc, Ph.D. (Plate XVI.)
The Joule-Thomson Effect for Air. By N. Eumorfopoulos, Fellow of University College, London, and J. Rai, Lieutenant in the Imperial Japanese Navy.
On Reversal in Vacuum Tube Spectra. By T R. Merton, F.R.S.
On "Relaxation-Oscillations" By Balth. van der Pol, Jun., D Sc.
The Crystalline Structure of Anhydrite. By Prof Jarl A. Wasastjerna
On Equilibrium and Motion of a Continuous Medium in Four-dimensional Space. By D. Meksyn
The X-Ray Spectra of the Lower Elements By Robert Thoraeus. (Plates XVII & XVIII)
Photophoresis of Colloidal Particles in Aqueous Solutions. By Wilfred W. Barkas, M Sc. (Plate XIX.)
Werner's Co-ordination Theory and the Electrical Structure of the Atom. The Relationship between Valency and Co-ordination. By S. H. C. Briggs, D.Sc.
The Flash Arc Spectrum of Potassium. By F. H Newman, D Sc, A.R.C.S (Plate XX.)
Researches on the Electric Discharge in Gases and the accompanying Radiation. By A Dauvillier, Dr. ès Sciences
A Simple Exposition of Electromagnetic Relations. By H. F. Biggs, M A., M.Sc.
Observations concerning the Artificial Disintegration of Elements. By J. Chadwick, Ph.D.
Scattering of Positive Rays by Gases.—II. By G P. Thomson, M A.
The Activity Coefficients of Aqueous Hydrochloric Acid at Extreme Dilutions By Gordon Nonhebel, B A., B.Sc.
On the Oblique Rebound of a Ball from a Fixed Plane. By R C. J Howland, M.A., M.Sc., and T. W. Dickson, B.A.
General Formulæ for two Syntonized Coupled Circuits. By Raymond M. Wilmotte, B.A.
The Ranges of Secondary β-Rays By J. M. Nuttall, M Sc, and E. J Williams, M.Sc.
Notes on Scattered X-Rays. The J Phenomenon (Part V.). By Prof. C G. Barkla, F.R.S, and Gladys I. Mackenzie, M.A., B.Sc
The Control of the J Phenomenon (Part VI.). By Prof. C. G. Barkla and Dr. W H Watson.
The Density of Fluids.—I. On a Relation between Density and Temperature and on the Latent Heat of Vaporization. By J H. Shaxby, D Sc., F Inst.P.
On a Simple Light-Quantum. By Prof. E. T. Whittaker, F.R S
On the Rate and Mechanism of the Aeration of Water under Open-Air Conditions. By W E Adeney, D.Sc, F.R C.Sc.I., F.I.C
On an Apparent Relation between the Rate in the Change of the Electric Resistance at Fusion and the Crystal Lattice of Metallic Elements. By Harald Perlitz.

With 5 Plates and numerous Illustrations in the Text.

N.B. In consequence of so many papers being submitted to the Philosophical Magazine it has been found impossible to secure publication as speedily as could be wished It has, therefore, been decided to issue two Supplementary Parts during the coming year (1927) at the price of 10s. each. The Subscription for 1927 will be £5 post free, including the two Supplementary Parts. There will be six double numbers as in 1926.

FOR BACK NUMBERS APPLY TO THE PUBLISHERS:

TAYLOR & FRANCIS,
Red Lion Court, Fleet Street, London, E.C.4

ARNOLD BOOKS

ANCIENT EGYPTIAN MATERIALS. By A Lucas, F.I.C., Chemist in the Department of Antiquities, Cairo. 240 pages. **7s. 6d.** net. [*Ready Nov.* 3.

THE EVOLUTION AND DEVELOPMENT OF THE QUANTUM THEORY. By N. M. Bligh, A.R.C.S., A.I.C. With a Foreword by Prof. Planck. **9s.** net. [*Ready Nov.* 15.

A HANDBOOK OF ORGANIC ANALYSIS. By H. T. Clarke, B.Sc., F.I.C. With an Introduction by Prof. J. Norman Collie, F.R.S. **Fourth Edition.** 372 pages. **8s. 6d.** net. [*Ready Nov.* 22.

ELEMENTARY BOTANY: An Introduction to the Study of Plant Life. By W. Watson, D.Sc., Biology Master, Taunton School. 225 Illustrations. **6s. 6d.** [*Ready Nov.* 22.

THE CORROSION OF METALS. By U. R. Evans, M.A. **Second Edition.** 248 pages. Illustrated. **15s.** net. [*Ready Nov.* 22.

ENGINEERING SCIENCE. A First Year's Course in Mechanics and Heat Engines. By William Ward, B.Sc., Senior Lecturer in Engineering, Technical School, Dudley. **3s.** [*Ready Nov.* 22

ELECTRIC TRAINS. By R. E. Dickinson, B.Sc., A.M.Inst.C.E., A M.I.E.E, Works Manager, Electric Train Repair Shops, New South Wales Government Railways. 288 pages. 139 Diagrams. **16s.** net. [*Ready Dec.* 2.

JUST PUBLISHED.

PHYSICO-CHEMICAL PERIODICITY. By E. S. Hedges, M Sc., Ph.D., Bedford College, London, and J. E. Myers, O.B.E., D.Sc., Senior Lecturer in Chemistry in the University of Manchester. With Foreword by Prof. F. G. Donnan. **7s. 6d.** net.

METAL-WORK. By H. M. Adam, Organiser and Instructor in Handicraft to the Eastbourne Education Committee, and J. H. Evans, A.M.I.Mech.E., Instructor in Metal-work, London County Council. **Second Edition. 6s. 6d.**

EDWARD ARNOLD & Co.
41 & 43, MADDOX ST, LONDON, W.1

WHATMAN

FILTER PAPERS

The range of WHATMAN Filter Papers now manufactured is the most complete produced by any mill in the world, and covers practically all the requirements of modern high-grade technical work.

They are obtainable from all Laboratory Furnishers and are packed in sealed and labelled packages.

Manufactured by W. & R. BALSTON, LTD., Maidstone, KENT.

Samples and Price List on application.

In case of difficulty apply to Sole Mill Representatives:—

Telephone:
CITY 7413 (3 lines)

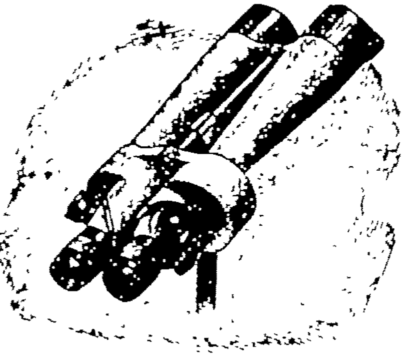
H. REEVE ANGEL & CO., LTD., 9 Bridewell Place, LONDON, E.C.4.

ZEISS

BINOCULAR TELESCOPE

"STARMORBI"

With image-erecting systems and triple ocular revolvers.



Clear aperture of objectives, 2¾ ins.
Focal length, 16¼", tube length, 19½".
Magnifications ×12, ×24, ×42.

Telescope, in leather case, sliding stand, and shoulder straps,

Price £76

Full particulars of Binocular Telescopes sent, on request, by the BRITISH REPRESENTATIVES:

CARL ZEISS (LONDON) LTD.

Winsley House, Wells St., Oxford St., London, W.1

MICROSCOPIC STAINS

Specially made for Bacteriological and Histological work.

The B.D.H. Standard Stains are tested histologically before they are issued. They can be relied upon to give the correct reaction for each stain.

Applications are invited for a copy of our Price List and Booklet upon Clinical Pathology and the use of Stains.

THE BRITISH DRUG HOUSES, LTD.

Makers of Fine Chemicals,

Graham Street, City Road, London, N.1.

Chemical Works: Wharf Road, London, N.1.

SPECIAL RESEARCH CHEMICALS 1926

An enlarged List of BOOTS' RESEARCH CHEMICALS has been prepared because of the rapid expansion of this important side of our activities.

More than 1000 Chemicals are included, and over 80% of them are made in our own laboratories.

Letters of appreciation received, and the extension of our business, indicate that the guaranteed purity of our products has become widely known.

FOR NEW LIST WRITE TO WHOLESALE SALES DEPARTMENT

BOOTS PURE DRUG COMPANY LIMITED

Manufacturing Chemists and Makers of Fine Chemicals

NOTTINGHAM

Telephone: 7000 *Nottingham.*
Telegrams: "*Drug,*" *Nottingham.*

On choosing a Loud Speaker

NO one would ever think of choosing a car without a great deal of thought and reflection. Yet how many people will buy a Loud Speaker without previously considering which type is suitable for their particular conditions? Haphazard choice of a Loud Speaker in fact has led to more dissatisfaction with radio than any other cause.

When buying a Loud Speaker consider these points:

1—TONE

First among the essentials of good reproduction is tone. Absolute freedom from distortion and a perfectly life-like rendering of every phase of the broadcast—orchestral and vocal, is necessary. It is upon this that **Brown** success has been founded.

2—VOLUME

It is essential that a Loud Speaker should be capable of giving a varied volume to meet individual needs; but whether the volume be great or small there must be no trace of distortion. There are very few Loud Speakers capable of rendering with real purity an unlimited amount of volume.

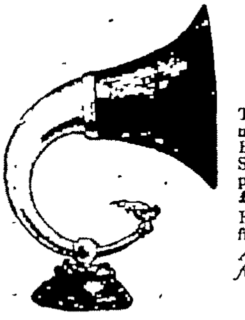
3—NAME

You may be shown Loud Speakers which *look* as good as the **Brown**, yet at much lower prices. Compare them, though, on quality of reproduction with any **Brown**—you cannot be other than impressed with the result. The name **Brown** stands for all that is best in radio reproduction—pure, unsurpassed tone combined with adequate volume.

¶

Illustrated here is the world-famous Brown "Q." It is universally acknowledged to be the height of Loud Speaker perfection.

Price £15 : 15s.



¶

There are nine models in the Brown Loud Speaker range—priced 30s. to £15·15s.

Headphones, too, from 20s. to 60s.

Ask your Dealer for a Catalogue.

LET YOUR FRIENDS LISTEN!

Brown

S. G. BROWN, LTD.
Western Avenue, N. Acton, W.3

Retail Showrooms: 19 Mortimer Street, W.1; 15 Moorfields, Liverpool, 67 High Street, Southampton. *Wholesale Depots:* 2 Lansdown Place West, Bath; Cross House, Westgate Road, Newcastle: 120 Wellington Street, Glasgow; 5-7 Godwin Street, Bradford; Howard S. Cooke & Co., 59 Caroline Street, Birmingham; N. Ireland: Robert Carmany, Union Chambers, 1 Union Street, Belfast.

G.A. 6252.

¶ W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE, will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ CATALOGUE 269. Scientific Books and Publications of learned Societies.

Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone: [illegible] (2 lines).

PATENTS AND CHEMICAL RESEARCH.

By HAROLD E. POTTS, M.Sc.,
CHARTERED PATENT AGENT.

Demy 8vo. Cloth. 8/6 net.

"There can be no question of the Author's grasp of the fundamentals of patent law; the discrimination with which he has selected his leading cases when discussing the validity of patents demonstrates this"—*Nature.*

THE UNIVERSITY PRESS OF LIVERPOOL, LIMITED,
HODDER AND STOUGHTON, LIMITED, LONDON.

MAN An illustrated monthly record of Anthropological Science, 2s. net per part, 20s. a year, post free anywhere.

CONTENTS OF NOVEMBER ISSUE.

ORIGINAL ARTICLES: The "Kithito" at Mivukoni, Mumoni District, Kenya Colony. (*Illustrated.*)—Some Factors in Racial Immunity and Susceptibility to Disease. (*Concluded.*)—Arrangement of Stones in Australia.—A Surgical Operation as performed by the Boonarra Tribe, Northern Australia (*With Plate M.*)—Stonehenge—Concerning the Sarsens—Limitations of the Sister's Son's Right in Fiji—Muhammadan Child-Killing Demons.—REVIEWS.—CORRESPONDENCE.

THE ROYAL ANTHROPOLOGICAL INSTITUTE,
52 Upper Bedford Place, Russell Square, London, W.C.1

GENERAL DISCUSSIONS OF THE FARADAY SOCIETY.

A list of REPRINTS available can be obtained from Messrs. GURNEY & JACKSON, 33 Paternoster Row, London, E.C.4, Official Publishers to the Society. Information relating to the Society may be obtained from the SECRETARY, 90 Great Russell Street, London, W.C.1

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free Books Purchased.

CHEMICAL AND TECHNICAL BOOKS

We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms.

Write for Catalogue.

WILLIAM BRYCE, Scientific Bookseller,
54-54a Lothian Street, EDINBURGH.

Just Issued
from the Natural History Department of
DULAU & COMPANY LTD.
34-36 Margaret St., Cavendish Square, London, W.1
CATALOGUE No. 143:
PHYTO-PATHOLOGY AND HORTICULTURE.
Post free on request

"POSTLIP"
(No. 633 MILL)
ENGLISH FILTER PAPERS

Manufactured in
ANNUALLY INCREASING QUANTITIES
for upwards of 50 years.

White and Grey Plain, Antique, Crinkled, and Embossed.

All sizes in Squares, Circles, and Folded Filters. Rolls made to order.

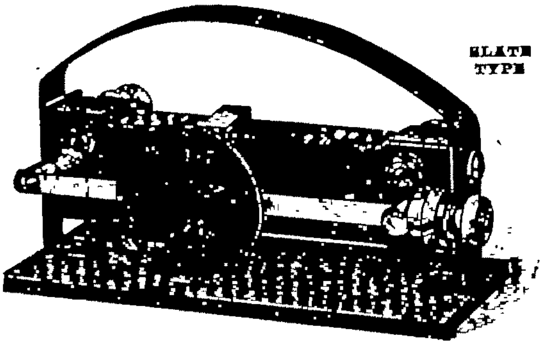
Pure Filterings for Laboratory Work and in quantities for all industrial purposes.

See Report of TESTS made by The National Physical Laboratory, a copy of which will be sent on application, together with free samples if required.

EVANS, ADLARD & CO., LTD.
POSTLIP MILLS,
WINCHCOMBE, CHELTENHAM, ENGLAND.

ZENITH

REGULATING RESISTANCES
FOR LABORATORY USE



Catalogue of all types post free

THE ZENITH ELECTRIC CO. LTD.
(Formerly The Zenith Manufacturing Co.)
Sole Makers of the "ZENITH" Electrical Products
Contractors to the Admiralty, War Office, Air Ministry, Post Office, L.C.C., &c.
ZENITH WORKS
VILLIERS ROAD, WILLESDEN GREEN, LONDON, N.W.2.

McGRAW-HILL SCIENTIFIC AND TECHNICAL BOOKS

ELEMENTS OF ASTRONOMY

By EDWARD ARTHUR FATH

Professor of Astronomy in Carleton College

THIS book attempts to present the subject-matter of astronomy to those who, through disinclination or lack of time, do not wish to read an extended mathematical treatment. Very little is presented in mathematical form, but an effort has been made to develop the necessary physical concepts so that the reader will, after completing the book, be in possession of the main facts of the subject as well as have an elementary understanding of the principles and methods involved in modern astronomical investigation. Ample discussion is given to the nature of spiral nebulæ; the Bohr theory of the atom; the Einstein theory of relativity; Eddington's investigations, etc.

307 pages. 191 illustrations 15s. net.

COMPANION VOLUME

THE TELESCOPE

By LOUIS BELL

285 pages. 189 illustrations. 15s. net.

HANDBOOK OF NON-FERROUS METALLURGY.
By DONALD M. LIDDELL. Two Volumes.
1440 pages **60s. 0d.** net

CORROSION: CAUSES AND PREVENTION.
By FRANK N. SPELLER. 621 pages. **30s. 0d.** net.

FUELS AND THEIR COMBUSTION.
By R. T HASLAM and R. P. RUSSELL.
807 pages **37s. 6d.** net.

CITRUS DISEASES AND THEIR CONTROL.
By H. S. FAWCETT and H. A. LEE. 581 pages **25s. 0d.** net.

INTRODUCTORY ELECTRODYNAMICS FOR ENGINEERS.
By E. BENNETT and H. M CROTHERS
655 pages **22s. 6d.** net

ECONOMIC GEOGRAPHY OF SOUTH AMERICA.
By R H. WHITBECK. 430 pages **17s. 6d.** net

INDUSTRIAL STOICHIOMETRY.
By W K LEWIS and A. H. RADASCH.
175 pages. **12s. 6d.** net

HYDRAULICS.
By JOSEPH N LECONTE. 348 pages. **15s. 0d.** net

MATHEMATICS FOR ENGINEERS.
By R. W. DULL 780 pages. **25s. 0d.** net

STEEL STRUCTURES—Stresses in Simple Structures.
By L C. URQUHART and C. E. O'ROURKE.
278 pages **17s. 6d.** net

ANIMAL ECOLOGY.
By A S PEARSE. 417 pages. **20s. 0d.** net.

ROOT DEVELOPMENT OF FIELD CROPS.
By J E WEAVER 290 pages **15s. 0d.** net

Sectional Catalogues sent post free on request.

McGRAW-HILL PUBLISHING CO. LTD., 6-8 Bouverie Street, LONDON, E.C.4

Foyles' Special Offer

MENDEL'S PRINCIPLES OF HEREDITY

By W. BATESON, M.A., F.A.S., V.M.H.

"The object of this book is to give a succinct account of discoveries in regard to Heredity made by the application of Mendel's method of research A translation of Mendel's two papers, together with a biographical note, is appended"

Third Edition, with additions, 1913

Published at 17/6 Offered, practically new, at **10/6** Postage 6d.

FOYLES, 121 Charing Cross Road, London, W.C.2.

Now ready. **Third Edition.**

A TEXT-BOOK OF

EXPERIMENTAL PSYCHOLOGY

By CHARLES S MYERS, M.A., M.D., Sc.D., F.R.S.,
and F. C. BARTLETT, M.A.

In two parts. **Price 16s net.**

The two parts are also sold separately:—Part I, Text-book, **10s 6d** net, Part II, Laboratory Exercises. With 40 Figures and Diagrams, **7s** net

"The edition just issued is probably the most complete text-book of experimental psychology in this or any other language. Every page is loaded with trustworthy statements of verified fact, yet the argumentation is so well ordered, and the style so concise and clear, that the book can be read with ease and pleasure"

Nature on the Second Edition.

Prospectus on application.

CAMBRIDGE UNIVERSITY PRESS
Fetter Lane, London, E.C.4

J. POOLE & CO.

ESTABLISHED 1854

NEW & SECOND-HAND

SCIENTIFIC AND EDUCATIONAL

BOOKSELLERS

ENQUIRIES BY LETTER RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals. General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."

NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

THE RESEARCH FOUNTAIN PEN (Patented).

Price 20s. free by post.

The ***only non-blotting*** pen the world has ever produced. Dip pens and other fountain pens required incessant care and attention in order to avoid blotting, this became a semi-conscious habit with the writer, but none the less it was a severe strain and handicap to him to have to look after his pen when his whole attention was taken up with original composition. The Research Pen requires no attention, it never blots, it may be lifted up and laid down with the certainty of being literally as cleanly as a pencil. The Research Pen is such a great change and improvement that writers really cannot form any adequate idea of its greater usefulness without trying the pen.

Another new feature is that the pen maintains a full and ***uniform*** quantity of ink on the nib This is even more important than the absence of blotting The ink on the nib of the Research Pen is like a cistern—always at the same good level and which can neither overflow nor descend below its proper height. In dip pens the ink on the nib was always lessening, in all other fountain pens the ink on the nib was continually varying in amount Hence in all former pens it rarely happened that a writer was "suited" with a nib He could not be suited when the pen wrote differently from time to time with the varying quantities of ink on the nib.

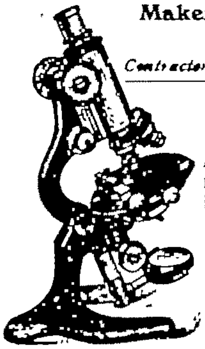
The Research Pen has proved eminently successful in getting writers suited with nibs, and we have received the most grateful of letters in consequence, we recognise and work to upwards of 100 varieties in gold nibs. The Research Pen attains a much higher standard of writing ability than former dip pen or fountain pen, and in some cases the speed of writing has been doubled

We are always glad to send a Research Pen on approbation to persons who occupy responsible positions. No statement is made regarding the pen which is not exactly true.

The Research Pen is more expensive than any other fountain pen, but the materials of the pen cost more and the workmanship is better. The penholder is made of beautifully tinted transparent bakelite There are also new parts in the pen which are not in any other pen, seeing that there are new and most valuable properties now for the first time present in any pen No trouble is experienced in filling and using the pen. It is also a most durable self-filling pen, it is the only kind of self-filling pen which is found to be durable in India and other warm countries. The Research Pen will also be found to be as cleanly as a safety pen—also a new departure.

A. MUNRO, Fountain Pen Manufacturer,
248 Corporation Street, BIRMINGHAM.

JAMES SWIFT & SON LTD.



Makers of the highest grade Microscopes and Accessories.

Contractors to all Scientific Departments of H.M. Govt.

NEW MODEL

"UNIVERSAL" MICROSCOPE

A perfectly designed Stand, with centring rotating mechanical stage, for Research in Pathology, Bacteriology, Haematology, etc.

Catalogue post free on request.

UNIVERSITY OPTICAL WORKS,
81 TOTTENHAM COURT ROAD,
LONDON, W.1.

SCIENTIFIC WORTHIES

MICHAEL FARADAY.
THOMAS HENRY HUXLEY.
CHARLES DARWIN.
JOHN TYNDALL.
SIR GEORGE GABRIEL STOKES.
SIR CHARLES LYELL.
SIR CHARLES WHEATSTONE.
SIR WYVILLE THOMSON.
ROBERT WILHELM BUNSEN.
LORD KELVIN.
BARON N. A. NORDENSKJÖLD.
HERMANN L. F. HELMHOLTZ.
SIR JOSEPH DALTON HOOKER.
WILLIAM HARVEY.
SIR GEORGE B AIRY.
J. LOUIS R. AGASSIZ
JEAN BAPTISTE ANDRÉ DUMAS.
SIR RICHARD OWEN.
JAMES CLERK MAXWELL.
JAMES PRESCOTT JOULE.
WILLIAM SPOTTISWOODE.
ARTHUR CAYLEY.
SIR C. W. SIEMENS.
JOHN COUCH ADAMS.
JAMES JOSEPH SYLVESTER.
DMITRI IVANOWITSH MENDELÉEFF.
LOUIS PASTEUR.
SIR ARCHIBALD GEIKIE.
LORD LISTER.
STANISLAO CANNIZZARO.
VON KÖLLIKER.
SIMON NEWCOMB.
SIR WILLIAM HUGGINS.
LORD RAYLEIGH.
EDUARD SUESS.
SIR WILLIAM CROOKES.
SIR WILLIAM RAMSAY.
DR. A RUSSEL WALLACE.
PROF. H. POINCARÉ
SIR J. J. THOMSON
SIR NORMAN LOCKYER
PROF. H. A. LORENTZ.
PROF. I. P. PAVLOV.
PROF. A. A. MICHELSON.

Proof Impressions of any of the above, printed on India Paper, may be had from the publishers, at 5s. each.

MACMILLAN & CO., Ltd.,
ST. MARTIN'S STREET, W.C.2.

G. C. DYMOND, F.I.C.P.A. H. E. POTTS, F.I.C.P.A.

W. P. THOMPSON & CO.,
CHARTERED PATENT AGENTS,
12 CHURCH STREET, LIVERPOOL,
and 50 LINCOLN'S INN FIELDS, LONDON.

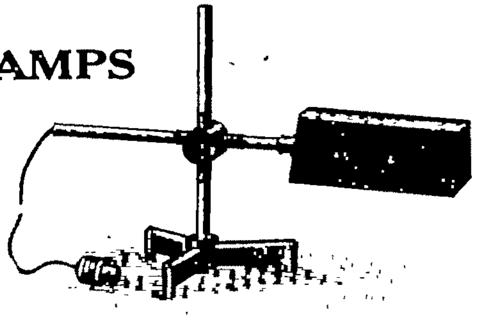
J. V. ARMSTRONG, F.I.C.P.A. W. H. BEESTON, R.P.A.

A. P. THURSTON, D.Sc., F.R.Ae.S.,
Patent Agent, 329 High Holborn, W.C 1.
Phone · Holborn 2542 Patents, Trade Marks and Designs.

KING'S PATENT AGENCY LTD., 146a Queen Victoria Street, E.C.4. Advice handbook free. 40 years' refs.

ELECTRIC MICROSCOPE LAMPS

For { High Power Microscopy
Dark Ground Illumination
Dissecting, etc



NEW DAYLIGHT LAMP
Particulars on request

HAWKSLEY & SONS, LTD. 83 WIGMORE STREET LONDON, W.1

HOPKIN & WILLIAMS, Ltd.

16 & 17 Cross St., Hatton Garden, London, E.C.1

Works: Ilford, Essex. Telegrams: "Cerium, Smith, London" Telephone: Holborn [illegible] and [illegible].

The Leading British House for

CHEMICAL REAGENTS

PURE, FINE, AND RARE CHEMICALS

Manufacturers of Guaranteed

Chemical Reagents for Analysis and Research.

Made and supplied to standards and specifications described in the publication

"Analytical Reagents: Standards and Tests."

Compiled by

EDMUND WHITE, B.Sc. (Lond.), F.I.C.

Published by

HOPKIN & WILLIAMS, LTD.

NEW EDITION, 1925.

CLOTH BOUND. INTERLEAVED.

Price 1/6 post free from the Publishers.

SIRA

MOUNTANT

for Critical Work

A neutral mountant. The acidic properties of Canada Balsam are known to affect certain substances and stains. **SIRA** Mountant is prepared in accordance with the directions of The British Scientific Instrument Research Association, and should be used in place of Canada Balsam.

Price 2/6 per bottle.

Sole Manufacturers:

Stafford Allen & Sons, Ltd.

Estab. 1833, *7 Cowper St., London, E.C.2*

From all Scientific Instrument Makers and Dealers.

Cholecystography

SODIUM SALTS OF

TETRABROM-PHENOLPHTHALEIN

AND

TETRAIODO-PHENOLPHTHALEIN

In Gelatin capsules for oral administration

In Glass containers for intravenous injection

Further information on request

BURROUGHS WELLCOME & CO., LONDON

xx 4619 *All Rights Reserved*

DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

Trustees: Sir J. J. THOMSON, O.M., F.R.S., Sir F. G. KENYON, K.C.B., F.B.A., Prof. A. C. SEWARD, Sc.D., F.R.S., Prof. R. S. CONWAY, Litt.D., F.B.A.

A *free* specimen copy of "Discovery" will be sent to anyone on request.

Contents of the November issue include:

LIVY AS A POLITICIAN.	R. S. CONWAY, LITT.D., F.B.A.
FLIGHT FACTOR IN BIRDS.	C. J. PATTEN, M.D., Sc.D.
CRUSADES PREACHED IN AMERICA.	LEWIS SPENCE.
HOLY WELLS.	R. C. S. WALTERS, B.Sc.
SCIENTIFIC PROBLEMS OF THE AMAZON.	C. W. D. FIFE.
AMERICAN UNIVERSITY LIFE.	A BRITISH STUDENT.

Copies of the August *British Association Number*, containing Sir Oliver Lodge's reminiscences of the 1894 Oxford meeting at which wireless was first demonstrated, can still be obtained, each 1s. 2d. post free.

Illustrated. 1s. Monthly.

Annual Subscription 12s. 6d. post free.

BENN BROTHERS LTD.

154 Fleet Street, London, E.C.4

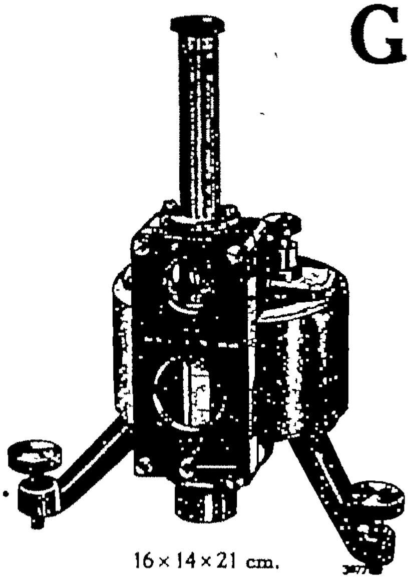
ANNOUNCEMENT.

Volume VIII. of *The Journal of General Physiology* will be a memorial to its founder, Dr. Jacques Loeb. This volume will contain papers by Dr. Loeb's pupils and his associates, together with a portrait and a sketch of his life. The volume will appear simultaneously with Volume IX. The publication of this volume began September 18, 1925.

Subscribers to the Journal, and others, may obtain the extra volume by sending their subscriptions (price $5.00) to

THE JOURNAL OF GENERAL PHYSIOLOGY,

AVENUE A AND 66TH ST., NEW YORK, N.Y.



A SIMPLE SENSITIVE GALVANOMETER

Cambridge A.M. Galvanometers can now be fitted with the Wadsworth reflecting device, whereby the normal sensitivity is doubled. For example, a galvanometer of this form, with a resistance of 25 ohms, will give a deflection of 275 millimetres per microampere at one metre scale distance, as compared with approximately half this value for the standard pattern.

16 × 14 × 21 cm.

Further particulars
on request.

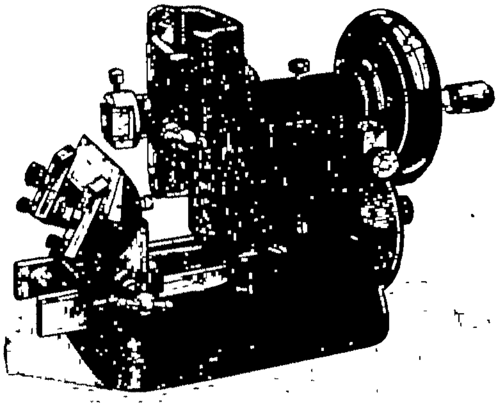
CAMBRIDGE
INSTRUMENT CO LTD

WORKS:—
LONDON, &
CAMBRIDGE

Head Office & Showrooms:—45, GROSVENOR PLACE
LONDON, S.W.1

AMERICAN COMPANY:
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

41



NO. 3.
AUTOMATIC ROTARY MICROTOME

NEW AND IMPROVED MODEL

WITH:—
DETACHABLE KNIFE HOLDER WITH FINE ADJUSTMENT FOR ANGLE.
UNIVERSAL OBJECT CLAMP, RIGID AND PRACTICAL.
TOTALLY ENCLOSED MECHANISM.
HEAVY CONSTRUCTION (WEIGHT 28 lbs.).

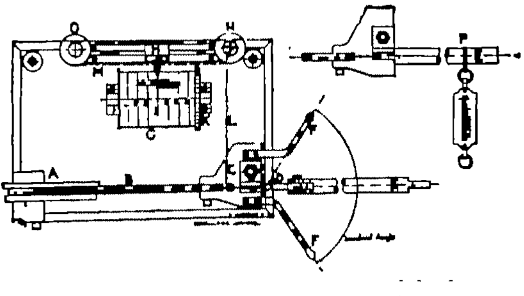
PRICE £17:17:6

LABORATORY EQUIPMENT CO.

MICROSCOPES AND ACCESSORIES, MICROTOMES,
PHOTOMICROGRAPHIC APPARATUS, BENCHES, Etc.

Showroom: 310/312 Regent Street, London, W.1
Telephone: Langham 3111

METAL TESTING IN WORKS & LABORATORIES



Capt. Sankey's Machine provides a reliable shop test. It is automatic, portable, inexpensive, and can be worked by unskilled labour. The personal element is removed, and a record is obtained which can be filed for reference.

Pamphlet from

C. F. CASELLA & CO.
49—50 PARLIAMENT STREET,
LONDON, S.W.1

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

J. & A. CHURCHILL

42 Illustrations. 15s. net. Postage 6d.

THE PREPARATION AND ANALYSIS OF ORGANIC COMPOUNDS

By J. BERNARD COLEMAN, A.R.C.Sc., F.I.C., F.C.S., and FRANCIS ARNALL, Ph.D., M.Sc., F.I.C., Lecturer in Chemistry, Chelsea Polytechnic, London.

"This highly systematic little work places before the student a comprehensive course of practical organic chemistry . . Altogether the book is a highly useful one, and well adapted to the needs of both the beginner and the advanced student in general practical organic chemistry."—CHEMICAL TRADE JOURNAL

---

115 Experiments. 30 Illustrations. 10s. 6d. net. Postage 6d.

THEORETICAL ORGANIC CHEMISTRY—Part I

By FRANCIS ARNALL, Ph.D., M.Sc., F.I.C., Lecturer in Chemistry, Chelsea Polytechnic, London, and F. W. HODGES, M.Sc., Senior Science Master, Coopers' Company School, London.

---

38 Illustrations. 12s. 6d. net. Postage 6d.

RECENT ADVANCES IN BIOCHEMISTRY

By J. PRYDE, B.Sc., M.Sc., Lecturer in Physiological Chemistry, Welsh National School of Medicine.

F.R.S. writes: "It is the best book of its kind I have ever seen."

2nd Edition. 70 Illustrations. 12s. 6d. net. Postage 6d.

RECENT ADVANCES IN PHYSIOLOGY

By C. LOVATT EVANS, D.Sc., M.R.C.S., L.R.C.P., F.R.S., Jodrell Professor of Physiology, University College, London.

---

2 Volumes. 72 Illustrations. £2 : 2s. net. Postage 1s.

THE ATMOSPHERIC NITROGEN INDUSTRY

WITH SPECIAL CONSIDERATION OF THE PRODUCTION OF AMMONIA AND NITRIC ACID

By DR. BRUNO WAESER. Translated by ERNEST FYLEMAN, B.Sc., Ph.D., F.I.C.
With a FOREWORD by J. F. CROWLEY, D.Sc., B.A., M.I.E.E.

"The author has been able, by drawing on the multitudinous articles available from technical and trade literature, to present a very comprehensive account of the wide ramifications of this increasingly important industry. . . . It undoubtedly constitutes the most comprehensive account of the development of the atmospheric nitrogen industry in Germany during the War that has yet appeared, and for that one fact alone, the book merits careful attention."—CHEMICAL TRADE JOURNAL

---

55 Illustrations. 9s 6d. net. Postage 6d.

GASWORKS LABORATORY HANDBOOK

By W. I. INESON, Chief Chemist, Bradford Corporation Gas Department, Lecturer in Gas Engineering and Gas Supply, Technical College, Bradford.

---

50 Illustrations. 10s. 6d. net. Postage 6d.

CHEMISTRY OF THE PROTEINS AND ITS ECONOMIC APPLICATIONS

By DOROTHY JORDAN LLOYD, M.A., D.Sc., F.I.C. INTRODUCTION by SIR F. G. HOPKINS, F.R.S.

Two Volumes. 36s. net. Postage 1s.

PARRY'S CYCLOPÆDIA OF PERFUMERY

"The author has made every effort to be accurate and also to be up-to-date—the recent patents on menthol and thymol, for instance, are covered, and the contribution by Langlais and Goby on orris oil. . . . Mr. Parry has produced two volumes containing a great deal of information useful for quick reference in the essential oil and perfumery laboratory, office and warehouse, and which we doubt not will be found in many such a place."—PERFUMERY AND ESSENTIAL OIL RECORD

---

207 Illustrations. 21s. net. Postage 9d.

GIUA'S CHEMICAL COMBINATION AMONG METALS

Translated by G. W. ROBINSON, Adviser in Agricultural Chemistry, University College, Bangor.

FRESENIUS' QUALITATIVE CHEMICAL ANALYSIS

Translated by C. A. MITCHELL. 17th Edition. 57 Illustrations and Spectroscopic Plate. 36s. net. Postage 9d.

---

162 Illustrations. 21s. net. Postage 9d.

HOOD & CARPENTER'S PRACTICAL CHEMISTRY

3rd Edition. 200 Illustrations. 21s. net. Postage 9d.

MARSHALL'S MICROBIOLOGY

A Text-Book of Micro-organisms: General and Applied

"We know of no other book which, in so limited a space, gives such an excellent account, general and special, of micro-organisms in all their aspects. The text contains numerous illustrations."—NATURE.

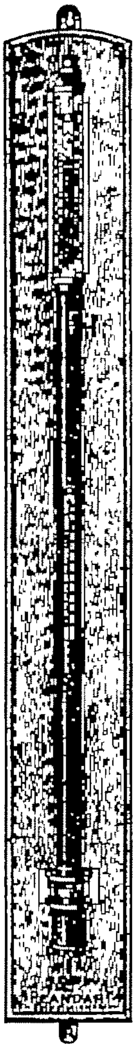
2nd Edition. Revised and Enlarged. 16 Plates and 38 Text-figures. 42s. net. Postage 9d.

WHYMPER'S COCOA AND CHOCOLATE:

Their Chemistry and Manufacture

London: J. & A. CHURCHILL, 7 Great Marlborough Street, W.1

THE
IMPROVED
"PEANDAR FORTINETTE"
STANDARD BAROMETER



This Barometer has been designed to meet the requirements of **Chemical Laboratories, Gas Works, Private Observers, Colleges,** etc., for an instrument giving **exact readings** at a moderate cost. The Frame, which is made of solid drawn brass tube, is enamelled black and finished in the very best manner, and is mounted on a polished oak board, with brackets for adjustment, and opal glass reflectors behind the scales and glass cistern. Each instrument is engraved **The Improved "Peandar Fortinette" Standard Barometer.**

BORE OF TUBE - **·25-inch**

The **Scales** are engine-divided, and engraved on the brass body to ·05 inch and 1 millimetre, and read by the verniers to **·002 inch** and **·05 mm.**, and are protected by an air-tight glass cover.

The **Thermometer** has both Fahrenheit and Centigrade scales, and is protected by a metal frame.

Price, complete as illustrated,

£7 7 0

National Physical Laboratory Certificate - £2 2 0 extra. Sent **Carriage Paid,** and safe delivery guaranteed, within the British Isles.

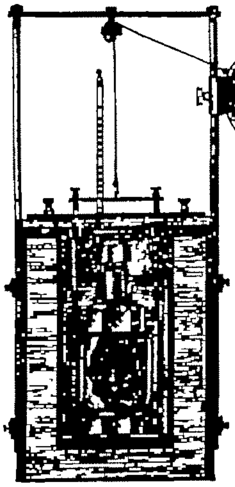
SOLE MAKERS **PASTORELLI & RAPKIN LTD.**
46 HATTON GARDEN, LONDON, E.C.1

Actual Manufacturers of Barometers, Thermometers, Hygrometers, Barographs, Thermographs, Hygrographs, Rain Gauges, Hydrometers, etc.

PRICE LISTS POST FREE ON APPLICATION.

Any instrument sent on approval if desired.

Telegrams—"Rapkin, London." ESTABLISHED 1750. Telephone—Holborn 1981.



THE
MAHLER-COOK
BOMB CALORIMETER

For determining the calorific value of Fuels (Coal, Coke, Oils, etc.).

The original Bomb Calorimeter, used all over the World and first introduced by the present makers in 1900. The only reliable, accurate, and high-class apparatus on the market to-day, and made by Engineers and high-pressure experts.

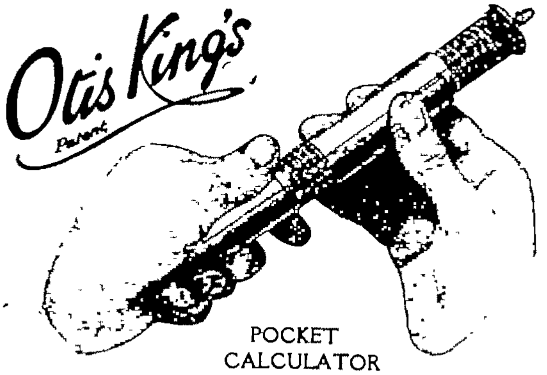
Stainless steel Bombs with descaled internal finish, or high tensile mild steel Bombs with enamelled interior.

Send for Illustrated Booklet containing all working instructions, tables, graphs, etc.

High Pressure Apparatus, Centrifuges, Microtomes, Electroscopes, Steam Meters, Electric Furnaces, etc.

CHAS. W. COOK & SONS,
ROYAL HOTEL WORKS,
ASHBY-DE-LA-ZOUCH, LEICS.

LONDON STOCKISTS **Messrs. Baird & Tatlock (London) Ltd., Cross Street, Hatton Garden, E.C. 1.**



"**accuracy is about four times that of the ordinary ten-inch slide rule . . .**"

writes a B.Sc., from Canada. This unsolicited letter goes on to state: "My estimate is that I have made about fifty thousand calculations with your product. About twenty-two thousand hydraulic calculations have been made in the last month with a probable error of any one calculation not greater than 5/100 of 1%."

Otis King Model K for multiplication, division, proportion, percentages. Model L gives, in addition, all powers and roots—fractional or otherwise—of all numbers without limit.

Price, packed in leather case, 21/- (special Black Cursor 1/6 extra), post free within U.K.

Write for illustrated and fully descriptive folder.

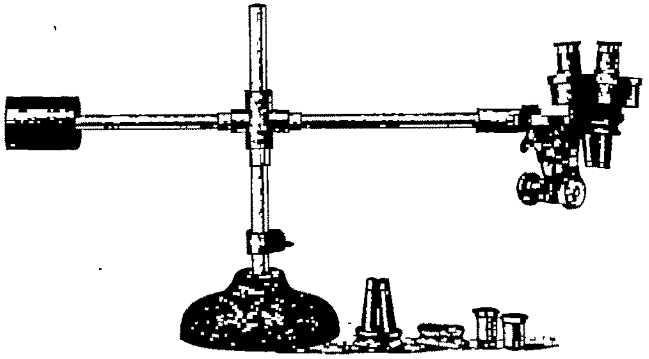
CARBIC LIMITED
(Dept. N), 51 Holborn Viaduct, London, E.C. 1.

Agents in most Dominions and Foreign Countries.

Bausch and Lomb

NEW WIDE-FIELD BINOCULAR MICROSCOPE

Designed to meet the increasing need for a high-grade binocular microscope that fulfils the following conditions:



1. **Stereoscopic Vision.**
2. **Extremely Large Field.**
3. **Long Working Distance.**
4. **High Eye Point.**
5. **Wide Range of Magnification.**

It gives the advantage of viewing the image in its true position, not inverted or reversed.

Supplied on four different stands covering every requirement, the microscope being interchangeable on each stand.

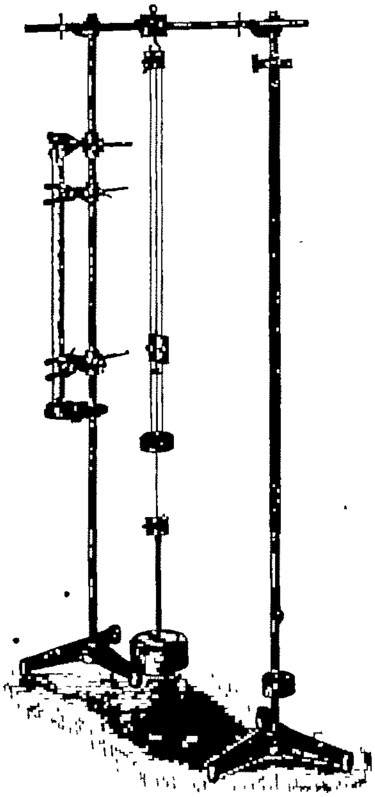
Illustrated descriptive list sent on request.

¶ **See Editorial Notice, NATURE, November 6, page 675.**

Also Microscopes for all purposes, Microtomes, Photomicrographic Apparatus, Centrifuges, Colorimeters, Hæmoglobinometers, Balopticon Projection Lanterns, etc.

Bausch & Lomb Optical Co. Ltd.
Contractors to British, Indian, Colonial and Foreign Governments.

37-38 HATTON GARDEN
LONDON E.C.1.
Our instruments may be obtained through all Dealers.



CUSSONS ADAPTABLE CLAMPS

for the Mechanical
and Physical Laboratory

Please send for new Catalogue

G. CUSSONS LTD.
The Technical Works, MANCHESTER
London Office: Thanet House, 231 Strand, W.C.2

ESTABLISHED 1876

Sir Richard Glazebrook's

DICTIONARY OF APPLIED PHYSICS

Can now be purchased on the convenient System of Divided Payments

The COMPLETE Work in 5 volumes
Delivered at once
For a first payment of
21/-

Single Volumes
Any one VOLUME
Delivered at once
For a first payment of
2/6

CONTENTS

Vol. I. Mechanics—Engineering—Heat.
" II. Electricity.
" III. Meteorology, Metrology, and Measuring Apparatus.
" IV. Light—Sound—Radiology.
" V. Aeronautics—Metallurgy—General Index.

7 DAYS FREE APPROVAL OFFER

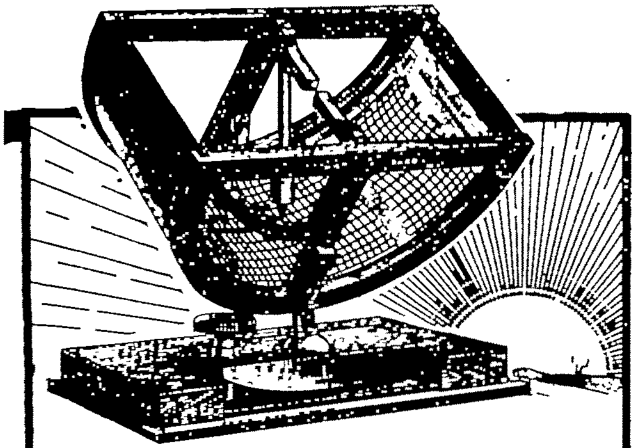
To the GLOBE PUBLISHING CO., LTD.,
Gloucester House, 19 Charing Cross Road, London, W.C.2.

Please send me for 7 days free examination
A complete copy of the "Dictionary of Applied Physics" in 5 volumes.
Volume... ... ... of the "Dictionary of Applied Physics."
(*Strike out lines not applicable.*)

It is understood that I can examine the $\frac{\text{work}}{\text{volume}}$ for seven days after I receive it and that I can return it to you on the eighth day if I decide not to keep it. Should I decide to retain the volume(s) I undertake to send you a first payment of $\frac{21/-}{2/6}$ for the complete work / for Volume.............only on the eighth day and to complete the purchase of the $\frac{\text{complete work}}{\text{Volume......}}$ by remitting $\frac{14}{19}$ further monthly payments of $\frac{21/-}{5/-}$ until the full price $\frac{£11\ 15\ 0}{£2\ 7\ 6}$ is paid. (I am not under 21 years of age.)

Name...
Address...

N.100 ....



The Ferguson
SOLAR CHRONOMETER

will show correct time without any calculation or allowance for equation. It is very portable (Model A being only 4 ins. in diameter) and it can be set up by anybody, no compass or level being required.

Model A, for use between 60° N. and 60° S. £5 15. 0
Model B, for use in any latitude . . . £6 15 0

With descriptive pamphlet.

J.H. STEWARD, Ltd., ESTAB. 1852.
Scientific Instrument Makers to the British and Foreign Governments,
406 & 457 STRAND, LONDON, W.C.2.

W. OTTWAY & Co. Ltd.
(Established 1640)
Actual Makers of Astronomical and Terrestrial Telescopes
OTTWAY'S "SPOTTER" TELESCOPE

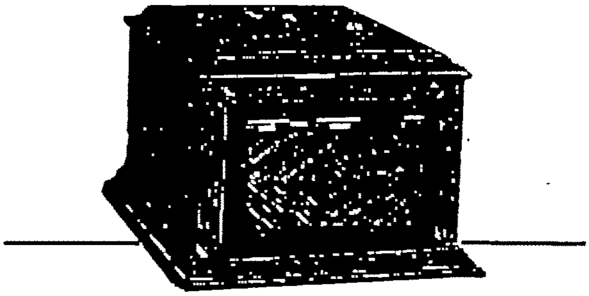
Fitted with 5 draw tubes. In Nickel Silver throughout, highly polished. Length fully extended 15", length closed 4½" Diameter of Object Glass 1", magnification 10. Body covered in crocodile.

REDUCED PRICE £1 : 16 : 0 post free.
Illustrated Leaflets sent on request
Orion Works, Ealing, London, W.5.

ULTRA VIOLET RAYS

WHICH ARE STOPPED BY GLASS PASS THROUGH
WINDOLITE,
The Practical Glass Substitute
for windows in **FACTORIES, SCHOOLS,** and **HOSPITALS;**
for **POULTRY HOUSES, BROODERS,** and **CATTLE SHEDS;**
for all **GARDEN USES.**
Light. Flexible. Unbreakable.
Easy to cut and fix.
Particulars post free, or Sample 3 ft. by 1 ft. for 4/6.

WINDOLITE (Dept. M), 179/185 Great Portland St., LONDON, W.1.



Conscientiously made—for you

THE careful, conscientious workmanship—the almost loving care with which Brown workers tend the instruments they make, is almost akin to the pride with which the Craftsmen of old fashioned their work. This pride of work is distinctly reflected in the finished product—it will be obvious to you the moment you see a Brown Loud Speaker or Headphone.

Each Brown Instrument is conscientiously made; we, its sponsors, know that in it we have designed a Loud Speaker which will give the most faithful rendering of Broadcast it is possible to imagine; one that, in purity of tone and adequacy of volume, sets a standard in reproduction unequalled throughout the world. Because we want to pass this on to you, we are determined that not by the slightest deviation from the high standard of workmanship, nor by a moment's relaxing in the discernment with which only the finest quality materials are chosen, shall the astounding fidelity of Brown reproduction be prejudiced.

¶ Art and Science go hand in hand in the Brown Cabinet Loud Speaker. Beautifully finished in rich Mahogany or Oak, it will harmonise with the setting of any room, while in purity of tone and adequacy of volume it stands alone among Loud Speakers of this type. In resistances of 2000 or 4000 ohms. **£6 . 6 . 0**

S. G. BROWN, LTD.
Western Avenue, North Acton, W.3

Retail Showrooms: 19 Mortimer Street, W.1, 15 Moorfields, Liverpool, 67 High Street, Southampton

Wholesale Depots: 2 Lansdown Place West, Bath; Cross House, Westgate Road, Newcastle; 120 Wellington Street, Glasgow, 5-7 Godwin Street, Bradford; Howard S. Cooke & Co., 59 Caroline Street, Birmingham, N. Ireland: Robert Carmany, Union Chambers, 1 Union Street, Belfast

Brown

"LET YOUR FRIENDS LISTEN!"

Gilbert Ad. 6470.

Transactions of the Optical Society

PRICE PER NUMBER, 10s. SUBSCRIPTION PER VOLUME, 50s.

Vol. XXVII. CONTENTS No. 4.

"Application of the Hartmann Test to the Measurement of Oblique Aberrations." By R. Kingslake, A.R.C.S., B.Sc.

"Note on Chalmers' Applications of the Hartmann Test." By T. Smith, M.A., F.Inst.P.

"The Distribution of Light in Elementary Optical Images." By Professor L. C. Martin, A.R.C.S., D.I.C., D.Sc.

"Note on the Criterion for the Best Position of Focus." By T. Smith, M.A., F.Inst.P.

Reviews Abstracts of Patent Specifications

PUBLISHED BY
THE OPTICAL SOCIETY
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY
SOUTH KENSINGTON : : : : LONDON, S.W.7

ADLARD & SON
LIMITED

"BARTHOLOMEW PRESS"

SCIENCE PRINTERS.

Home and Export.

New London Offices:
21 Hart Street, Bloomsbury, W.C.1.

NATURE Subscription rates

Inland		Foreign
£2 12 0	*Year*	£2 17 0
£1 6 0	*Half-year*	£1 10 0
13 0	*Quarter*	16 0

Cheques and Postal Orders should be made payable to Macmillan & Co., Ltd.

Please send me "NATURE" for ______ months, for which I enclose remittance value ______

Name ______

Address ______

Date ......

This Form may be handed to a Bookseller or Newsagent, or sent direct to
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET, LONDON, W.C.2

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals, General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."
Nature.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get

HENRY SOTHERAN & CO.,
140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

JUST PUBLISHED. Cr. 8vo **5s. 6d.** net, postage 2d.

VOLUME ALTERATIONS ON AND IN SOLUTION

By FRANK L. TEED, D.Sc.(Lond.), M.Inst.M.M. of the Middle Temple, Barrister-at-Law

LONDON: H. K. LEWIS & CO. LTD., 136 GOWER STREET, W.C.1.

GERMAN BOOKS
AND PERIODICALS
supplied by
W. MULLER, Foreign Bookseller,
26 Hart Street, Bloomsbury, London, W.C.1
References in all countries.

SCIENTIFIC BOOKS
AND PERIODICALS
Including the Publications of the Learned Societies,
ON SALE BY
WHELDON & WESLEY Ltd.
2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2
Classified Catalogues sent post free. Books Purchased.

NATURAL SCIENCE
BOOKS AND PERIODICALS
INCLUDING THE PUBLICATIONS OF THE LEARNED SOCIETIES
CATALOGUES GRATIS LIBRARIES PURCHASED
BERNARD QUARITCH LTD.
11 Grafton Street, New Bond Street, London, W.1

OXYGEN
And other Gases.

The British Oxygen Co. have works for the production of Oxygen, Nitrogen, Carbonic Acid, Nitrous Oxide, Hydrogen, and Argon in all chief industrial centres. The Company's Plants are capable of an aggregate output of **about four million cubic feet per day.**

Special Terms quoted to the Trade.

Catalogue and full particulars on application to the Head Offices of the Company—

THE BRITISH OXYGEN CO., Ltd.,
ANGEL ROAD, UPPER EDMONTON,
LONDON, N.18.

BLACKIE'S CHEMICAL BOOKS

Just Published

PRACTICAL ORGANIC CHEMISTRY For Students of Pharmacy and Medicine. By I. VANCE HOPPER, Ph.D., A.R.C.S.I., F.I.C., and WILLIAM M. CUMMING, D Sc., F.I.C , Lecturers on Organic Chemistry, The Royal Technical College, Glasgow. Designed especially to suit the needs of students taking the Chemist and Druggist Qualifying Examination of the Pharmaceutical Society. **4s.** net.

Second edition, revised and enlarged.

THE FOUNDATIONS OF CHEMICAL THEORY : The Elements of Physical and General Chemistry. By R. M. CAVEN, D.Sc.(Lond.), F.I.C., Professor of Inorganic and Analytical Chemistry in the Royal Technical College, Glasgow. **12s. 6d.** net.

MANUALS OF PURE AND APPLIED CHEMISTRY. General Editor: R. M. CAVEN, D.Sc.(Lond.), F.I.C.

THE STRUCTURE OF MATTER. By J. A. CRANSTON, D.Sc., A.I.C., Lecturer in Physical Chemistry, Royal Technical College, Glasgow. Second Impression. **12s.** 6d. net.

CHEMICAL SYNTHESIS : Studies in the Investigation of Natural Organic Products. By HARRY HEPWORTH, D.Sc.(Lond.), F.I.C., a member of the Research Staff of Nobel Industries, Ltd **20s.** net.

COMPLEX SALTS. By WILLIAM THOMAS, B.A. (Cantab.), M.Sc.(Wales), Ph.D (Aberdeen), A.I.C., Lecturer in Chemistry, University of Aberdeen **10s.** net.

QUANTITATIVE CHEMICAL ANALYSIS and Inorganic Preparations. By R. M. CAVEN, D.Sc. (Lond.), F.I.C.

IN TWO PARTS :—

PART I. : **Preparation of Inorganic Salts, and Simple Exercises in Gravimetric and Volumetric Analysis.** **3s. 6d.** net.

PART II. : **Volumetric Analysis ; Gravimetric Separations ; Analysis of Minerals and Alloys ; Preparation of Inorganic Compounds.** **5s.** net.

SYSTEMATIC QUALITATIVE ANALYSIS. For Students of Inorganic Chemistry. By R. M. CAVEN, D.Sc.(Lond.), F.I.C. **5s.** net.

A TEXTBOOK OF ORGANIC CHEMISTRY. By A. BERNTHSEN, Ph.D. Edited by J. J. SUDBOROUGH, Ph.D., D.Sc., F.I.C., Hon. Fellow of, and formerly Professor of Organic Chemistry in the Indian Institute of Science, Bangalore **12s. 6d.** net.

PRACTICAL ORGANIC CHEMISTRY. By J. J. SUDBOROUGH, Ph.D., D.Sc., F.I.C., and T. CAMPBELL JAMES, D.Sc., F.I C., Professor of Chemistry, University College of Wales, Aberystwyth. A companion book to Sudborough's edition of Bernthsen's "Organic Chemistry." **8s** net.

SYSTEMATIC INORGANIC CHEMISTRY. From the Standpoint of the Periodic Law. By R. M. CAVEN, D.Sc.(Lond.), F.I.C., and G. D. LANDER, D.Sc.(St. And. and Lond.), F.I.C. **9s.** net.

Catalogue of Advanced Scientific and Mathematical Books post free.

BLACKIE & SON, LTD.
50 OLD BAILEY, LONDON, E.C.4

FROM CONSTABLE'S LIST

NOMOGENESIS or EVOLUTION DETERMINED BY LAW. L. S. BERG, D.Sc. With an Introduction by D'ARCY WENTWORTH THOMPSON Demy 8vo. Illustrated. **28s.** net.

FROM A REVIEW IN NATURE

"This volume represents the mature thought of an accomplished ichthyologist and traveller who speaks from the point of view of a naturalist and field observer and marshals, in the first nine chapters, all the difficulties that have arisen through field observation in the original concept of Darwinism. . . . A thoughtful and, in large part, original contribution to the newer modern aspect of the evolution theory."—*Oct.* 30, 1926.

PRINCIPLES OF HUMAN GEOGRAPHY. By P. VIDAL DE LA BLACHE. Edited by EMMANUEL DE MARTONNE. Demy 8vo. Illustrated **18s.** net.

PHOTOMETRY. JOHN W. T. WALSH, M.A, M.Sc, A.M.I.E.E., F.Inst.P. Royal 8vo Illustrated. **40s.** net.

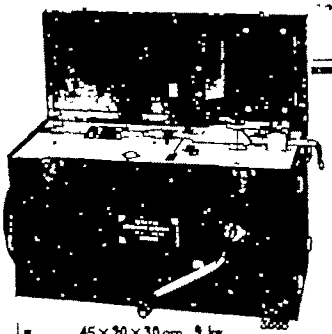
SYSTEMATIC ORGANIC CHEMISTRY. A complete laboratory guide to the preparations and estimations of Organic Chemistry. W. M CUMMING, D.Sc., F.I.C.; I. V. HOPPER, Ph.D., B Sc., A.R.C.Sc.I., F.I.C. ; and T. S. WHEELER, Ph.D , B.Sc., F.R.C.Sc.I , F.I.C. Demy 8vo. Illustrated. **25s.** net.

THE STATES OF AGGREGATION : The Changes in the State of Matter in their Dependence upon Pressure and Temperature. GUSTAV TAMMANN, Director of the Institute of Physical Chemistry at the University of Göttingen. Authorised translation from the 2nd German Edition by R. F MEHL, Ph.D. Demy 8vo. 308 pages. Illustrated. **24s.** net.

INTRODUCTION TO THEORETICAL PHYSICS. ARTHUR HAAS, Ph.D. Translated by T. VERSCHOYLE. 2 volumes. Demy 8vo. Illustrated. Vol. I., **21s.** net. Vol. II, **21s.** net.

Complete Lists of Scientific Books sent Post Free on Request.

10 & 12 ORANGE ST., LONDON, W.C.2



45×20×30 cm 9 kg

RIVERS-McDOUGALL FATIGUE MACHINE

(Portable Model)

This machine provides an efficient and reliable method of studying and registering the distraction of the attention due to mental fatigue or to disturbing sensory stimuli. The test requires a maximal sustained effort of attention from the subject, and produces a continuous graphical record of the results, which lends itself to examination and analysis. The machine is useful for comparing the capacity of individuals for concentrated effort, the influence of excitement, drugs, rest, etc.

WRITE FOR FURTHER PARTICULARS.

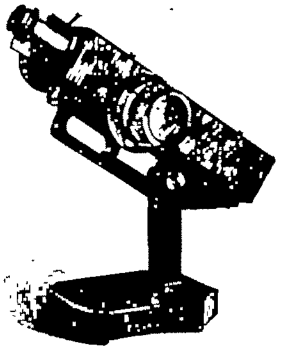
54

CAMBRIDGE
INSTRUMENT Co Ltd

Works - LONDON & CAMBRIDGE
Head Office & Showrooms - 45, GROSVENOR PLACE LONDON, S.W.1

AMERICAN COMPANY
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

B-S
Spectrometer
Reading directly in wave-lengths



The instrument is equipped with a symmetrical slit, illuminated pointer to the eyepiece, and an extra dense glass prism.

Height of instrument 12 inches.

"British and Best"

Full particulars from the Makers:

BELLINGHAM & STANLEY LTD.
71 Hornsey Rise, London, N.19
Phone: Mountview 2270

NEW
STUDENT'S MICROSCOPE STAND L O

The Microscope is one of the well-known standard Leitz series, of generous proportions, with large square object stage.
The objectives and eyepieces are of our own manufacture, entirely British, and of the highest quality, the objectives consisting of fully corrected achromatic lenses.

SPECIFICATION

L O Outfit No. 1—Microscope stand, with coarse and fine adjustments, square object stage, Abbe condenser and iris diaphragm with spiral focussing screw, and triple nosepiece. Ogilvy & Co achromatic objectives: ⅓″, 0·28 N.A., and ⅙″, 0·85 N.A. Eyepieces ×6 and ×10. Complete in cabinet £15 10 0

REPAIRS

Optical and mechanical repairs to all kinds of scientific instruments are carried out efficiently in our own workshops by thoroughly experienced mechanics

OGILVY & CO.
Optical Engineers,
20 Mortimer Street, London, W.1

Telephone: Museum 3406
Few minutes Oxford Circus

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.

WEALTH, VIRTUAL WEALTH AND DEBT

By Professor F. SODDY. 10s. 6d.

An examination of the economic paradox that threatens the future of industrialised nations—material productivity and financial bankruptcy, glut and unemployment, superabundance and poverty, with world war as the outlet—from the standpoint of physical science.

Some Press Opinions:

"Here at long last is somebody talking about economics without seeming merely to juggle with paradoxical ideas. It is the secret of Prof. Soddy's clarity that he is a scientist."—*Granta*.

"Prof. Soddy has written a profoundly interesting book. The value of it lies in the conjunction of absolute fearlessness with a close and masterly logical analysis."—*Saturday Review*.

"A valuable contribution to economic thinking by a leading expert in a quite different branch of science."—*New Statesman*.

"A keen and successful exposure of the defects of our bank credit system together with a set of remedial proposals designed to secure a stable price level."—*New Leader*.

GEORGE ALLEN & UNWIN LTD.
40 Museum Street, London, W.C.1

Journal of Scientific Instruments

(Published on the 15th day of each month)

PRODUCED BY THE INSTITUTE OF PHYSICS, WITH THE CO-OPERATION OF THE NATIONAL PHYSICAL LABORATORY

PRICE: SINGLE COPIES, 2s. 6d. ANNUAL SUBSCRIPTION, 30s. including postage. Send subscriptions to the CAMBRIDGE UNIVERSITY PRESS, Fetter Lane, London, E.C.4.

CONTENTS OF NOVEMBER ISSUE.—VOL. IV, No. 2

NOTE ON SHIELDED NON-INDUCTIVE RESISTANCES. By L. HARTSHORN and R. M. WILMOTTE

A MACHINE FOR RATING INCANDESCENT LAMPS. By C. G. EDEN and N. R. CAMPBELL

AN INTERFERENCE APPLIANCE FOR THE ACCURATE COMPARISON OF LENGTH GAUGES. By F. H. ROLT and C. H. KNOYLE.

THE VALVE BRIDGE. A NEW METHOD OF MEASURING THE ANODE IMPEDANCE AND VOLTAGE FACTOR. By W. BAGGALLY

DESCRIPTION OF AN IMPROVED THORNER DAYLIGHT FACTOR METER. By A. K. TAYLOR.

LABORATORY AND WORKSHOP NOTES.
  SELENIUM CELLS.
  MAGNESIUM ALLOYS
  HEAT TREATMENT OF METALS.
  DIAPHRAGMS AND HEAT TREATMENT. By F. STOKES.

A NEW SENSITIVE GALVANOMETER OF SHORT PERIOD AND LOW RESISTANCE.

REVIEWS.

TABULAR INFORMATION ON SCIENTIFIC INSTRUMENTS: XV. BRITISH OPTICAL GLASS

Volume IV. commences with the October number. This volume only will contain 15 parts and the Annual Subscription will be 37s. 6d. Vols. I., II., and III. can be obtained complete, bound in cloth, for 35s. each

New Scribner Books

OUR MOBILE EARTH

By REGINALD DALY, Head of the Department of Geology in Harvard University. With many photographs, diagrams, and maps **21s. net.**

"Our Mobile Earth" tells all that is known of the crust of the earth its origin and structure; of earthquakes; of how the continents were formed; of how the mountain chains came into being—all the successive steps of Nature in the making of the habitable world.

"Professor Daly's fascinating book."—*Morning Post*

"It should be welcome to many classes of readers: geographers, biologists and palæontologists, as well as astronomers and physicists."—*Times Literary Supplement.*

BEYOND THE MILKY WAY

By GEORGE ELLERY HALE, D.Sc., Assoc. R.A.S., Director of the Mount Wilson Observatory of the Carnegie Institution of Washington. Illustrated **7s. 6d. net.**

Dr Hale, who is well known for his pioneer work in astronomy, summarises the suppositions in regard to another universe, and outlines some of the newest discoveries both astronomical, dealing with the infinitely big, and physics—dealing with the infinitely little. He describes how the late Ernest Fox Nichols was the first to measure the heat radiation of stars, and points the way to future great developments.

By the same author.

THE NEW HEAVENS. **7s. 6d. net.**

THE DEPTHS OF THE UNIVERSE. **7s. 6d. net.**

"No one is more competent than Professor Hale to survey this great territory of which he is the leading pioneer explorer, and his account of the methods used to examine it and the rich store of new knowledge gathered from it, makes it as fascinating a scientific story as ever was told."—*Nature*

EVOLUTION AND RELIGION IN EDUCATION

By Professor HENRY FAIRFIELD OSBORN, President of the American Museum of Natural History. **7s. 6d. net.**

Professor Osborn's book sets forth the reasoned and tempered views of a great evolutionist who is also a religionist.

Other books by Professor Osborn

FROM THE GREEKS TO DARWIN. (New edition.) An outline of the development of the evolution idea. **12s. 6d. net.**

EVOLUTION OF MAMMALIAN MOLAR TEETH. To and from the triangular type. Profusely illustrated **14s. net.**

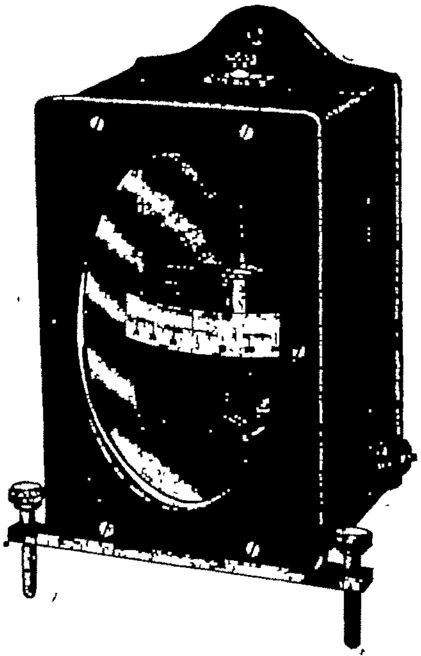
THE AGE OF MAMMALS. In Europe, Asia and North America. Profusely illustrated. **40s. net.** (At present out of print, new edition in preparation.)

A Prospectus of all Professor Osborn's books sent on request

CHARLES SCRIBNER'S SONS
7 BEAK STREET, LONDON, W.1

GAMBRELL BROS. LTD.

Established 1898.



Wall or Table Galvanometer Moving Coil.

The following are some of our standard lines:

Please send for Lists in which you are interested.

LIST	
"G"	Galvanometers, moving coil, pointer and reflecting.
"OG"	Galvanometers, "Onwood" pattern.
"GA"	Galvanometer Accessories, including Lamps, Scales, Universal Shunts, etc.
"K.S"	Keys and Switches.
"IR"	Gambrell's "Independent" Plug Contact Resistance Boxes and Wheatstone Bridges.
"HR"	Megohms and High Resistances.
"SR"	Switch pattern Resistance Boxes and Wheatstone Bridges, all grades, including Direct Reading.
"P.K"	Potentiometers, Kelvin Low Resistance Bridges, Kelvin Double Ratio Boxes, Volt Ratio Boxes, Standard Cells, Low Resistance Shunts.
"RR"	Rheostats and Single Resistances.
"C"	Condensers, Standard and Secondary.
"V.A"	Voltmeters, Ammeters, Milliameters.
"T.A"	Apparatus for Electro-Titration.

MERTON ROAD, SOUTHFIELDS,

London, S.W.18.

Phones: PUTNEY 3641-2 (Instrument).
VICTORIA 9938 (Wireless).

Radio Sales Dept. for Wireless Apparatus 76 VICTORIA ST., LONDON, S.W.1.

BRITISH INDIA

Schott & Gen. Jena

BRITISH INDIA

JENA RESISTANCE LABORATORY GLASSWARE AND GLASS FILTER APPARATUS

STOCKED BY ALL IMPORTANT LABORATORY FURNISHERS

For Rupee price lists current all over India apply to the SOLE DISTRIBUTORS FOR BRITISH INDIA:

ADAIR, DUTT & CO. LTD.

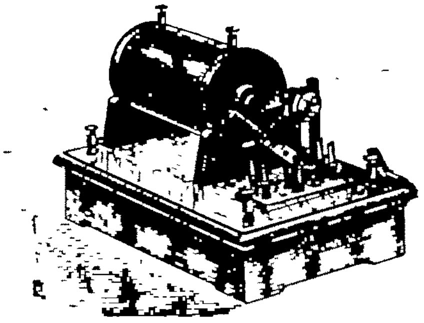
(Incorporated in England)

Stephen House, Dalhousie Square East,
CALCUTTA

Exchange Building, Ballard Estate,
BOMBAY

Head Office: 47 Victoria Street, London, S.W.1, where Government indents may be sent.

Max Kohl A.G.
Chemnitz A1 (Germany)
Manufacturers of
Physical Apparatus
Laboratory Furniture
Induction Coils · Oil Air Pumps
Experimental Switchboards
Projection Apparatus



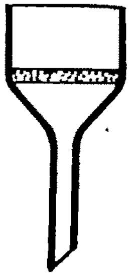
Induction Coil, with Platinum Interruptor, with Condenser and Ruhmkorff Commutator.

Special Lists on request

Schott & Gen. Jena

JENA
GLASS FILTERS

CRUCIBLES
SUCTION FILTERS
EXTRACTION TUBES

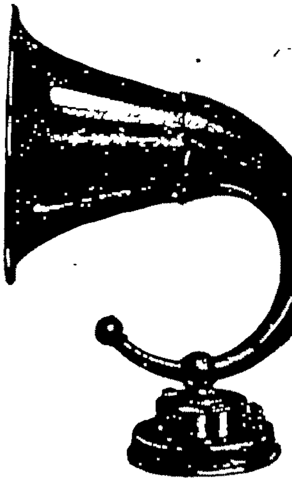


WITH FILTER-DISCS FUSED INTO GLASS CONTAINERS

Colorimeter Tubes
With end-plates fused on in parallel plane

Quartz Filter Crucibles
of highest heat and chemical resistance

For particulars apply to the Representative
E. O. MAEMPEL
Finsbury Pavement House, Moorgate,
LONDON, E.C.2
or to the Wholesalers.



The Mouthpiece of the Ether

BEFORE you buy a Loud Speaker ask these questions · is it pure in tone?—is its volume adequate?—will it reproduce evenly and accurately music and speech alike?—will it still retain these qualities after years of use?

If the Loud Speaker you buy fails in any one of these respects, you have not made the wisest choice possible to you. For in one of the nine Brown models there is an instrument to suit your pocket, which conforms with every requirement of the perfect Loud Speaker, and which will render you the same faithful service years after, as on the day you bought it.

We do not make extravagant claims for the Brown—it is not necessary. An instrument which has risen in a few years from a small "local" sale to world-wide fame; which has found its way into the homes of people of every nationality; and whose name has come to be universally regarded as a veritable synonym for perfect Radio reproduction—a Loud Speaker with such a record of achievement behind it surely needs no further recommendation.

¶ In the Brown H.Q. model are to be found a beauty of outline and perfect balance rarely seen in a Loud Speaker, with tonal purity and astonishing volume such as the most discerning could not wish to better. Standing twenty inches in height and in resistances of 2000 or 4000 ohms. **£6.0.0**

S. G. BROWN, LTD.
Western Avenue, North Acton, W.3

Retail Showrooms: 19 Mortimer Street, W.1; 15 Moorfields, Liverpool; 67 High Street, Southampton.

Wholesale Depots: 2 Lansdown Place West, Bath; Cross House, Westgate Road, Newcastle, 120 Wellington Street, Glasgow, 5-7 Godwin Street, Bradford; Howard S. Cooke & Co, 59 Caroline Street, Birmingham; N. Ireland · Robert Carmany, Union Chambers, 1 Union Street, Belfast.

Brown

G.A. 6373.

B.D.H. CHEMICALS
FOR RESEARCH AND ANALYSIS

BRITISH MANUFACTURE

Over 3500 Substances for use in Research and Analysis are kept in stock, and we are continually adding to the list of our manufactures. The reliable quality of the B.D.H. Organic Chemicals and Analytical Reagents has led to their adoption by those who place the highest value on scientific accuracy.

A copy of our latest Catalogue will be supplied on application.

THE BRITISH DRUG HOUSES, LTD.
Makers of Fine Chemicals,
Graham St., City Road, London, N.1.
Chemical Works: Wharf Road, London, N.1.

For Critical Work

SIRA
IMMERSION OIL

Refractive index 1·524. For use with modern immersion oil objectives, condensers and other optical instruments. Free from corrosive action on metal and glass. Prepared in accordance with the directions of The British Scientific Instrument Research Association, and positively the only oil that will give the best results in critical work. *Sole Manufacturers: Stafford Allen & Sons, Ltd. Established 1833, 7 Cowper St., London, E.C.2.*

Price 2/6 per bottle.

From all Scientific Instrument Makers and Dealers.

JAMES SWIFT & SON LTD.
MAKERS OF THE HIGHEST GRADE MICROSCOPES AND ACCESSORIES.

Contractors to all Scientific Departments of H. M. Government

"Advanced Student"

PETROLOGICAL MICROSCOPES

"Lapidex," "Advanced Student," "Petros," "Survey" and "Dick" models for all classes of Petrological and Mineralogical Research

Illustrated Descriptive Lists of Petrological Microscopes and Accessory Apparatus sent on request

University Optical Works,
81 TOTTENHAM COURT ROAD,
LONDON, W.1.

For Accurate Control

The "Coolidge" X-Ray Tube

The "Coolidge" tube is unequalled for physical and industrial X-ray work because it allows of an accuracy of control impossible with other types of tube. Both the quantity and penetrating power of X-rays delivered are under the complete control of the operator when the "Coolidge" tube is used, the quantity varying in direct proportion to the temperature of the cathode filament, and the penetrating power in direct proportion to the potential applied to the tube. You know exactly what you are doing when you use a "Coolidge" tube, and you can repeat accurately a given set of conditions at any time. If you value scientific accuracy, pin your faith to the "Coolidge" tube.

Send for full particulars and prices.
All types in stock.

WATSON & SONS
(ELECTRO-MEDICAL) LTD.
SUNIC HOUSE, PARKER ST.,
KINGSWAY, LONDON, W.C.2.

Telephone: Regent 1227. *Telegrams: "Skiagram, Westcent, London."*

MICROSCOPES, MICROTOMES AND ACCESSORY APPARATUS
NEW AND SECOND-HAND

Thoma-Hawksley Haemacytometers
Haemaglobinometers, Spectroscopes
Colorimeters, Sphygmomanometers, etc.

"LABORATORY" $\frac{1}{12}$" O.I. OBJECTIVE
£3 : 15 : 0

REPAIRS
to any make of microscope or objective and other scientific apparatus a speciality.

Estimates submitted

HAWKSLEY & SONS, LTD.
83 WIGMORE STREET, LONDON, W.1

Telephone: Langham 3859. *Telegrams:* Diffract, Wesdo, London

Chance's "Resistance"

Samples—Free of Cost.

We are prepared to send buyers of Chemical Glass a few samples of Chance's "Resistance" Laboratory Glassware, Free of Cost, to enable users to verify the following statement for themselves :—

For heat-resisting qualities combined with general resistance to chemical attack—CHANCE'S LABORATORY GLASSWARE is superior to any other make, whether British or Foreign.

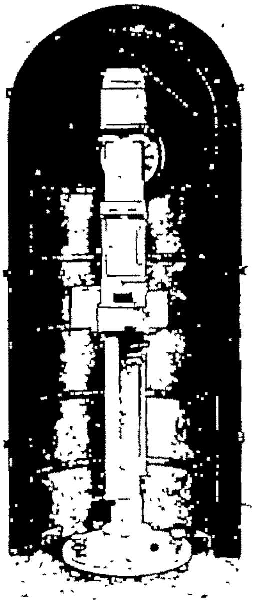
Send us your Trade Card and ask for samples.

STOCKED BY ALL THE MOST IMPORTANT LABORATORY FURNISHERS.

CHANCE BROTHERS and Co. LIMITED
GLASS WORKS SMETHWICK BIRMINGHAM

Laboratory Glassware

Oertling



NEW TYPE

EÖTVÖS TORSION BALANCE

FOR LOCATING DEPOSITS OF OIL AND MINERALS

¶ See article, "The Eötvös Torsion Balance and its Use in the Field," by Capt. H. Shaw and E. Lancaster Jones, NATURE, June 23, 1923, page 849 *et seq.*

Government and Prospecting Geologists, Mining and Oil Companies should be in possession of our Manual of Instruction, price £1 · 1s. prepaid (see review in NATURE, September 18, 1926, page 406).

Booklet describing the Instrument will be sent post free.

EXPLORATION WORK CARRIED OUT
Correspondence Invited

MANUFACTURERS:

L. OERTLING LTD. (ESTAB 1849), 88-90 Turnmill Street, LONDON, E.C.1

MACMILLAN'S NEW AND RECENT BOOKS.

REALITY: A NEW CORRELATION OF SCIENCE AND RELIGION. By BURNETT HILLMAN STREETER, Canon of Hereford. 8s. 6d. net.

This book is a plain and popular statement of a position which the author has reached after many years of reflection and much discussion with persons of different points of view.

NATURAL MAN: A RECORD FROM BORNEO. By CHARLES HOSE, Hon. Sc.D., formerly Divisional Resident, and member of the Supreme Council of Sarawak. With a Preface by PROF. G. ELLIOT SMITH, F.R.S. With Illustrations and Map. Super Royal 8vo. 30s. net.

PEOPLE OF THE VEIL. Being an Account of the Habits, Organisation, and History of the Wandering Tuareg Tribes which inhabit the mountains of Air or Asben in the Central Sahara. By FRANCIS RENNELL RODD. With 51 pages of Illustrations and 6 Maps and Plans. Super Royal 8vo. 30s. net.

THE WESTMINSTER GAZETTE.—"Mr. Francis Rennell Rodd's record of travel and adventure, and his character-drawing of the many strange people with whom he came in contact, make his work one of serious geographical and ethnographical value."

IN UNKNOWN ARABIA. By MAJOR R. E. CHEESMAN, O.B.E., F.R.G.S., H.M. Consul in North-west Abyssinia. With a Foreword by SIR PERCY COX, G.C.M.G. With Illustrations and Maps. Super Royal 8vo. 25s. net.

THE TIMES LITERARY SUPPLEMENT.—"The interest of this book is so various and it is so eminently readable that those who feel no particular concern with Arabia will find it as attractive as those who do."

A SHORT HISTORY OF MARRIAGE. By EDWARD WESTERMARCK, Ph.D., Author of "Ritual and Belief in Morocco," etc. 8vo. 10s. 6d. net.

ORIGINS OF EDUCATION AMONG PRIMITIVE PEOPLES. A Comparative Study in Racial Development. By W. D. HAMBLY, B.Sc., Anthropologist for the Wellcome Expedition to the Sudan, Assistant Curator, African Ethnology, Field Museum, Chicago. With a Preface by DR. CHARLES HOSE (of Sarawak). With Illustrations. 8vo. 25s. net.

SUNDAY TIMES.—"It is not necessary to be an anthropologist to appreciate and enjoy Mr. Hambly's most entertaining book, for it is written as much for the layman as for the student."

HOLISM AND EVOLUTION. By GENERAL THE RIGHT HON. J. C. SMUTS. 8vo. 18s. net.

THE OBSERVER.—"An important contribution to the new world-outlook that is preparing."

PROJECTIVE GEOMETRY. By CLEMENT V. DURELL, M.A., Senior Mathematical Master at Winchester College. Crown 8vo. 7s. 6d.

THE MATHEMATICAL GAZETTE, in a review of the volume of which this is an abridged form, says: "The author possesses a thorough grasp of his subject, and the power of presenting it in an eminently attractive manner. . . . The book is a notable and most attractive addition to the literature of the subject.'

ANSWERS, HINTS AND SOLUTIONS OF THE EXERCISES IN SAME. Crown 8vo. Limp Cloth. 2s. 6d.

HIGHER MATHEMATICS FOR STUDENTS OF ENGINEERING AND SCIENCE. By FREDERICK G. W. BROWN, M.Sc.(London), F.C.P., Senior Mathematical Master, West Ham Secondary School. Crown 8vo. 10s.

WORLD POWER.—"The author is quite right in the claim made in the preface 'that the book should be of service to all students reading mathematics for a degree, whether in arts, science, or engineering.' The book is an excellent one and should find a wide field of usefulness."

AN ATLAS OF HUMAN ANATOMY FOR STUDENTS AND PHYSICIANS. By CARL TOLDT, M.D., assisted by PROFESSOR A. D. ROSA, M.D. Adapted to English and American and International Terminology by M. EDEN PAUL, M.D.Brux., M.R.C.S., L.R.C.P. Revised Edition. With 1505 Illustrations. 2 vols. Demy 4to. 42s net.

CURRICULUM PROBLEMS. By THOMAS H. BRIGGS, Teachers College, Columbia University. Crown 8vo. 4s. 6d. net.

**** Send for Macmillan's Illustrated Christmas Catalogue, post free on application.***

MACMILLAN & CO., LTD., LONDON, W.C.2.

¶ **W. HEFFER & SONS, Ltd., 4 PETTY CURY, CAMBRIDGE,** will be glad to receive offers of Complete Libraries, Sets of Journals, and Smaller Collections of Books, for which they are prepared to offer full current value and pay cash.

¶ They have a very highly organised department for the supply to Librarians, Institutions, and others, of Scientific Books and Journals, both English and Foreign (new and second-hand).

¶ **CATALOGUE 269.** Scientific Books and Publications of learned Societies.

Licensed Valuers for Probate.

Telegrams and Cables: HEFFER, CAMBRIDGE. Telephone. [illegible]

That Book you want!

Foyles can supply any Scientific Book that is in print and most of those that are out of print. They have a Special Department for this class of literature under a Manager who has experience and knowledge of the Natural Sciences. Call and consult him, or write and you will get an intelligent reply. Books sent on approval. Over a million volumes Second-hand and New on every conceivable subject in stock. Twenty-one Departmental Catalogues issued, any of which will be sent gratis and post free on mentioning interests.

That Book you do not want!

Foyles will buy it.—A single volume to a library.

Expert valuers sent any distance.

FOYLES, 121 Charing Cross Road, London.

Just Issued

from the Natural History Department of

DULAU & COMPANY LTD.

54-56 Margaret St., Cavendish Square, London, W.1

CATALOGUE No. 143:

PHYTO-PATHOLOGY AND HORTICULTURE.

Post free on request.

A feature of NATURE is its Supplements—the monthly one on "Recent Scientific and Technical Books" and those published occasionally on specific pieces of scientific research. In the latter class are "Electrons, Atoms and Molecules," by Prof. T. M. Lowry (May 29), and "Some New Possibilities in Solar Research," by Dr. G. E. Hale (July 3). The numbers can be sent to any address by the publishers on receipt of the published price, plus postage.

SOTHERAN'S CATALOGUE OF SCIENCE AND TECHNOLOGY.

Already published. Part I: Sets of Scientific Periodicals. General and Collected Works (pp. 80). Part II: Mathematics (pp. 128). Part III: Astronomy, Geodesy, Chronology, Horology, and Dialling (pp. 112). Part IV: Physics, Letters A-R (pp. 112). Part V: Physics, Letters S-Z, and Supplement (pp. 56). Part VI: Geology, Meteorology and Physical Geography, Mineralogy and Crystallography; Microscopy (pp. 144). Just published: Part VII: Chemistry and Chemical Technology (pp. 208). In preparation: Part VIII: Mining and Metallurgy.

"This special catalogue of Messrs. Sotheran needs no recommendation, being well known for its valuable bibliographic notes, and the number of choice and rare books offered for sale."

NATURE.

Messrs. Sotheran are always ready to buy libraries or smaller collections of books on exact science, as well as sets of scientific periodicals. They invite correspondence in connexion with books rare and difficult to get.

HENRY SOTHERAN & CO.,

140 Strand, W.C.2, and 43 Piccadilly, W.1, London.

J. POOLE & CO.

ESTABLISHED 1854

NEW & SECOND-HAND

SCIENTIFIC AND EDUCATIONAL

BOOKSELLERS

ENQUIRIES BY LETTER RECEIVE IMMEDIATE ATTENTION

86 Charing Cross Road, London, W.C.2

CHEMICAL AND TECHNICAL BOOKS

We carry a very large stock both Second-hand and New in all departments of Technology, and can quote the best terms.

Write for Catalogue.

WILLIAM BRYCE, Scientific Bookseller,

54-54a Lothian Street, EDINBURGH.

SCIENTIFIC BOOKS

AND PERIODICALS

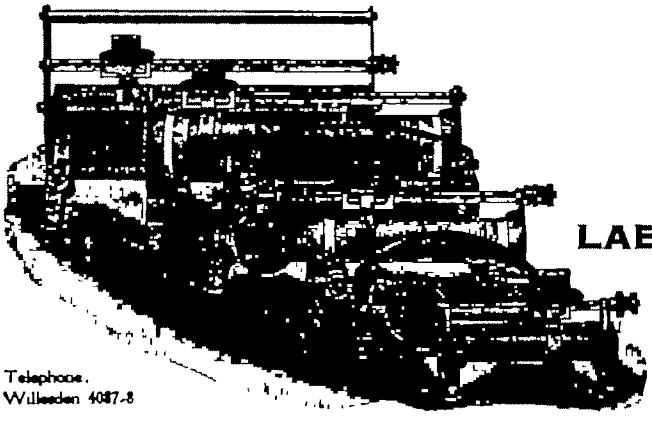
Including the Publications of the Learned Societies,

ON SALE BY

WHELDON & WESLEY Ltd.

2, 3, & 4 ARTHUR ST., NEW OXFORD ST., LONDON, W.C.2

Classified Catalogues sent post free. Books Purchased.



ZENITH

LABORATORY RESISTANCES

CATALOGUE OF ALL TYPES ON REQUEST

THE ZENITH ELECTRIC CO. LTD.

(Formerly the Zenith Manufacturing Co.)

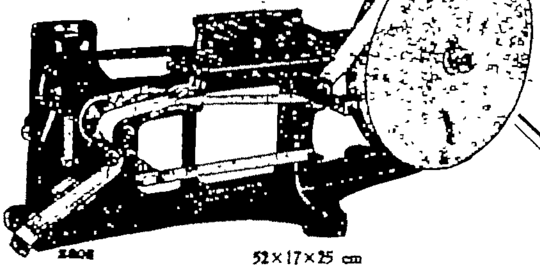
Contractors to the Admiralty, War Office, Air Ministry, Post Office, L.C.C., &c.

ZENITH WORKS, VILLIERS ROAD,

WILLESDEN GREEN, LONDON, N.W.2

Telephone.
Willesden 4087-8

THIS
CONVENIENT
CHRONOGRAPH
for
LABORATORY USE



May be used to record the occurrence of any event which can be arranged to make or break an electric circuit. Time signals at the rate of 50 per second can be recorded with an accuracy of 0·01 second. In conjunction with suitable accessories, it provides a means of taking recalescence curves.

DELIVERY FROM STOCK.

CAMBRIDGE
INSTRUMENT CO LTD
WORKS:- LONDON. & CAMBRIDGE
Head Office & Showrooms:- 45. GROSVENOR PLACE LONDON, S.W.1
AMERICAN COMPANY.
Cambridge Instrument Co., Inc., Grand Central Terminal, New York

31

CASELLA
LONDON

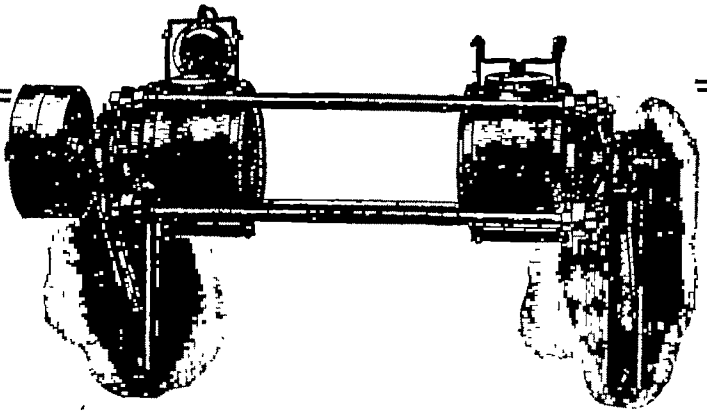
ACCURATE CHEMICAL
THERMOMETERS

Write for Catalogue
to
C. F. CASELLA & CO.
LIMITED
Parliament Street,
S.W.1

HOPKIN & WILLIAMS, Ltd.
16 & 17 Cross St., Hatton Garden, London, E.C.1
Works: Ilford, Essex.
Telegrams "Cerium, Smith, London"
Telephone: Holborn [illegible] and [illegible].

The Leading British House for
CHEMICAL REAGENTS
PURE, FINE, AND RARE CHEMICALS
Manufacturers of Guaranteed
Chemical Reagents for Analysis and Research.
Made and supplied to standards and specifications described in the publication
"Analytical Reagents: Standards and Tests."
Compiled by
EDMUND WHITE, B.Sc. (Lond.), F.I.C.
Published by
HOPKIN & WILLIAMS, LTD.
NEW EDITION, 1925.
CLOTH BOUND INTERLEAVED.
Price 1/6 post free from the Publishers.

PRINTED IN GREAT BRITAIN BY R. & R. CLARK, LTD., EDINBURGH.



MILLS & GRINDERS

We have for many years specialised in the supply of machinery for the laboratory and are in a position to give prompt delivery. Information and quotations on application. The illustration shows a porcelain jar mill at £14 : 10s. with one jar, and £5 : 16s. per additional jar.

CRUSHERS & SIFTERS

MACHINERY

FOR THE LABORATORY

You are invited to visit our Showrooms, centrally situated at five centres, where every assistance in the choice of laboratory equipment of all kinds will gladly be provided.

DELIVERY FROM STOCK &

JOHN J. GRIFFIN & SONS LTD

Kemble St
Kingsway

LONDON
W.C. . . 2

BAIRD & TATLOCK LTD

GLASGOW
45 Renfrew St
EDINBURGH
7. Teviot Place

MICROID

MANCHESTER
34. Gt. Ducie St.
LIVERPOOL
64 Brownlow Hill

HARLING'S DRAWING INSTRUMENTS

(Manufactured throughout in our London Factory and therefore guaranteed)

Have all the latest improvements and are the best quality and value possible.

Prices from 19s. per Set

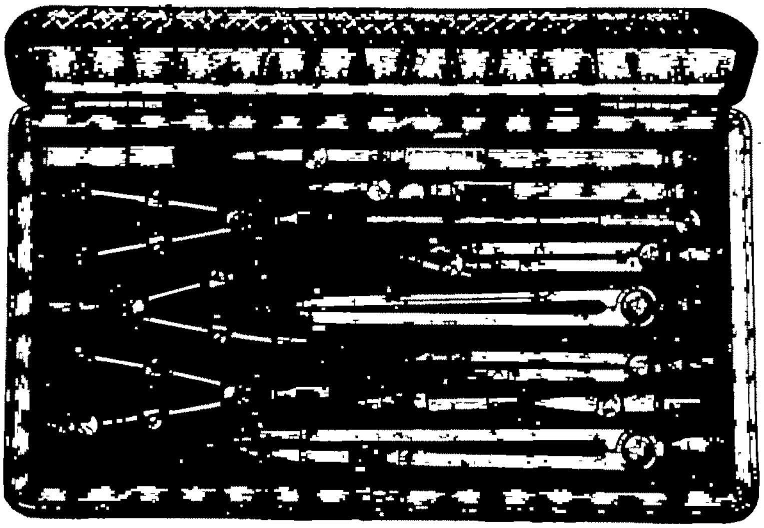
B.E 130 (as Illustrated). SNAP CASE, covered in green leather, lined velvet, containing: Half-set with lengthening bar, Hair Spring Divider, Bow Pen, Bow Pencil, three Spring Bows, two Drawing Pens, one jointed, case of leads, two spare needles and key

£4 15 0

RUSTLESS STEEL is used for the Pens, Ink Points and Spring Bows. Head Joints have CONE BEARINGS. Handles of Compasses, Bows and Dividers are SELF-CENTRING.

One customer writes respecting our new self-centring handles:

"They are quite the neatest I have seen."



NEW ADJUSTABLE PARABOLIC CURVE

10s. 6d.

See Article in the ENGINEER, May 22, 1925.

NEW HATCHETT PLANIMETER

16s.

NEW PORTABLE BEAM COMPASSES

With Duralumin Beam in three 10-inch sections.

£1 15 0

SPECIAL SETS

of instruments made up to suit individual or college requirements.

NATURE **says:** ***"All the instruments are thoroughly well made; the design is good and the instruments are suitable in a high degree to the work of an engineer's drawing office."***

ASK FOR CATALOGUES
5b (Revised edition of 5a)—Highest Grade Standard "British Empire" Drawing Instruments.
6a—"Technical School" Series of Standard "British Empire" Drawing Instruments.
8a—Drawing Scales and Boards, T and Set-Squares, Slide Rules, Eidographs, Pantographs, etc.
Post free to readers of NATURE.

W. H. HARLING, 117 MOORGATE, LONDON, E.C.2.

Established 1831. Contractor to the Admiralty, War Office, Council of India, Crown Agents for the Colonies, etc. Factory: Grosvenor Works, Clapton, E.5.

MACMILLAN'S NEW AND RECENT BOOKS.

REALITY: A NEW CORRELATION OF SCIENCE AND RELIGION. By CANON BURNETT HILLMAN STREETER. 8s. 6d. net.

This book is a plain and popular statement of a position which the author has reached after many years of reflection and much discussion with persons of different points of view.

HOLISM AND EVOLUTION. By GENERAL THE RIGHT HON. J. C. SMUTS. 8vo. 18s. net.

THE DAILY NEWS.—"A noble and suggestive book, to which justice cannot be done in a short review, but which will repay the careful study of all those concerned with the spiritual interpretation of life."

NATURAL MAN: A RECORD FROM BORNEO. By CHARLES HOSE, Hon. Sc.D., formerly Divisional Resident, and member of the Supreme Council of Sarawak. With a Preface by PROF. G. ELLIOT SMITH, F.R.S. With Illustrations and Map. Super Royal 8vo. 30s. net.

THE WESTMINSTER GAZETTE.—"The most complete and instructive study we have yet had of the people of Borneo and their way of life; and, of course, nobody but a man who has lived and worked among them as Dr. Hose has done, could have written it."

PEOPLE OF THE VEIL. Being an Account of the Habits, Organisation, and History of the Wandering Tuareg Tribes which inhabit the mountains of Air or Asben in the Central Sahara. By FRANCIS RENNELL RODD. With Illustrations and Maps. Super Royal 8vo. 30s. net.

THE WESTMINSTER GAZETTE.—"Mr. Francis Rennell Rodd's record of travel and adventure, and his character-drawing of the many strange people with whom he came in contact, make his work one of serious geographical and ethnographical value."

IN UNKNOWN ARABIA. By MAJOR R. E. CHEESMAN, O.B.E., F.R.G.S., H.M. Consul in North-west Abyssinia. With a Foreword by SIR PERCY COX, G.C.M.G. With Illustrations and Maps. Super Royal 8vo. 25s. net.

THE TIMES LITERARY SUPPLEMENT.—"The interest of this book is so various and it is so eminently readable that those who feel no particular concern with Arabia will find it as attractive as those who do."

A SHORT HISTORY OF MARRIAGE. By EDWARD WESTERMARCK, Ph.D., Author of "Ritual and Belief in Morocco," etc. 8vo. 10s. 6d. net.

ORIGINS OF EDUCATION AMONG PRIMITIVE PEOPLES. A Comparative Study in Racial Development. By W. D. HAMBLY, B.Sc., Anthropologist for the Wellcome Expedition to the Sudan, Assistant Curator, African Ethnology, Field Museum, Chicago. With a Preface by DR. CHARLES HOSE (of Sarawak). With Illustrations. 8vo. 25s. net.

SUNDAY TIMES.—"It is not necessary to be an anthropologist to appreciate and enjoy Mr. Hambly's most entertaining book, for it is written as much for the layman as for the student."

PROJECTIVE GEOMETRY. By CLEMENT V. DURELL, M.A., Senior Mathematical Master at Winchester College. Crown 8vo. 7s. 6d.

THE MATHEMATICAL GAZETTE, in a review of the volume of which this is an abridged form, says: "The author possesses a thorough grasp of his subject, and the power of presenting it in an eminently attractive manner. . . . The book is a notable and most attractive addition to the literature of the subject."

ANSWERS, HINTS AND SOLUTIONS OF THE EXERCISES IN SAME. Crown 8vo. Limp Cloth. 2s. 6d.

HIGHER MATHEMATICS FOR STUDENTS OF ENGINEERING AND SCIENCE. By FREDERICK G. W. BROWN, M.Sc.(London), F.C.P., Senior Mathematical Master, West Ham Secondary School. Crown 8vo. 10s.

WORLD POWER.—"The author is quite right in the claim made in the preface 'that the book should be of service to all students reading mathematics for a degree, whether in arts, science, or engineering.' The book is an excellent one and should find a wide field of usefulness."

AN ATLAS OF HUMAN ANATOMY FOR STUDENTS AND PHYSICIANS. By CARL TOLDT, M.D., assisted by PROFESSOR A. D. ROSA, M.D. Adapted to English and American and International Terminology by M. EDEN PAUL, M.D.Brux., M.R.C.S., L.R.C.P. Revised Edition. With 1505 Illustrations. 2 vols. Demy 4to. 42s. net.

PRINCIPLES OF GENERAL CHEMISTRY. By STUART R. BRINKLEY, Assistant Professor of Chemistry, Yale University. Illustrated. 8vo. 15s. net.

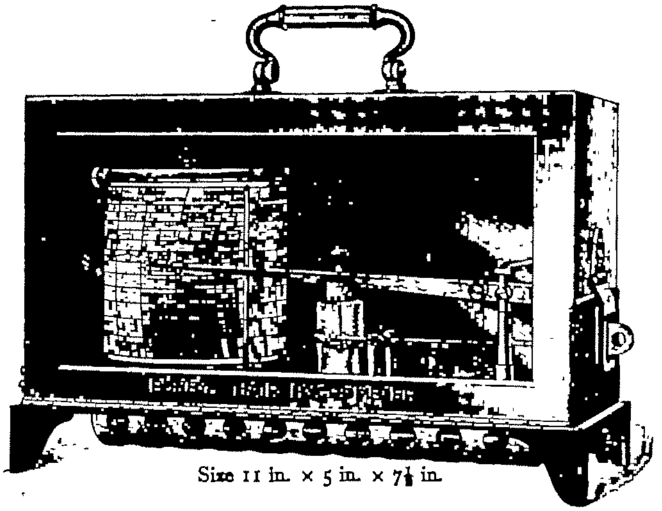
LABORATORY MANUAL. Arranged to accompany "Principles of General Chemistry." By STUART R. BRINKLEY and ERWIN B. KELSEY, Assistant Professors of Chemistry, Yale University. Illustrated. 8vo. 6s. 6d. net.

**⁎* Send for Macmillan's Illustrated Christmas Catalogue, post free on application.*

MACMILLAN & CO., LTD., LONDON, W.C.2.

"EDNEY" HAIR HYGROGRAPHS

of guaranteed accuracy



Size 11 in. × 5 in. × 7½ in.

THE "EDNEY" HAIR HYGROGRAPH

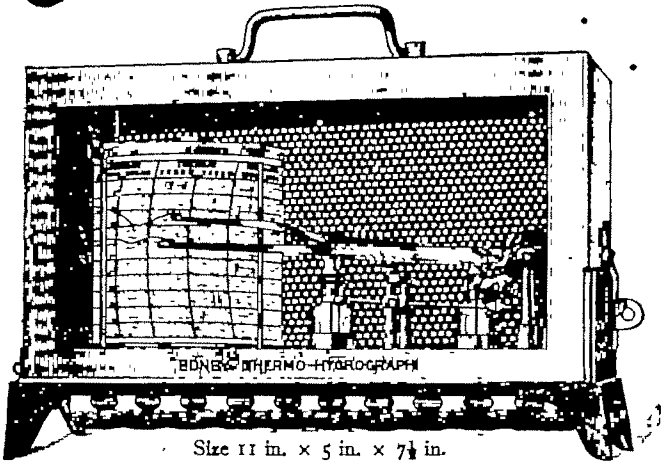
records directly the **percentage of humidity** in the atmosphere of the room or place being tested. Actuated by a string of human hair, the movement is transmitted through levers to the pen, which records on the chart the exact percentage of humidity. The chart is ranged 0-100 per cent. The Instrument is strongly mounted on cast-iron base with hinged copper cover.

Price complete, with charts for one year and bottle of ink **£8 0 0**

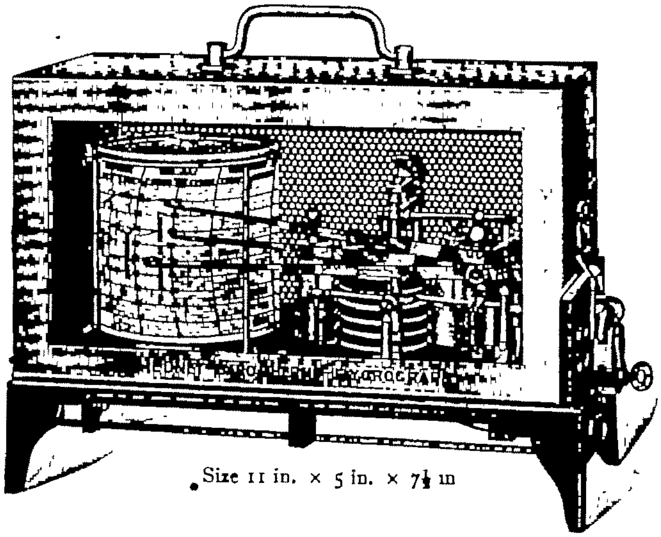
THE "EDNEY" THERMO-HYGROGRAPH

records on the same chart by different coloured inks the **temperature and humidity** of the atmosphere. The chart is ranged 0-100 Faht. and 0-100 per cent. The Instrument is strongly mounted on cast-iron base with hinged copper cover.

Price complete, with charts for one year and red and blue inks . . . **£12 12 0**



Size 11 in. × 5 in. × 7½ in.



Size 11 in. × 5 in. × 7½ in.

THE "EDNEY" BARO-THERMO-HYGROGRAPH

records on the same chart by three different coloured inks the **pressure, temperature, and humidity** of the atmosphere. The chart is ranged 28·5-31 ins., 0-100 Faht., and 0-100 per cent. The Instrument is strongly mounted on cast-iron base with hinged copper cover

Price complete, with charts for one year, and red, blue, and green inks . . **£16 16 0**

SOLE MAKERS **PASTORELLI & RAPKIN LTD.** (ESTAB. 1750), **46 Hatton Garden, LONDON, E.C.1**

Telephone: Holborn 1981] ***Any instrument sent on approval if desired.*** [*Telegrams:* Rapkin, London

Carriage paid and safe delivery of all our instruments guaranteed within the British Isles.

BLACKIE'S LIST

TWO IMPORTANT NEW BOOKS

Just Published

SPACE AND TIME

By ÉMILE BOREL

Honorary Director of L'École Normale Supérieure; Professor of Mathematical Physics in the Faculty of Sciences of Paris; Member of the Institute

Large Crown 8vo. Price **7s. 6d.** net

A semi-popular account of the Theory of Relativity by one of the most distinguished of living French mathematicians Beginning with the principles of space and time measurement, it leads up to Einstein's epoch making idea Professor Borel has specially added for the English edition an extended discussion of recent theoretical and experimental researches.

Ready shortly

THE ABSOLUTE DIFFERENTIAL CALCULUS

By TULLIO LEVI-CIVITA

Professor of Rational Mechanics in the University of Rome Fellow of the R. Accademia Nazionale dei Lincei

Demy 8vo. Price **21s.** net.

A concise and lucid account of the Calculus of Tensors by the eminent Italian mathematician who, with Ricci, discovered the method, and to whom many of its most powerful developments are solely due.

The book appeared in Italian in 1925, but the English translation has been specially revised by the author, who has contributed for the English edition two entirely new chapters on the physical applications of the method The translation has been made by Miss M. Long, equal to Fourth Wrangler in the Mathematical Tripos, Scholar of Girton College, and formerly Assistant Lecturer, Bedford College for Women.

THE CALCULUS OF OBSERVATIONS:

A Treatise on Numerical Mathematics. By E T. WHITTAKER, Sc.D., F.R.S., Professor of Mathematics in the University of Edinburgh, and G. ROBINSON, M.A., B.Sc., Lecturer in Mathematics in the University of Edinburgh. Large Demy 8vo. xvi+392 pages. **Second Edition (Third Impression). 18s. net.**

This book covers completely the course of study prescribed for London University B.Sc. Honours in Mathematics. Part II.; Pure Mathematics, Section 5.

PLANE GEOMETRY. An Account of the more Elementary Properties of the Conic Sections, treated by the Methods of Pure and Co-ordinate Geometry. By L. B. BENNY, M.A.(Cantab.), B.A.(Lond.), F.R.A.S., sometime Mathematical Scholar of Christ's College, Cambridge; Principal of Leigh Technical School, Lancs. Large Crown 8vo. **10s. 6d. net.**

This book covers one of the alternative courses in Geometry for the Pass B.Sc. Examination of the University of London in Pure Mathematics.

APPLIED CALCULUS. By F. F. P. BISACRE, O.B.E., M.A., B.Sc., A.M.Inst.C.E. Large Crown 8vo. **10s. 6d. net.**

This book has been specially written for science and engineering students who desire to acquire a working knowledge of the calculus, but whose preliminary mathematical equipment is slight.

A GENERAL TEXT-BOOK OF ELEMENTARY ALGEBRA. By E. H. CHAPMAN, M.A. (Cantab.), D.Sc.(Lond.), Headmaster, Ernest Bailey Secondary School, Matlock. With or without Answers. **7s. 6d. net.**

A complete course in Algebra for the Final B.Sc. Examination of London University.

Write for New Catalogue of Advanced Scientific and Technical Books.

BLACKIE AND SON, LIMITED
50 Old Bailey, London, E.C.4.

JOHN MURRAY

By VISCOUNT HALDANE

Human Experience: A Study of its Structure. "Full of that quiet scholarship, sound reasoning, and swift mastery of a problem characteristic of the author." —*Daily Telegraph.* **6s.** net.

The Reign of Relativity. As a result of conversations with Professor Einstein, Lord Haldane has added fresh paragraphs to this new edition. Fourth Edition. **21s.** net.

The Philosophy of Humanism and of other Subjects. An admirable sequel to "The Reign of Relativity."—*Manchester Guardian.* **12s.** net.

By Prof. FREDERICK SODDY, M.A., F.R.S.

The Interpretation of Radium and the Structure of the Atom. "Admirably conceived."—*Spectator.* Fourth Edition. Revised and Enlarged. With Illustrations. **15s.** net.

Science and Life. Aberdeen Addresses. "We are the Professor's debtor for a most suggestive book."—*Morning Post* Third Impression. **10s. 6d.** net.

Cloud Studies. By ARTHUR W. CLAYDEN. Second Edition. Re-arranged and Enlarged. 64 Illustrations. **15s.** net

Heredity. By J. A. THOMSON, M.A., LL.D. New and Fifth Edition. Thoroughly Revised. **21s.** net.

Variation, Heredity and Evolution, Recent Progress in the Study of. By R. H. LOCK, M.A., Sc.D. Fifth Edition. Revised by LEONARD DONCASTER, Sc.D., F.R.S. With Portraits and Diagrams. **9s.** net.

Mechanism, Life and Personality. An Examination of the Mechanistic Theory of Life and Mind. By J. S. HALDANE, M.D., LL.D., F.R.S., University of Oxford Second Edition. **6s.** net.

Practical Zoology, A Junior Course of. By the late Prof. A. MILNES MARSHALL, M.D., D.Sc., F.R.S., and the late HERBERT HURST, M.D. Ninth Edition Revised by Prof. F. W. GAMBLE, D.Sc., F.R.S., University of Birmingham. **12s.** net.

The Realm of Nature. An Outline of Physiography. By H. R. MILL, D.Sc., LL.D. Third Edition (Tenth Impression). Revised and entirely Reset. **7s. 6d.** net.

Microscopy. The Construction, Theory and Use of the Microscope. By EDMUND J. SPITTA, F.R.A.S., F.R.M.S. Diagrams and Illustrations. Third Enlarged Edition. **25s.** net.

Physical Science, The Recent Development of. By WILLIAM C. DAMPIER WHETHAM, M.A., F.R.S. Fifth Edition Entirely Revised and greatly Enlarged. **9s.** net

Splendours of the Sky. By ISABEL M. LEWIS. "Her object has certainly been pleasantly fulfilled, without the slightest loss of accuracy." —*Morning Post.* Illustrated. **9s.** net.

John Murray, Albemarle St., London, W.1

Recent Scientific and Technical Books.

*Volumes marked with an asterisk have been received at "*NATURE*" Office.*

Mathematics: Mechanics: Physics

Ballard, P. B. Fundamental Arithmetic Large Cr. 8vo. Book 1. Answers only. 7*d* net. Book 2. Answers only. 7*d*. net Book 3. Answers only. 8*d*. net. Teacher's Book 4, with Notes and Answers. Pp. 79. 2*s*. 3*d*. (London: University of London Press, Ltd., 1926.)

Barkla, C. G., and Carse, G. A. Notes on Practical Physics. for Junior Students. Second edition. Demy 8vo. Pp. xii+119 (London and Edinburgh: Gurney and Jackson, 1926.) 6*s*. 6*d* net.*

Becquerel, Jean. Cours de physique à l'usage des élèves de l'enseignement supérieur et des ingénieurs Tome 2: Élasticité acoustique. Roy 8vo. Pp. ii+427. (Paris: J. Hermann, 1926.) 6*s*.*

Borchardt, W. G. Elementary Arithmetic. Cr. 8vo. Pp xii+259+xxxii+xxvi. (London: Rivingtons, 1926.) 3*s*.

Borel, Émile. Traité du calcul des probabilités et de ses applications Tome 2: Les applications de la théorie des probabilités aux sciences mathématiques et aux sciences physiques Fasc. 1: Applications à l'arithmétique et à la théorie des fonctions; leçons professées par É Borel, rédigées par P. Dubreil. 8vo. Pp. 100. 17 francs Tome 4: Applications diverses et conclusion. Fasc. 1 Applications au tir, par J. Haag. 8vo. Pp. 184. 25 francs (Paris: Gauthier-Villars et Cie, 1926.)

Bouligand, G., et Rabaté, G. Initiation aux méthodes vectorielles et aux applications géométriques de l'analyse, à l'usage des élèves de mathématiques spéciales et des élèves des Facultés des Sciences 8vo. Pp 215. (Paris: Libr. Vuibert, 1926.) 28 francs.

Boutaric, A. Thermodynamique et chimie. D'après la deuxième édition de l'ouvrage de Pierre Duhem Roy. 8vo Pp. vi+651. (Paris: J. Hermann, 1926.) 70 francs *

Brown's Completed Burdwood Azimuth Tables: Computed for Intervals of Four Minutes New edition, revised and enlarged. Roy. 8vo. Pp' 346. (Glasgow: J. Brown and Son, Ltd., 1926.) 10*s*. 6*d* net.

Court, Lilian. A Civil Service Arithmetic. Cr. 8vo. Pp. 160. (London and New York: The Gregg Publishing Co., Ltd., 1926.) 2*s*. 6*d*.

Du Pasquier, L.-Gustave. Le calcul des probabilités: son évolution mathématique et philosophique. Roy. 8vo. Pp. xxi+304. (Paris: J Hermann, 1926.) 49 francs.*

Durell, Clement V. Projective Geometry. Cr. 8vo. Pp. x+222. (London: Macmillan and Co, Ltd., 1926.) 7*s*. 6*d*.*

Edser, Edwin. General Physics for Students: a Text-Book on the Fundamental Properties of Matter. Reprinted, with additions. Gl. 8vo. Pp. ix+676. (London: Macmillan and Co., Ltd., 1926.) 8*s*. 6*d*.*

Egnell, Axel. L'ochématique (le calcul vectoriel): ses applications géométriques et ses rapports avec le calcul différentiel absolu. 8vo. Pp. xiv+572 (Paris: Gauthier-Villars et Cie, 1926.) 80 francs.

Elliott, T. C. J. The Dial Machine. an Apparatus for the Elementary Mathematical Laboratory. Cr. 8vo. Pp. 98. (Peterborough: The Peterborough Press, Ltd, 1926.) 4*s*. 6*d*.*

Eyraud, Henri. Les équations de la dynamique de l'éther, avec un note sur la technique du repérage de l'espace et du temps dans ses rapports avec la relativité. Roy. 8vo. Pp. iii+67. (Paris: Albert Blanchard, 1926.) 12 francs.*

Forestier, A. L'énergie rayonnante: tableaux synoptiques de l'échelle des longueurs d'onde et des principales caractéristiques de rayonnement électromagnétique, avec un résumé des théories actuelles. Deuxième édition augmentée des travaux les plus récents. Imp. 8vo. Pp. 75. (Paris: Albert Blanchard, 1926.) 20 francs.*

Gay, L. Les mathématiques du chimiste. Roy 8vo. Pp. vii+208. (Paris: J. Hermann, 1926.) 3*s*. 8*d*.*

Gibbs, R. W. M., and Richards, G. E. Mathematical Tables: with Full Tables of Mathematical and General Constants. Second edition, revised. Fcap. 4to. Pp. 16. (London: Christophers, 1926.) 8*d*.

Gonseth, F. Les fondements des mathématiques: de la géométrie d'Euclide à la relativité générale et à l'intuitionisme. Roy. 8vo. Pp. xiv+243. (Paris: Albert Blanchard, 1926.) 25 francs *

Hillier, I. L. The "Individual" Arithmetic: a Four Years' Course of Assignments. Fourth year, Contract 4: Individual Work Assignments. Edited by A. J Lynch. Gl. 8vo. Pp. 94. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd, 1926.) 10*d*

Howard, B. A. School Trigonometry. Part 2. Cr. 8vo. Pp. vi+85-174. (London: Ginn and Co, Ltd., 1926.) 1*s*. 9*d*.

Hughes, H. The "Short Methods" Mental Arithmetic. Cr. 8vo. Part 1: Junior and Intermediate Grades Pp. 80. Part 2: Senior Grade. Pp. 85. (Exeter: A. Wheaton and Co., Ltd, 1926.) 1*s*. 6*d*. net each.

Hutchinson, Robert W. Junior Technical Electricity. Second edition. Cr 8vo. Pp viii+385. (London: University Tutorial Press, Ltd, 1926.) 4*s*. 6*d* *

Institute of Physics. Physics in Industry: Lectures delivered before the Institute of Physics. Vol 4. Lecture 8: Physics in the Rubber Industry, with Special Reference to Tyre Manufacture, delivered in the Rooms of the Royal Society, London, on 29th April 1925, by Walter Makower; Lecture 9: The Physicist in Agriculture, with Special Reference to Soil Problems, delivered in the Rooms of the Chemical Society, London, on 25th November 1925, by Bernard A Keen. Roy. 8vo. Pp. 63+4 plates. (London: Oxford University Press, 1926.) 3*s*. net.*

Klein, Felix. Vorlesungen uber die Entwicklung der Mathematik im 19 Jahrhundert Teil 1. Für den Druck bearbeitet von R Courant und O Neugebauer. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen, Band 24.) Pp. xiv+386. (Berlin: Julius Springer, 1926.) 21 gold marks.

Knight, Charles K. Advanced Life Insurance: with Illustrations of the Principles and Practices of Actuarial Science Med. 8vo. Pp. xi+426. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 25*s*. net.*

Lay, Ed. J. S. The Pupils' Class-Book of Arithmetic. Teacher's Book 7. Cr 8vo. Pp. 418. (London: Macmillan and Co., Ltd., 1926.) 3*s*. 6*d*

Levi-Cività, Tullio, e Amaldi, Ugo. Lezioni di meccanica razionale Volume secondo: Dinamica dei sistemi con un numero finito di gradi di libertà. Parte prima. Roy. 8vo. Pp x+527. (Bologna: Nicola Zanichelli, 1926.) 65 lire.*

Livens, G. H. The Theory of Electricity. Second edition Demy 8vo Pp. vi+427. (Cambridge: At the University Press, 1926.) 16*s*. net.*

Neugebauer, Otto. Die Grundlagen der ägyptischen Bruchrechnung. 4to. Pp v+44+8 Tafeln. (Berlin: Julius Springer, 1926.) 7.50 gold marks

Peirce, Benjamin Osgood. Mathematical and Physical Papers, 1903–1913. Med. 8vo. Pp. viii+444. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1926.) 21*s*. net.*

Ponton, D. Stories about Mathematics-Land. Book 1. Cr. 8vo. Pp. 186 (London and Toronto. J. M. Dent and Sons, Ltd., 1926.) 3*s*. 6*d*.

Research Department, Woolwich. R.D. Report No 68. Portable X-ray Equipment Roy. 8vo. Pp. 9+5 plates. (London: H.M. Stationery Office, 1926.) 1*s*. 6*d*. net.*

Siddons, A. W., and Hughes, R. T. Notes and Answers to Exercises in "Junior Geometry." Cr. 8vo. Pp. 22. (Cambridge: At the University Press, 1926.) 1*s*.

Sommerfeld, Arnold. Three Lectures on Atomic Physics. Translated by Henry L Brose. Cr. 8vo. Pp. iv+70. (London: Methuen and Co., Ltd., 1926.) 2*s*. 6*d*. net.*

Tombrook, W. Miller's Experiments and the Constitution of Matter: a Hypothesis. Translated from the Dutch. Demy 8vo. Pp. 25. (Bergen op Zoom, Holland: P. Harte, 1926.) *

Engineering

Abell, T. B. Stability and Seaworthiness of Ships: a Text-Book for Officers of the Mercantile Marine and for all concerned with the Loading of Ships. Demy 8vo Pp. viii+297. (London: Hodder and Stoughton, Ltd., 1926.) 18*s*. net.

Barman, Christian. The Bridge: a Chapter in the History of Building. Ex. Cr. 4to. Pp. xvii+249 (London: John Lane, The Bodley Head, Ltd., 1926) 31*s*. 6*d* net

Brough, Bennett H., and **Dean, Harry.** A Treatise on Mine-Surveying. Seventeenth edition, revised by Henry Louis. Cr. 8vo. Pp. 491 (London: Charles Griffin and Co., Ltd., 1926.) 10*s* 6*d*. net.

Cotton, H. Electrical Technology: a Text-book for the following Examinations—National Certificate, City and Guilds, A.M.I.E.E, B.Sc Engineering In 8 weekly Parts. Demy 8vo Part 1. Pp xv+48 (London: Sir Isaac Pitman and Sons, Ltd., 1926) 1*s*. net each part.*

Cross, Harold H. U. Electric Lighting Starting and Ignition for Motor Cars. Fourth edition, enlarged. Demy 8vo. Pp. 372. (London: Crosby Lockwood and Son, 1926.) 15*s*. net.

Dubbel, Heinrich. Öl- und Gasmaschinen (Ortfeste und Schiffsmaschinen): ein Handbuch fur Konstrukteure, ein Lehrbuch fur Studierende. (Berlin: Julius Springer, 1926.) 37 50 gold marks.

Ewing, Sir J. Alfred. The Steam-Engine and other Heat-Engines. Fourth edition, revised and enlarged. Med. 8vo. Pp. viii+662. (Cambridge: At the University Press, 1926) 25*s* net.*

Fischer-Hinnen, J. Électrotechnique des praticiens: avec nombreux exemples de calculs et d'essais de machines et transformateurs. Traduit de l'allemand par P. Gaibrois Roy. 8vo. Pp xviii+624 (Paris: Libr Dunod, 1926) 68 francs

Foerster, E. Nordamerikanische Seehafentechnik. (Sonderabdruck aus "Werft, Reederei, Hafen," Hefte 17, 18, 20, 22, 23, 24, 1925, und Hefte 2, 4, 6, 10, 12, 15, 16, 17, 1926.) 4to. Pp. 74. (Berlin: Julius Springer, 1926.) 7 50 gold marks.

Franklin, William S., and **Terman, Frederick E.** Transmission Line Theory and some related Topics. Demy 8vo. Pp. 320. (London: Constable and Co, Ltd., 1926.) 10*s*. net

Frick, P., et **Canaud, J.-L.** Tracé et terrassements. (Bibliothèque de l'ingénieur des travaux publics.) Deuxième édition, par R. Guillemont. Cr. 8vo. Pp. viii+704+2 planches. (Paris; Libr Dunod, 1926.) 56 francs.

Gibson, Charles R. Machines and how they Work: all Explained in an Easy Fashion, showing in many Cases how the Machines came About. (Science for Children Series.) Cr. 8vo. Pp. 249+8 plates. (London: Seeley, Service and Co., Ltd., 1926.) 5*s* net.

Graffigny, H. de. Le petit constructeur mécanicien. Pp 245. (Paris: Libr. Desforges; Girardot et Cie, 1926.) 15 francs.

Greenhalgh, Richard, Edited by. Pitman's Building Educator. Complete in 30 fortnightly Parts. Part 1 Cr. 4to. Pp. ii+56. (London: Sir Isaac Pitman and Sons, Ltd, 1926.) 1*s*. 3*d* net each part.*

Gutton, C. Radiotechnique générale. (Grandes Encyclopédies industrielles.) Roy. 8vo. Pp. 572. (Paris: J.-B. Baillière et fils, 1926.)

Heldt, P. M. The Gasoline Automobile: its Design and Construction. Vol. 1: The Gasoline Engine Seventh edition. (Nyack, N.Y.: P M Heldt; London: Iliffe and Sons, Ltd., 1926) 40*s*. net.

Hovey, Otis Ellis. Movable Bridges. Vol. 1: Superstructure. Demy 8vo. Pp 352 (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 30*s*. net

Jolley, L. B. W. Alternating Current Rectification and Allied Problems: a Mathematical and Practical Treatment from the Engineering View-Point. Second edition, revised and enlarged. Demy 8vo Pp. xxxi+472+27 plates. (London: Chapman and Hall, Ltd., 1926) 40*s*. net.*

Kármán, Th. von, Herausgegeben von Abhandlungen aus dem Aerodynamischen Institut an der technischen Hochschule, Aachen. Heft 7: Über die Grundlagen der Balkentheorie, von Th. von Kármán; Die Spannungen und Formänderungen von Balken mit rechteckigem Querschnitt, von Friedrich Seewald; Stegbeanspruchung hoher Biegungstrager, von Ilse Kober. 4to. Pp. 42. (Berlin: Julius Springer, 1926) 4.50 gold marks.

Krey, H. Erddruck, Erdwiderstand und Tragfähigkeit des Baugrundes. (Berlin: Julius Springer, 1926.) 21 gold marks.

Lamb, David R. Modern Railway Operation. (Pitman's Transport Library.) Demy 8vo. Pp. xiii+169. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 7*s* 6*d*. net.

Lombardi, L. Corso teorico-pratico di elettrotecnica. Vol. 1. Pp xii+642. 70 lire. Vol. 2. Pp. xi+869. 100 lire (Milan: F. Vallardi, 1926.)

Mathis, A.-R. Deuxièmes notes sur les huiles pour transformateurs. Roy. 8vo. Pp. xii+196 (Paris: Libr. Dunod, 1926.) 82 francs.

Maycock, W. Perren. Electric Lighting and Power Distribution. Vol. 1. Revised by C. H. Yeaman. Ninth edition. Cr. 8vo. Pp. xiii+562. (London: Sir Isaac Pitman and Sons, Ltd, 1926) 10*s*. 6*d*. net.

Monkswell, Lord. The Railways of Great Britain. New edition. Demy 8vo. Pp. 254. (London: Geoffrey Bles, 1926.) 12*s* 6*d*. net.

Munro's Marine Engineers' Annual Pocket Log and Diary, 1927. Cr. 8vo. Pp. 312. (Glasgow: J. Munro and Co., Ltd., 1926.) 2*s*. 6*d*. net.

Ostertag, P. Les cycles frigorifiques: fonctionnement des machines et installations frigorifiques exposé à l'aide du diagramme entropique. Traduit sur la deuxième édition allemande revue et augmentée par E. Prior. Roy. 8vo. Pp. x+172. (Paris: Libr. Dunod, 1926.) 38 francs.

Pacoret, E. Aide-mémoire-formulaire de la T S F., théorique et pratique: radiotélégraphie, radiotéléphonie, radiotélémécanique, radiotélévision. Large Gl. 8vo. Pp. xv+577. (Paris: Albert Blanchard, 1926.) 32 francs*

Pearson, S. O., Compiled by Dictionary of Wireless Technical Terms: Definitions of Terms and Expressions commonly used in Wireless Telegraphy and Telephony. Demy 18mo Pp. 254. (London: Iliffe and Sons, Ltd., 1926.) 2*s*. net.

Pounder, C. C. Crankshaft Design. (London: The Association of Engineering and Shipbuilding Draughtsmen, 1926.) 2*s*.

Priester, Hans E. Der Wiederaufbau der deutschen Handelsschiffahrt. (Berlin: Julius Springer, 1926.) 10 50 gold marks

Pritchard, Capt. J. Laurence. The Book of the Aeroplane. Cr. 8vo. Pp. 255+24 plates (London: Longmans, Green and Co., Ltd, 1926.) 7*s*. 6*d*. net.*

Rabozée, H. Cours de résistance des matériaux. Roy. 8vo. Pp. 984. (Paris: Libr. Dunod, 1926.) 130 francs.

Roberjot, P. Cours élémentaire d'électricité industrielle. Ex. Cr. 8vo Pp xvi+491 (Paris: Libr. Dunod, 1926) 18 francs.

Rousselet, Louis, et **Petitet, Aimé.** Stabilité des constructions usuelles: calculs algébriques et graphiques des efforts dans l'ossature principale. Deuxième édition revue, corrigée et augmentée. Ex Cr. 4to. Pp. vi+329 (Paris: Libr. Dunod, 1926.) 56 francs.

Schmid, Hanns. Statische Probleme des Tunnel- und Druckstollenbaues und ihre gegenseitigen Beziehungen: Gleichgewichtsverhältnisse im massiven und kreisförmig durchorterten Gebirge und deren Folgeerscheinungen; Spannungsverhaltnisse unterirdischer Gewolbebauten. (Berlin: Julius Springer, 1926) 8.40 gold marks.

Seiler, E. Elektrische Zundung, Licht und Anlasser der Kraftfahrzeuge. (Halle a S: Wilhelm Knapp, 1926.) 7 60 gold marks

Slichter, W. I. Principles underlying the Design of Electrical Machinery 8vo. (London: Chapman and Hall, Ltd., 1926) 18*s* 6*d* net.

Smith, Ernest F. Rotary and Motor Converters: for Operators and Attendants. Cr. 8vo. Pp. 245. (London: Crosby Lockwood and Son, 1926.) 7*s*. 6*d*. net.

Spreen, Wilhelm. Stromquellen fur den Röhrenempfang (Heiz- und Anodenbatterien). (Bibliothek des Radio-Amateurs, Band 6.) Zweite, erweiterte Auflage. 8vo. Pp. 79. (Berlin: Julius Springer, 1926.) 2.25 gold marks.

Vieweger, H. Recueil de problèmes avec solutions sur l'électricité et ses applications pratiques. Traduction française de G. Capart. Cinquième édition. Pp. xviii + 442 + 2 planches. (Paris: Libr. Dunod, 1926.) 48 francs.

Watkins, J. H. Successful Crystal and One-Valve Circuits: a Book for Wireless Experimenters and all who wish to improve the Performance of their Crystal Receivers. Cr. 8vo. Pp. xi + 104. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 3*s*. 6*d*. net.

Webber, Harry. Simple Facts about Electricity: for House and Workshop. Cr. 8vo. Pp. 102. (Keighley: Wadsworth and Co., 1926.) 1*s*. 9*d*.

Wilson, F. S. Fellowes. The Largest Ships of the World. Roy. 8vo. Pp. 239. (London: Crosby Lockwood and Son, 1926.) 10*s*. 6*d*. net.

Chemistry: Chemical Industry

Adie, R. H. Chemistry for Agricultural Students. Cr. 8vo. Pp. vii + 357. (London: University Tutorial Press, Ltd., 1926.) 5*s*. 6*d*.

Barry, T. Hedley; Drummond, Alan A., and **Morrell, R. S.** The Chemistry of the Natural and Synthetic Resins. (Oil and Colour Chemistry Monographs.) Roy. 8vo. Pp. viii + 196. (London: Ernest Benn, Ltd., 1926.) 21*s*. net.*

Berner, Endre. A Contribution to the Thermochemistry of Organic Compounds. Pp. 134. (Oslo: Morten Johansens Boktrykkeri, 1926.)

Briggs, Dennis Brook. Classified Problems in Chemistry. Cr. 8vo. Pp. viii + 152. (London: Sidgwick and Jackson, Ltd., 1926.) 3*s*. 6*d*.*

Brockman, C. J. Electro-Organic Chemistry. Roy. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 25*s*. net.

Caven, R. M. Gas and Gases. (Home University Library of Modern Knowledge.) Fcap. 8vo. Pp. 256. (London: Williams and Norgate, Ltd.; New York: Henry Holt and Co., 1926.) 2*s*. net.

Chapelet, A. Blanchiment. Deuxième édition. Pp. 359. (Paris: Gauthier-Villars et Cie, 1926.) 52 francs.

Cooper, William C. Qualitative Analysis. (New-World Science Series.) Ex. Cr. 8vo. Pp. viii + 142. (Yonkers-on-Hudson, N.Y.: World Book Co., 1926.) 1.52 dollars.

Cushny, Arthur R. Biological Relations of Optically Isomeric Substances. 8vo. (London: Baillière, Tindall and Cox, 1926.) 9*s*. net.

Deming, Horace G., and **Arenson, Saul B.** Exercises in General Chemistry and Qualitative Analysis. Second edition, revised. Med. 8vo. Pp. xii + 282. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 9*s*. net.*

Doyle, Aida M., Prepared by. Digest of Patents relating to Coal-tar Dyes and Allied Compounds. 8vo. Pp. vii + 585. (Easton, Pa.: The Chemical Publishing Co., 1926.) 20 dollars.

Eggert, John. Lehrbuch der physikalischen Chemie in elementarer Darstellung. Roy. 8vo. Pp. x + 538. (Leipzig: S. Hirzel, 1926.) 24 gold marks.

Friend, J. Newton, Edited by. A Text-Book of Inorganic Chemistry. Vol. 7, Part 3: Chromium and its Congeners. By Reece H. Vallance and Arthur A. Eldridge. Med. 8vo. Pp. xxvi + 380. (London: Charles Griffin and Co., Ltd., 1926.) 18*s*. net.*

Gattefossé, R.-M. Distillation des plantes aromatiques et des parfums. 8vo. Pp. 152. (Paris: Libr. Desforges; Girardot et Cie, 1926.) 16.50 francs.

Giua, Mich. Sviluppo storico dell' atomistica e della dottrina della valenza. Roy. 8vo. Pp. 140. (Torino: Unione tipografico-editrice torinese, 1926.)

Gmelin. Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. Unter beratender Mitwirkungen von Franz Peters. System-Nummer 5: Fluor. Sup. Roy. 8vo. Pp. xvi + 86. System-Nummer 13: Bor. Sup. Roy. 8vo. Pp. xix + 142. (Leipzig und Berlin: Verlag Chemie G.m.b.H., 1926.) *

Hawley, L. F., and **Wise, L. E.** The Chemistry of Wood. (American Chemical Society Monograph Series.) Pp. 334. (New York: The Chemical Catalog Co., Inc., 1926.) 6 dollars.

Hedges, E. S., and **Myers, J. E.** The Problem of Physico-Chemical Periodicity. Demy 8vo. Pp. 95 + 2 plates. (London: Edward Arnold and Co., 1926.) 7*s*. 6*d*. net.*

Hopper, I. Vance, and **Cumming, William M.** Practical Organic Chemistry: for Students of Pharmacy and Medicine. Cr. 8vo. Pp. 127. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1926.) 4*s*.

Howe, Harrison E. Chemistry in the World's Work. (Library of Modern Sciences.) Demy 8vo. Pp. vii + 244 + 26 plates. (London: Chapman and Hall, Ltd., 1926.) 15*s*. net.*

Keghel, Maurice de. La fabrication des colles. Pp. 701. (Paris: Gauthier-Villars et Cie, 1926.)

Liesegang, E. Kolloidchemie. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, Band 6.) Zweite Auflage. Pp. xii + 176. (Dresden und Leipzig: Theodor Steinkopff, 1926.) 8 gold marks.

Lorentz, Richard, und **Eitel, Wilhelm.** Pyrosole: das kolloide Phanomen in der gluhend flussigen Materie und seine Erstarrungszustande. Unter Berucksichtigung des latenten photographischen Bildes. (Kolloidforschung in Einzeldarstellungen, Band 4.) Med. 8vo. Pp. ix + 290 + 20 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 20 gold marks.*

Lowy, Alexander, and **Baldwin, Wilmer E.** A Laboratory Book of Elementary Organic Chemistry. Demy 4to. Pp. ix + 182. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 15*s*. net.*

Mines Department: Safety in Mines Research Board. Paper No. 28: The Spontaneous Combustion of Coal; the Most Readily Oxidizable Constituents of Coal. By W. Francis and R. V. Wheeler. Roy. 8vo. Pp. 51. (London: H.M. Stationery Office, 1926.) 1*s*. 6*d*. net.*

Oppenheimer, C., und **Pincussen, L.,** Herausgegeben von. Tabulae Biologicae. Ed. W. Junk. Band 3: Allgemeine Chemie, konstanten chemischer Verbindungen, Chemie der Organe, Stoffwechsel, Grosse und Massenverhaltnisse beim Menschen, Pharmakologie, Immunitat. Sup. Roy. 8vo. Pp. vi + 829. (Berlin: W. Junk, 1926). 63*s*.*

Ostwald, Wolfgang, with the Collaboration of **Wolski, P.,** and **Kuhn, A.** Practical Colloid Chemistry. Translated by I. Newton Kugelmass and Theodore K. Cleveland. Cr. 8vo. Pp. xvi + 191. (London: Methuen and Co., Ltd., 1926.) 7*s*. 6*d*. net.*

Palmer, Leroy S. Laboratory Experiments in Dairy Chemistry. Roy. 8vo. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 7*s*. 6*d*. net.

Plimmer, R. H. A. Practical Organic and Bio-Chemistry. New edition. Roy. 8vo. Pp. x + 568. (London: Longmans, Green and Co., Ltd., 1926.) 21*s*. net.*

Rehwald, Felix. Starch-Making and the Manufacture of Dextrin, Starch Sugar, Syrup and Sugar Colouring: a Handbook for Starch, Dextrin and Starch-Sugar Manufacturers. Translated from the fifth revised German edition by Chas. Salter. Demy 8vo. Pp. viii + 264. (London: Scott, Greenwood and Son, 1926.) 12*s*. 6*d*. net.*

Remington's Practice of Pharmacy. Seventh edition, by E. Fullerton Cook and C. H. Lawall, with Collaborators. Roy. 8vo. Pp. xxiv + 2090. (Philadelphia and London: J. B. Lippincott Co., Ltd., 1926.) 45*s*. net.

Rosenthal und Co. A-G., Ph. Mitteilungen der Porzellanfabrik. Heft 9: Über die Durchschlagsspannung und den Verlustwinkel bei festen Isolatoren. Von Kurt Draeger. Erster Teil. 8vo. Pp. ii + 30. (Berlin: Julius Springer, 1926.) 1.80 gold marks.

Scott, Wilfred W. Inorganic Quantitative Chemical Analysis: a Laboratory Manual for Colleges. 8vo. Pp. vi + 178. (Easton, Pa.: The Chemical Publishing Co., 1926.) 2.50 dollars.

Sears, Géo. W. A Systematic Qualitative Chemical Analysis: a Theoretical and Practical Study of Analytical Reactions of the more common Ions of Inorganic Substances. Second edition, revised. Med. 8vo. Pp. x + 165. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 10*s*. net.*

Southcombe, J. E. Chemistry of the Oil Industries. (Outlines of Industrial Chemistry.) Second edition, revised and enlarged Demy 8vo. Pp. xi + 224. (London: Constable and Co., Ltd , 1926.) 12*s*. 6*d*. net.*

Stock, Alfred, und **Stähler, Arthur.** Praktikum der quantitativen anorganischen Analyse. Dritte, durchgesehene Auflage. Unveranderter Neudruck. 8vo. Pp. viii + 142. (Berlin: Julius Springer, 1926.) 4 20 gold marks.

Teed, Frank L. Volume Alterations on and in Solution. Cr. 8vo. Pp. x + 62. (London: H. K. Lewis and Co., Ltd., 1926.) 3*s*. 6*d*. net.*

Thorpe, Jocelyn Field, and **Whiteley, Martha Annie.** A Student's Manual of Organic Chemical Analysis: Qualitative and Quantitative. Re-issue with Appendix on New Methods of Organic Analysis, by H. ter Meulen and J. Heslinga. Roy. 8vo. Pp. x + 250. (London: Longmans, Green and Co , Ltd., 1926.) 9*s* net.*

Wiborg, Frank B. Printing Ink, a History: with a Treatise on Modern Methods of Manufacture and Use. Demy 8vo. Pp. xx + 299. (New York and London: Harper and Bros., 1926.) 16*s*. net.

Wood, Jr., Horatio C., and **La Wall, Charles H.,** Edited by; with the assistance of Youngken, H. W., Anderson, J. F., and Griffith, Ivor. The Dispensatory of the United States of America. Pp. 1790. (Philadelphia and London: J. B. Lippincott Co , 1926.) 65*s*. net.

Wood, John K. The Chemistry of Dyeing (Chemical Monographs, No. 2.) New and revised edition. Cr. 8vo. Pp. viii + 104. (London: Gurney and Jackson, 1926.) 3*s*. 6*d*. net.*

Technology

Adam, Hugh M., and **Evans, James H.** Metal-Work. Second edition. Cr. 8vo. Pp. viii + 277. (London: Edward Arnold and Co., 1926.) 6*s*. 6*d*. net.*

Bordeaux, Alb. L'or et l'argent. (Grandes Encyclopédies industrielles.) Roy. 8vo. Pp. 596. (Paris: J.-B. Baillière et fils, 1926.)

Caldecott, W. A., and others. A Text-Book of Rand Metallurgical Practice. Third edition, revised. Vol. 1. 8vo. (London: Charles Griffin and Co., Ltd., 1926.) 30*s* net.

Chaplet, A. Pour le cimentier, amateur ou professionnel. procédés, recettes, formules, tours de mains, conseils et 'trucs' divers pour la confection des travaux de ciment et de béton armé. Cr. 8vo. Pp. viii + 148. (Paris: Libr. Dunod, 1926.) 11 francs.

Frick, P. Fouilles et fondations. Deuxième édition, mise à jour par Paul Levy-Salvador. Gl 8vo. Pp. viii + 560. (Paris: Libr. Dunod, 1926.) 49.50 francs

Fritz, Felix. Das Linoleum und seine Fabrikation: mit besonderer Berucksichtigung seiner Geschichte, Eigenschaften und Verwendung. Pp. 384. (Berlin: Alfred Weber, 1926.) 25 gold marks.

Gnehm. Manuel du teinturier. Édition française entièrement remaniée par Raoul de Muralt. Cr. 8vo Pp. xvi + 400. (Paris: Libr. Dunod, 1926) 52 francs

Goodyear, Frederick. Printing and Book Crafts for Schools. Demy 8vo. Pp. 214 (London, Calcutta and Sydney: George G. Harrap and Co , Ltd., 1926) 10*s*. 6*d*. net.

Gueldon, J. Réparation, montage et réglage des instruments de pesage usuels. Ex. Cr. 8vo. Pp. 198. (Paris: Libr. Dunod, 1926.) 18 francs.

Jennings, Arthur Seymour. Paint and Colour Mixing: a Practical Handbook for Painters, Decorators, Paint Manufacturers, Artists, and all who have to mix Colours. Seventh edition, revised. Demy 8vo. Pp. 341. (London: Trade Papers Publishing Co., Ltd , 1926) 12*s*. 6*d*. net.

Lefèvre, Albert. Pour le contremaître industriel: recettes, formules, méthodes, procédés, 'trucs' et tours de mains du praticien. Gl. 8vo Pp. vi + 170. (Paris: Libr. Dunod, 1926.) 12 francs.

Logan, J. Douglas. Dental Prosthetics. (Outlines of Dental Science, Vol. 4.) Cr. 8vo. Pp. 224. (Edinburgh: E. and S. Livingstone, 1926.) 7*s*. 6*d*. net.

Reiser, Joseph. L'organisation du contrôle et la technique des vérifications comptables. Roy. 8vo. Pp xvi + 200. (Paris: Libr. Dunod, 1926.) 35 francs.

Wykes, A. L. The Working of Viscose Silk. Cr 8vo. Pp. 36. (Manchester: John Heywood, Ltd., 1926) 2*s*. net.

Astronomy

League of Nations. Report on the Reform of the Calendar submitted to the Advisory and Technical Committee for Communications and Transit of the League of Nations by the Special Committee of Enquiry into the Reform of the Calendar. (Publications of the League of Nations, VIII. Transit, 1926, VIII 6) (A. 33, 1926, VIII) Sup. Roy. 8vo. Pp. 163. (Geneva · League of Nations; London: Constable and Co., Ltd., 1926.) 3*s*. 3*d*. net.*

Proctor, Mary. The Romance of Comets. Cr. 8vo Pp xiii + 210 + 16 plates. (New York and London: Harper and Bros , 1926) 7*s*. 6*d*. net *

Meteorology: Geophysics

Air Ministry: Meteorological Office. British Meteorological and Magnetic Year Book, 1919, Part 5. Réseau Mondial, 1919. Monthly and Annual Summaries of Pressure, Temperature and Precipitation at Land Stations, generally Two for each Ten-Degree Square of Latitude and Longitude. (M.O. No. 235g.) (Published by the Authority of the Meteorological Committee.) Roy. 4to. Pp. xiii + 115. (London: H M. Stationery Office, 1926.) 22*s*. 6*d*. net *

Brooks, C. E. P. Climate through the Ages: a Study of the Climatic Factors and their Variations. Demy 8vo. Pp. 439. (London: Ernest Benn, Ltd., 1926) 15*s*. net.*

Gutenberg, B., Herausgegeben von. Lehrbuch der Geophysik. Lieferung 2. Sup Roy. 8vo. Pp. 177-400. (Berlin: Gebruder Borntraeger, 1926.) 13.80 gold marks.*

Humphreys, W. J. Rain Making and other Weather Vagaries. Cr. 8vo. Pp x + 157 (Baltimore, Md.: Williams and Wilkins Co., London: Baillière, Tindall and Cox, 1926.) 11*s*. 6*d*. net.*

Geology: Mineralogy

Economic Geological Survey: Department of Science and Agriculture. Report by H. J. C. Connolly of the Preliminary Survey of the Mazaruni and Puruni Diamond Fields, British Guiana, March-December 1925. Part 1. Fcap. folio. Pp. v + 103 + 8 plates. (London: The Crown Agents for the Colonies, 1926.) *

Geological Survey, England, Memoirs of the. Explanation of Sheet 319. The Geology of the Country near Lewes. By H J Osborne White. Roy. 8vo. Pp v + 97 + 4 plates. (London: H M. Stationery Office; Southampton: Ordnance Survey Office, 1926.) 2*s* 6*d* net *

Groth, P. Entwicklungsgeschichte der mineralogischen Wissenschaften. Roy 8vo. Pp. v + 262. (Berlin: Julius Springer, 1926) 18 gold marks.*

Meunier, Stanislas. Dictionnaire de géologie. Ex. Cr. 8vo Pp. xii + 716. (Paris: Libr. Dunod, 1926.) 98 francs.

Milner, Henry B. Supplement to An Introduction to Sedimentary Petrography: with Special Reference to Loose Detrital Deposits and their Correlation by Petrographic Methods. Cr. 8vo. Pp. 156 + plates 17-28. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co , 1926) 9*s*. 6*d*. net.*

Pirsson, Louis V. Rocks and Rock Minerals: a Manual of the Elements of Petrology without the Use of the Microscope. Second edition, revised by Adolph Knopf. Ex Cr. 8vo Pp vii + 426. (New York: John Wiley and Sons, Inc., London: Chapman and Hall, Ltd., 1926.) 17*s* 6*d* net *

Zumoffen, G. Géologie du Liban. 8vo. Pp. iv + 168. (Paris: Henry Barrère, 1926.)

Geography: Travel

Aitchison, George. Unknown Brighton. Ex. Cr. 8vo. Pp. xiv + 168. (London: John Lane, The Bodley Head, Ltd., 1926) 7*s*. 6*d* net

Armfield, Maxwell. An Artist in Italy. 4to. Pp. 112 + 16 plates. (London: Methuen and Co., Ltd., 1926.) 15*s* net.

Banfield, E. J. Last Leaves from Dunk Island. Demy 8vo. Pp. xxvi + 232. (Melbourne and Sydney, N.S.W.: Angus and Robertson, Ltd., 1926) 10*s*. 6*d*. net.

Bedell, Mary Crehore. Modern Gypsies: the Story of a Twelve Thousand Mile Motor Camping Trip encircling the United States. Ex. Cr. 8vo. Pp. 262. (London: Simpkin, Marshall and Co., Ltd, 1926) 5*s*. net.

Beebe, William. The *Arcturus* Adventure: an Account of the New York Zoological Society's First Oceanographic Expedition. Roy. 8vo. Pp. 459. (New York and London: G. P. Putnam's Sons, Ltd., 1926.) 25*s*. net.

Birkett, W. S., and **Lewis, G. G.** The Pupil's Europe Atlas: for Use by the Comparative Method. Roy. 4to Pp. 48. (London: Evans Bros, Ltd., 1926.) 1*s*.

Bone, James. The Perambulator in Edinburgh. Cr. 4to. Pp. 179+16 plates. (London: Jonathan Cape, Ltd., 1926.) 12*s*. 6*d*. net.

Brown, Lady Richmond. Unknown Tribes, Uncharted Seas. Cheap edition. Med 8vo. Pp. 284. (London: Gerald Duckworth and Co, Ltd., 1926) 10*s*. 6*d*. net.

Butt-Thompson, Capt. F. W. Sierra Leone: its History and Tradition. Demy 8vo. Pp. 275+11 plates. (London: H. F. and G. Witherby, 1926) 15*s*. net *

Buxton, Rev. Harold. Trans-Caucasia. Cr. 8vo. Pp 98. (London: The Faith Press, Ltd., 1926.) 3*s*. net

Byron, Robert. Europe in the Looking-Glass: a Motor Drive from Grimsby to Athens. Demy 8vo. Pp 237. (London: George Routledge and Sons, Ltd, 1926) 8*s*. 6*d*. net.

Cheesman, Major R. E. In Unknown Arabia Sup. Roy. 8vo Pp. xx+447+32 plates. (London: Macmillan and Co, Ltd., 1926.) 25*s*. net.*

Coles, K. Adlard. Close Hauled: being the Adventures of the Author and his Wife cruising alone amongst the lesser-known Islands of the Baltic during a Voyage in a 29-ft. Ketch from Latvia to England. Demy 8vo. Pp. 188. (London: Seeley, Service and Co., Ltd., 1926) 10*s*. 6*d*. net.

Cook, John A. Pursuing the Whale: a Quarter-Century of Whaling in the Arctic. Med. 8vo Pp 356. (London: John Murray, 1926.) 18*s* net.

Cox, J. Charles. Essex. (Little Guides) Fcap. 8vo Pp. 326. (London: Methuen and Co, Ltd., 1926.) 5*s*. net.

Cox, Lilian E. Going East: First Impressions of India. Cr. 8vo. Pp 79. (London: Edinburgh House Press, 1926) 1*s*. net.

Curzon of Kedleston, Marquess. Leaves from a Viceroy's Note-Book: and other Papers. Med. 8vo. Pp. x+414+32 plates. (London: Macmillan and Co., Ltd, 1926.) 28*s*. net.*

Doughty, Charles M. Travels in Arabia Deserta. Thin paper edition in one vol., complete and unabridged Demy 8vo. Pp. 742. (London: Jonathan Cape, Ltd, 1926.) 30*s* net.

Dyott, G. M. On the Trail of the Unknown: in the Wilds of Ecuador and the Amazon. Demy 8vo Pp. 288. (London: Thornton Butterworth, Ltd., 1926) 21*s*. net.

Foster, Cecil. 1700 Miles in Open Boats: the Story of the Loss of the S.S. *Trevessa* in the Indian Ocean, and the Voyage of her Boats to Safety Second edition Demy 8vo. Pp xii+177. (London: Martin Hopkinson and Co, Ltd., 1926.) 5*s*. net.

Geoffrey, Theodate. An Immigrant in Japan Demy 8vo. Pp. 294. (London. T. Werner Laurie, Ltd, 1926) 12*s* 6*d* net.

Goad, Harold Elsdale. Franciscan Italy Med 8vo. Pp 296. (London: Methuen and Co., Ltd., 1926.) 15*s* net.

Haywood, Lieut.-Col. A. H. W. Sport and Service in Africa: a Record of Big-Game Shooting, Campaigning and Adventure in the Hinterland of Nigeria, the Cameroons, Togoland, etc.; with an Account of the Ways of Native Soldiers and Inhabitants and a Description of their Villages and Customs as well as the Fauna and Flora. Demy 8vo. Pp. 285. (London: Seeley, Service and Co., Ltd, 1926.) 21*s*. net

Hull, E. M. Camping in the Sahara. Med 8vo Pp. 189. (London: Eveleigh Nash and Grayson, Ltd., 1926.) 10*s* 6*d*. net.

Huntington, Ellsworth, and **Williams, Frank E.** Business Geography. Second edition. 8vo. (London: Chapman and Hall, Ltd, 1926.) 17*s*. 6*d*. net.

Hutton, Edward. Cities of Sicily. Cr. 8vo Pp 255. (London: Methuen and Co.; Ltd., 1926.) 10*s*. 6*d*. net.

Huxley, Aldous. Jesting Pilate: the Story of a Journey. Med. 8vo. Pp. 291. (London: Chatto and Windus, 1926.) 16*s*. net.

Lucas, E. V. London Being "A Wanderer in London" and "London Revisited" in one volume, rearranged, with new matter and new pictures. Med. 8vo. Pp. xii+431. (London: Methuen and Co, Ltd., 1926.) 20*s*. net

Maxwell, Donald. Unknown Suffolk: being a Series of Unmethodical Explorations of the County. Gl. 4to. Pp. xiii+202. (London: John Lane, The Bodley Head, Ltd., 1926.) 15*s* net.

Meldrum, Rev. Neil. Forteviot: the History of a Strathearn Parish. Demy 8vo. Pp. xii+303. (Paisley: Alexander Gardner, Ltd., 1926.) 7*s*. 6*d*. net.

Migeod, Frederick William Hugh. A View of Sierra Leone. Med. 8vo. Pp. xii+351+8 plates (London: Kegan Paul and Co., Ltd., 1926) 31*s*. 6*d*. net.*

Mills, Lady Dorothy. Through Liberia. Demy 8vo. Pp 240. (London: Gerald Duckworth and Co., Ltd, 1926.) 15*s*. net.

Molony, J. Chartres. A Book of South India. Ex. Cr. 8vo. Pp. xii+252. (London: Methuen and Co, Ltd., 1926) 7*s* 6*d*. net.

Moncrieff, A. R. Hope. Essex. Demy 8vo Pp. 274 (London: A. and C. Black, Ltd, 1926.) 7*s*. 6*d*. net.

Newbigin, Alice M. S. A Wayfarer in Spain. Cr. 8vo Pp. 215. (London: Methuen and Co., Ltd., 1926.) 7*s*. 6*d* net.

Norden, Hermann. Byways of the Tropic Seas: Wanderings among the Solomons and in the Malay Archipelago Demy 8vo. Pp. 250+30 plates. (London: H. F. and G. Witherby, 1926) 16*s*. net *

O'Brien, Conor. Across Three Oceans: a Colonial Voyage in the Yacht *Saoirse*. Demy 8vo. Pp. 306. (London: Edward Arnold and Co., 1926) 16*s*. net.

Ossendowski, Ferdinand. The Fire of Desert Folk: the Account of a Journey through Morocco. English Text by Lewis Stanton Palen. Med. 8vo. Pp 312. (London: George Allen and Unwin, Ltd., 1926.) 16*s*. net.

Pearson, Hugh. The Diamond Trail. an Account of Travel among the little known Bahian Diamond Fields of Brazil. Demy 8vo. Pp. 230+12 plates. (London: H. F. and G. Witherby, 1926.) 12*s*. 6*d*. net.*

Peers, E. Allison. Royal Seville. Med 8vo. Pp 131. (New York and London: Harper and Bros, 1926.) 7*s*. 6*d* net.

Powell, E. Alexander. The Map that is Half Unrolled: Equatorial Africa from the Indian Ocean to the Atlantic. Demy 8vo. Pp xv+355 (London: John Long, Ltd., 1926) 18*s*. net.

Ray, Joseph E. The New Canada. Cr. 8vo. Pp. 156. (London: Hutchinson and Co., Ltd., 1926.) 4*s*. 6*d* net.

Rouff, Curnonsky, and **Rouff, Marcel.** Paris, the Environs of Paris and Normandy. (The Yellow Guides for Epicures.) Fcap 8vo Pp. 320. (London: Thornton Butterworth, Ltd, 1926.) 10*s*. 6*d*. net.

Stanford's London Atlas of Universal Geography. Folio (London: Edward Stanford, Ltd, 1926.) 30*s*. net; half morocco, 45*s*. net.

Taffrail (Comdr. Taprell Dorling). Sea Venturers of Britain. Part 1: In Queen Elizabeth's Reign. Cr. 8vo. Pp. viii+103+4 plates. Part 2: At the Empire's Birth. Cr. 8vo. Pp. viii+105-208+6 plates. Part 3: The Heroes of Polar Exploration. Cr. 8vo. Pp. iv+209-317+4 plates (London and Glasgow: W. Collins, Sons and Co., Ltd., 1926.) Parts, 1*s*. 6*d*. net each; complete, 3*s*. 6*d*. net.

Thurston, C. B. A Progressive Geography. Book 4: Eurasia. Gl. 8vo. Pp. 224. (London: Edward Arnold and Co, 1926.) 2*s*. 9*d*.

Turley, Charles. With the Prince round the Empire. Cr. 8vo. Pp. xi+141+16 plates (London. Methuen and Co., Ltd., 1926.) 3*s* 6*d* net.

Ward, Capt. F. Kingdon. The Riddle of the Tsangpo Gorges. Demy 8vo. Pp. xv+328+16 plates. (London: Edward Arnold and Co., 1926) 21*s*. net.*

Younghusband, Sir Francis. The Epic of Mount Everest. Ex. Cr. 8vo. Pp. 319+16 plates. (London: Edward Arnold and Co., 1926.) 7*s*. 6*d*. net.*

General Biology: Natural History Zoology: Botany

Alluaud, Ch., et Jeannel, R. Voyage de Ch. Alluaud et R. Jeannel en Afrique orientale (1911–1912): résultats scientifiques. Reptiles et batraciens. Par F. Angel. Roy. 8vo. Pp. 63 + 3 planches. (Paris: Paul Lechevalier, 1925.) 18.50 francs.*

Barbour, Thomas. Reptiles and Amphibians: their Habits and Adaptations. Med. 8vo Pp. xx + 125 + 52 plates (London, Calcutta and Sydney · George G. Harrap and Co, Ltd., 1926) 10*s.* 6*d.* net *

Barker, Cicely Mary, Poems and Pictures by. Flower Fairies of the Autumn: with the Nuts and Berries they Bring. (Tiny Tots Series) Demy 18mo. Pp. 28 + 24 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd, 1926.) 1*s* 6*d.* net

Braun, M., und Seifert, O. Die tierischen Parasiten des Menschen. Teil 2: Klinik und Therapie der tierischen Parasiten des Menschen. Von O. Seifert. 8vo. Pp. vi + 574. (Leipzig: Kurt Kabitzsch, 1926.) 27 gold marks

Campbell, Douglas Houghton. An Outline of Plant Geography. Demy 8vo. Pp. x + 392 (52 plates). (New York: The Macmillan Co., 1926.) 17*s.* net.*

Chun, Carl, Herausgegeben von, und nach seinem Tode fortgesetzt von A. Brauer, E. Vanhoffer und C. Apstein. Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia* 1898–1899. Im Auftrage des Reichsministeriums des Innern. Siebzehnter Band, Drittes Heft: Hydroiden der deutschen Tiefsee-Expedition. Bearbeitet von Eberhard Stechow. Sup. Roy. 4to Pp. 164. (Jena: Gustav Fischer, 1925.)*

Drabble, Eric. Text Papers in Botany: for the Use of Candidates preparing for School Certificate, Matriculation; Oxford Locals, College of Preceptors and similar Examinations Demy 8vo Pp. iv + 100. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 2*s.*

Finn, Frank. Wild Animals of Yesterday and To-day. Ex Cr. 8vo. Pp. 201. (London: S. W. Partridge and Co., Ltd, 1926) 3*s.* 6*d.* net.

Fishery Board for Scotland. Scientific Investigations, 1926, No 2: Haddock Biology. 3: Metabolism of Haddock and other Ganoid Fish in the Aquarium. By Harold Thompson Imp. 8vo. Pp. 14 + 4 plates. (Edinburgh and London: H.M. Stationery Office, 1926.) 2*s.* 6*d.* net.*

Fishery Board for Scotland. Salmon Fisheries, 1926, No 4: Salmon Investigations in Scotland, 1923. 1: Salmon of the River Dee (Aberdeenshire). By W. J. M. Menzies and P. R. G Macfarlane. Imp. 8vo Pp. 46. (Edinburgh and London: H M. Stationery Office, 1926) 4*s.* net *

Forestry Commission. Bulletin No. 8: British Bark-Beetles. By J. W. Munro. Roy. 8vo. Pp. 77 + 10 plates. (London: H.M. Stationery Office, 1926.) 2*s.* 6*d.* net.*

Gager, C. Stuart., General Botany: with Special Reference to its Economic Aspects. With three Chapters on Heredity and Variation in Plants, by Orland E White. Demy 8vo. Pp. xvi + 1056. (Philadelphia: P. Blakiston's Son and Co., 1926.) 4 dollars net.*

Hopkinson, Emilius. Records of Birds bred in Captivity. Demy 8vo. Pp. x + 330. (London: H. F. and G. Witherby, 1926.) 15*s.* net.*

Hyman, Libbie Henrietta. A Laboratory Manual for Elementary Zoology. Second edition. Sup. Roy. 8vo. Pp. xviii + 182. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1926.) 12*s.* 6*d.* net.*

Lindau, Gustav, Begrundet von Kryptogamenflora fur Anfanger: eine Einfuhrung in das Studium der blutenlosen Gewachse fur Studierende und Liebhaber. Fortgesetzt von R. Pilger. Sechster Band: Die Torf- und Lebermoose. Von Wilhelm Lorch. Die Farnpflanzen. (Pteridophyta) Von G. Brause. Neu bearbeitet von H. Andres. Zweite, verbesserte und stark vermehrte Auflage. Pp. 124. 21 gold marks Vierter Band, Abteilung 1: Die Algen. Von Gustav Lindau. Zweite, umgearbeitete und vermehrte Auflage. Von Hans Melchior. Pp. 322 + 16 Tafeln. 20.40 gold marks. (Berlin: Julius Springer, 1926)

Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol 9, No. 2, 1926: Plaice-Egg Production in 1920–21, treated as a Statistical Problem, with Comparison between the Data from 1911, 1914 and 1921. By H. J. Buchanan-Wollaston. Imp. 8vo. Pp. 36 + 11 charts. (London: H.M Stationery Office, 1926.) 8*s.* 6*d* net *

Newman, H. H., Editor. The Nature of the World and of Man By W C. Allee, G. W. Bartelmez, J. H. Bretz, A. J. Carlson, R T. Chamberlin, F -C. Cole, M. C. Coulter, H. C. Cowles, E. R. Downing, E O. Jordan, C. H. Judd, H. B. Lemon, F. R. Moulton, H. H. Newman, A. S. Romer and J. Stieglitz. Med. 8vo Pp. xxiv + 566 + 14 plates. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1926.) 20*s* net.*

Pienaar, A. A. The Adventures of a Lion Family, and other Studies of Wild Life in East Africa. Translated from the Afrikaans by B. and E. D. Lewis Cheaper impression. Cr 8vo. Pp. 272. (London: Longmans, Green and Co., Ltd., 1926) 4*s.* 6*d.* net.

Plessis, Huart du. La chèvre: races, élevage, exploitation. Cr. 8vo Pp. 150. (Paris: Librairie des Sciences agricoles, 1926.) 6 francs

Sharp, Dallas Lore. "Sanctuary! Sanctuary!" Demy 8vo. Pp. 227. (New York and London: Harper and Bros, 1926) 7*s* 6*d* net

Smith, Thomas. The Life of a Fox. New edition. Cr. 4to. Pp. 125. (London: Edward Arnold and Co., 1926.) 21*s.* net.

Thomson, J. Arthur, Edited by. Ways of Living: Nature and Man. Ex. Cr. 8vo. Pp. 246 (London: Hodder and Stoughton, Ltd, 1926.) 3*s.* 6*d* net.

Thorburn, Archibald, Written and illustrated by. British Birds. New edition. In 4 vols. Demy 8vo. Vol. 4. Pp. x + 154 + plates 145-192. (London: Longmans, Green and Co., Ltd., 1926.) 16*s.* net.*

Horticulture: Forestry: Agriculture

Brown, E. T. A Year in my Flower Garden. Med 8vo. Pp xii + 220. (London: Chapman and Hall, Ltd, 1926) 7*s* 6*d.* net.

Caillas, Alin. Les trésors d'une goutte de miel. Cr. 8vo. Pp. 158. (Paris: Librairie spéciale agricole, 1926.) 7 50 francs.

Collings, Gilbeart H. The Production of Cotton. 8vo. (London: Chapman and Hall, Ltd, 1926.) 17*s.* 6*d* net.

Cotter, Sir James L. A Simple Guide to Rock Gardening. Cr. 8vo Pp. 126. (London: The Sheldon Press; New York and Toronto: The Macmillan Co., 1926.) 2*s.* 6*d* *

Dillistone, Frederick E. Violet Culture: for Pleasure and Profit. Demy 8vo. Pp. 32. (London: Ernest Benn, Ltd, 1926) 2*s* net.

Hiley, W. E. The Financial Return from the Cultivation of Scots and Corsican Pines. (Oxford Forestry Memoirs, No. 6.) Imp. 8vo. Pp. 32. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 3*s.* 6*d.* net.*

Hume, H. Harold. The Cultivation of Citrus Fruits. (The Rural Science Series.) Demy 8vo Pp. xxi + 561. (New York. The Macmillan Co., 1926) 21*s.* net *

Jekyll, Gertrude. Home and Garden: Notes and Thoughts, Practical and Critical, of a Worker in Both. Cheaper reissue. Med. 8vo. Pp. xv + 301. (London: Longmans, Green and Co., Ltd., 1926.) 10*s.* 6*d.* net.

Jekyll, Gertrude. Wood and Garden: Notes and Thoughts, Practical, of a Working Amateur. Thirteenth impression. Med. 8vo. Pp. xvi + 236. (London: Longmans, Green and Co, Ltd., 1926) 10*s.* 6*d.* net

Machefel, L. La production et le commerce des céréales: statistique, législation douanière, réglementations intérieures. Cr. 8vo Pp 130. (Paris: Librairie Agricole de la Maison rustique, 1926) 6 francs.

Macself, A. J. The Fruit Garden. (Home Garden Books, No. 12.) Large Cr. 8vo. Pp. 222. (London; Thornton Butterworth, Ltd., 1926.) 6*s.* net.

Ministry of Agriculture and Fisheries. Miscellaneous Publications, No. 55: The Sex-linked Method in Poultry Breeding. By R. C. Punnett. Roy. 8vo. Pp. 9 + 2 plates. (London: Ministry of Agriculture and Fisheries, 1926.) 9*d.* net.*

Ministry of Agriculture and Fisheries. Research and the Land: an Account of Recent Progress in Agricultural and Horticultural Science in the United Kingdom. By V. E. Wilkins Demy 8vo. Pp. xiv + 388 + 34 plates. (London: H.M Stationery Office, 1925) Paper, 2*s* 6*d*. net; cloth, 3*s* 6*d* net.*

Sanders, T. W. Fruit and its Cultivation: the Cultivation of all Kinds of Hardy Fruits, including Planting, Pruning, Training and Propagation, Selections of Varieties, and Descriptions of Insect and Fungoid Pests with Remedies for the Eradication Fourth edition. Med. 8vo Pp. 297. (London: W. H. and L. Collingridge, 1926) 7*s*. 6*d*. net.

Tanner, Arthur Edmund. Tobacco: from the Grower to the Smoker. (Pitman's Common Commodities and Industries Series) Second and revised edition, edited by F. W Drew. Cr. 8vo. Pp. xiii + 111. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 3*s*. net.

Turrentine, J. W. Potash: a Review, Estimate and Forecast (The Wiley Agricultural Series) Med. 8vo. Pp. ix + 188. (New York. John Wiley and Sons, Inc; London: Chapman and Hall, Ltd., 1926.) 15*s*. net.*

Ward, Capt. F. Kingdon. Rhododendrons for Everyone. Cr. 8vo. Pp. 124 (London: *Gardeners' Chronicle*, Ltd, 1926) 3*s*. 6*d*. net.

Wickes, Dean R. Flowers of Peitaiho. (Educational Series, No. 1.) Pott 8vo. Pp. 88. (Peking: Peking Society of Natural History, 1926.) 50 cents.*

Anatomy: Physiology

Borst, Max. Pathologische Histologie: ein Unterrichtkurs fur Studierende und Ärzte. Zweite Auflage. Sup. Roy. 8vo. Pp xiii + 435. (Leipzig: F C. W. Vogel, 1926.) 48 gold marks.

Cokkinis, A. J. The Reproduction of Life: a Handbook of the Science of Reproduction in Nature and Man. Demy 8vo. Pp. xvi + 287. (London: Baillière, Tindall and Cox, 1926) 10*s* 6*d*. net.*

Hall, Winfield S., and **Jeannette, W.** Sexual Knowledge. Cr. 8vo. Pp. 320. (London: T. Werner Laurie, Ltd, 1926.) 6*s*. net

Hermann, G., et Morel, C. Précis d'anatomie pathologique. (Collection Testut) Deuxième édition, revue et corrigée par C. Morel. 8vo. Pp. 820 + 8 planches. (Paris: Gaston Doin et Cie, 1926) 66 francs.

Kuczynski, R. Deutschlands Versorgung mit Nahrungs- und Futtermitteln. Zweiter Teil: Deutschlands Versorgung mit pflanzlichen Nahrungs- und Futtermitteln (Die Volksernahrung, Heft 7.) 8vo. Pp. v + 406. (Berlin: Julius Springer, 1926.) 18 gold marks.

Mottram, V. H. The Functions of the Body: an Outline of Physiology. Cr. 8vo. Pp. xii + 260. (London: Nisbet and Co, Ltd., 1926.) 7*s*. 6*d*. net.

Anthropology: Archæology

Baikie, Rev. James. The Amarna Age: a Study of the Crisis of the Ancient World. Ex. Cr 8vo. Pp. xix + 465 + 32 plates. (London: A. and C. Black, Ltd., 1926.) 12*s*. 6*d*. net.*

Budge, Sir E. A. Wallis. Cleopatra's Needles and other Egyptian Obelisks: a Series of Descriptions of all the Important Inscribed Obelisks, with Hieroglyphic Texts, Translations, etc Med. 8vo Pp xxii + 308 (London: Religious Tract Society, 1926.) 10*s*. 6*d* net.

Buren, E. Douglas van. Greek Fictile Revetments in the Archaic Period Post 4to. Pp. xx + 208 + 39 plates (London: John Murray, 1926.) 24*s* net.

Capart, Jean, and **Werbrouck, Marcelle.** Thebes: the Glory of a Great Past. Roy. 4to Pp 362 (London: George Allen and Unwin, Ltd, 1926.) 63*s* net.

Guillaume, Paul, and **Munro, Thomas.** Primitive Negro Sculpture. Illustrated from the Collection of the Barnes Foundation at Merion, Pennsylvania. Cr. 4to. Pp. 134. (London: Jonathan Cape, Ltd, 1926.) 25*s*. net.

Hambly, W. D. Tribal Dancing and Social Development. Demy 8vo. Pp. 296 + 26 plates. (London: H. F. and G. Witherby, 1926.) 21*s*. net.*

Heydrich, M., und **Buschan, G.**, Herausgegeben von. Ethnologischer Anzeiger: Jahresbibliographie und Bericht über die völkerkundliche Literatur. Jahrgang 1, Heft 1 Sup. Roy. 8vo. Pp. 32. (Stuttgart: E. Schweizerbart G.m b.H., 1926) 4 gold marks.*

Imbelloni, J. La Esfinge Indiana: antiguos y nuevos aspectos del problema de los orígenes americanos. Sup. Roy. 8vo. Pp. 399 + 19 plates. (Buenos Aires: Librería "El Ateneo," 1926.) *

Luquet, G.-H. L'art et la religion des hommes fossiles. Roy. 8vo. Pp. 231. (Paris: Masson et Cie, 1926) 4*s*. 4*d*.*

Malinowski, Bronislaw. Myth in Primitive Psychology. (Psyche Miniatures: General Series, No. 6) Pott 8vo. Pp. 128. (London: Kegan Paul and Co, Ltd., 1926) 2*s* 6*d*. net.*

Massingham, H. J. Fee, Fi, Fo, Fum: or, The Giants in England. (Psyche Miniatures: General Series, No. 5.) Pott 8vo. Pp. 175 + 4 plates. (London: Kegan Paul and Co., Ltd, 1926) 2*s*. 6*d* net.*

Massingham, H. J. Downland Man. Med. 8vo. Pp. 422. (London: Jonathan Cape, Ltd., 1926) 21*s* net.

Merhart, Gero v. Bronzezeit am Jenissei: ein Beitrag zur urgeschichte Sibiriens. Med 8vo. Pp. 190 + 12 Tafeln. (Wien. Anton Schroll und Co., 1926.) 12*s*.*

Mills, J. P. The Ao Nagas. With a Foreword by Henry Balfour, and Supplementary Notes and Bibliography by J. H. Hutton (Published by direction of the Government of Assam.) Demy 8vo. Pp. xviii + 500 + 32 plates. (London: Macmillan and Co., Ltd., 1926.) 30*s*. net *

Ray, Sidney Herbert. A Comparative Study of the Melanesian Island Languages. Roy. 8vo. Pp. xvi + 598. (Cambridge. At the University Press, 1926) 30*s*. net

Reisinger, F. Poland E., and **Wagner, R.** The Culture of Ancient Greece and Rome: General Sketch. Translated from the second German edition (1924) by J. H. Freese. Roy 8vo. Pp. 335. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1926) 21*s*. net.

Rodd, Francis Rennell. People of the Veil: being an Account of the Habits, Organisation and History of the Wandering Tuareg Tribes which inhabit the Mountains of Air or Asben in the Central Sahara. Roy. 8vo. Pp xvi + 504 + 51 plates. (London: Macmillan and Co., Ltd, 1926) 30*s* net.*

Rose, H. J. Primitive Culture in Italy. Cr. 8vo. Pp. ix + 253 (London: Methuen and Co., Ltd, 1926.) 7*s*. 6*d*. net.*

Rout, Ettie A., Report made by. Maori Symbolism: being an Account of the Origin, Migration and Culture of the New Zealand Maori, as recorded in certain Sacred Legends From the Evidence of Hohepa Te Rake (an Arawa Noble). Roy. 8vo. Pp. xxxii + 322 + 32 plates. (London: Kegan Paul and Co, Ltd, 1926.) 21*s*. net.*

Sayce, Rev. A. H. Assyria: its Princes, Priests and People. Ex. Cr. 8vo. Pp. xxvi + 194. (London: Religious Tract Society, 1926.) 3*s*. 6*d*. net

Schmidt, Max. The Primitive Races of Mankind: a Study in Ethnology. Translated by Alex. K. Dallas. Med. 8vo. Pp 360. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd, 1926) 21*s* net.

Summers, Montague. The History of Witchcraft and Demonology. (The History of Civilization Series.) Med. 8vo. Pp. xv + 353 + 8 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926) 12*s* 6*d*. net *

Thompson, R. Lowe. The Hunter in our Midst. (Psyche Miniatures: General Series, No 4.) Pott 8vo. Pp. 89. (London: Kegan Paul and Co., Ltd, 1926.) 2*s* 6*d* net.*

Tremayne, Arch. [illegible]rds from Erech: Time of Cyrus and Cambys[illegible]–521 B.C). (Yale Oriental Series: Babylonian T[illegible], No. 7.) Med 4to Pp. 48 + 74 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1926.) 23*s* net

Waters, M. W. Cameos from the Kraal. Roy. 8vo. Pp. 58. (Lon[illegible]n: Simpkin, Marshall and Co, Ltd, 1926.) 2*s*. 6*d*. net.

Weigall, Arthur. Wanderings in Roman Britain Cr. 8vo. Pp. 341 + 12 plates. (London: Thornton Butterworth, Ltd., 1926.) 6*s*. net.

Medical Sciences

Barbour, A. H. F., and **Watson, B. P.** Gynecological Diagnosis and Pathology. Third edition, revised. Med. 8vo Pp 239. (Edinburgh: W. Green and Son, Ltd., 1926.) *7s. 6d.* net.

Beaumont, G. E., and **Dodds, E. C.** Recent Advances in Medicine: Clinical, Laboratory, Therapeutic. Third edition, revised Demy 8vo. Pp. 422. (London: J. and A. Churchill, 1926.) *12s. 6d.* net.

Bensaude, R. Traité d'endoscopie recto-colique; rectoscopie, sigmoïdoscopie. Deuxième édition Pp. 180. (Paris: Masson et Cie, 1926.) *16s. 8d.*

Blanc, H., et **Négro, M.** La cystographie: étude radiologique de la vessie normale et pathologique. Pp 192. (Paris: Masson et Cie, 1926.) *6s. 8d*

Browne, A. R. I. Medical Electricity for Students. (Oxford Medical Publications.) Second edition. Cr 8vo. (London: Oxford University Press, 1926.) *12s. 6d.* net

Burke, E. P. Scourges of To-day:- Venereal Disease, Cancer, Tuberculosis, Alcoholism. (The Modern Health Books.) Fcap. 8vo Pp. xiii+166. (London: Faber and Gwyer, Ltd., 1926) *3s. 6d* net.

Buschke, A., und **Langer, Erich,** Herausgegeben von. Lehrbuch der Gonorrhöe. Nebst einem Anhang: Die Sterilitat des Mannes. Pp. xii+570. (Berlin: Julius Springer, 1926) 46.50 gold marks.

Cameron, Thomas W. M. Diseases of Animals in Relation to Man (The Modern Health Books) Fcap 8vo. Pp. 222. (London: Faber and Gwyer, Ltd, 1926.) *3s. 6d.* net.

Clark, Charles A. Dental Radiography. (Outlines of Dental Science, Vol. 5.) Cr. 8vo. Pp. 120. (Edinburgh: E. and S. Livingstone, 1926.) *7s. 6d.* net.

Comrie, John D. Black's Medical Dictionary. Eighth edition, entirely reset. Demy 8vo. Pp viii+998. (London: A. and C. Black, Ltd., 1926.) *18s* net.

Head, Henry. Aphasia and Kindred Disorders of Speech. In 2 vols Cr. 4to. Vol 1. Pp. xvi+549. Vol. 2 Pp. xxxiii+430. (Cambridge: At the University Press, 1926) *63s* net.

Hewat's Examination of the Urine and other Clinical Side-Room Methods. Seventh edition, revised and enlarged by G. L. Malcolm-Smith. 32 mo. Pp 228. (Edinburgh: E. and S. Livingstone, 1926) *3s.* net.

Hugel, R., et **Delater, G.** Le système veineux normal et pathologique: guide des malades et des prédisposés (varices, phlébites, hémorroïdes, etc.) Cr 8vo. Pp. 184. (Paris: Gaston Doin et Cie, 1926.) 15 francs.

Hutyra, Franz, and **Marek, Josef.** Special Pathology and Therapeutics of the Diseases of Domestic Animals 3 vols. Third edition. Roy. 8vo. (London: Baillière, Tindall and Cox, 1926.) *105s.* net.

Kennedy, Alexander Mills. Medical Case-taking: a Guide for Clinical Clerks. Cr. 8vo. Pp. 148. (London: Edward Arnold and Co., 1926.) *5s.* net.

Kerr, James. The Air we Breathe. (The Modern Health Books.) Fcap. 8vo. Pp. 191. (London: Faber and Gwyer, Ltd., 1926.) *3s. 6d.* net.

Lestchinski, Alex. Les états nerveux et leurs traitements. Cr. 8vo Pp. 312. (Paris: Félix Alcan, 1926.) 20 francs.

Lust, F. Diagnostik und Therapie der Kinderkrankheiten. Vierte Auflage. Pp. 508. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 10.50 gold marks.

Mallett, Reddie. The Book of Health Ex. Cr. 8vo. Pp. xii+240 (London: Watts and Co., 1926.) *7s. 6d* net.

Marfan, A.-B. Clinique des maladies de la première enfance. Pp. 608 (Paris: Masson et Cie, 1926.) *7s 6d.*

Marsden, Prosper H. [illegible]ntal Materia Medica (Outlines of Dental Science, [illegible].) Cr 8vo Pp. 155. (Edinburgh: E. and S. Livingstone, 1926.) *7s. 6d.* net.

Masters, David. How to conquer Consumption. Ex. Cr. 8vo. Pp. ix+252. (London: John Lane, The Bodley Head, Ltd., 1926.) *6s.* net.

Muskens, L. J. J. Épilepsie: vergleichende Pathogenese, Erscheinungen, Behandlung. (Monographien aus dem Gesamtgebiete der Neurologie und Psychiatrie, Heft 47.) Pp. viii+395. (Berlin Julius Springer, 1926.) 30 gold marks.

Nobécourt, P. Clinique médicale des enfants Tome 3: Troubles de la nutrition et de la croissance Pp 404. (Paris: Masson et Cie, 1926.) *6s.*

Parsons, Sir John H. Diseases of the Eye. Fifth edition, revised. Demy 8vo. Pp. 684 (London: J. and A. Churchill, 1926) *19s.* net.

Popischill, Dionys. Von den akut-infektiösen Respirationsstenosen der Kinder. Pp. 42 (Berlin: S. Karger, 1926) 2.40 gold marks.

Rassers, J. R. F. Die Pathogenese des chronischen Magendarmgeschwürs Pp. 69. (Leiden: S. C. Van Doesburgh, 1926)

Redding, J. Magnus. X-ray Diagnosis: a Manual for Surgeons, Practitioners and Students. Med. 8vo. Pp 244+80 plates (London: Cassell and Co, Ltd., 1926) *21s* net.

Sachs, B., and **Hausman, Louis.** Nervous and Mental Disorders from Birth through Adolescence Med. 8vo Pp. xvi+861+3 plates. (New York: Paul B Hoeber, Inc., 1926.) 10 dollars

Schaffer, Karl. Über das morphologische Wesen und die Histopathologie der hereditarsystematischen Nervenkrankheiten. (Monographien aus dem Gesamtgebiete der Neurologie und Psychiatrie, Heft 46) Pp. vi+253. (Berlin: Julius Springer, 1926) 24 gold marks

Smith, G. F. Rawdon. Dental Anaesthesia. (Outlines of Dental Science, Vol. 1.) Cr 8vo. Pp. 152. (Edinburgh: E. and S. Livingstone, 1926.) *7s. 6d.* net.

Solomon, Iser. Précis de radiothérapie profonde. Pp. 512 (Paris: Masson et Cie, 1926) *10s.*

Stewart, Harry Eaton. Diathermy: with Special Reference to Pneumonia. Second edition, revised. Cr 8vo. Pp xx+228. (New York: Paul B. Hoeber, Inc, 1926.) 3 dollars.

Stokes, John H. Clinical Syphilology. 8vo. Pp. 1144. (Philadelphia and London: W. B Saunders Co, Ltd., 1926.) *55s.* net.

Waterman, N. Der heutige Stand der chemotherapeutischen Carcinomforschung. (Sonderabdruck aus "Ergebnisse der inneren Medizin und Kinderheilkunde," Band 30.) Roy. 8vo. Pp. ii+74 (Berlin: Julius Springer, 1926.) 6.60 gold marks

Weber, Arthur. Die Elektrokardiographie und andere graphische Methoden in der Kreislaufdiagnostik. Roy. 8vo. Pp. ix+208. (Berlin: Julius Springer, 1926.) 18 gold marks.

Wilson, R. Macnair. The Beloved Physician, Sir James Mackenzie: a Biography. Demy 8vo. Pp. x+316. (London: John Murray, 1926.) *12s.* net.

Miscellany

Begtrup, Holger; Lund, Hans, and **Manniche, Peter.** The Folk High Schools of Denmark and the Development of a Farming Community. Cr 8vo. Pp 168. (Kjøbenhavn: Nyt Nordisk Forlag Arnold Busck, London: Oxford University Press, 1926) *6s.* net.

Fiddes, Edward. American Universities: a Lecture delivered at the University of Manchester on 16th November 1925. (Manchester University Lectures, No. 25) Cr. 8vo. Pp 34. (Manchester: At the University Press; London: Longmans, Green and Co., Ltd, 1926.) *2s. 6d.* net.

Naturwissenschaften, Herausgegeben von der Schriftleitung der. Ergebnisse der exakten Naturwissenschaften. Funfter Band. Roy. 8vo. Pp iii+329. (Berlin: Julius Springer, 1926.) 21 gold marks.*

Risdon, P. J. The Romance of our Wonderful World: the Story simply told of the Earth's Beginning, its Manifold Wonders, and the Tremendous Forces which have transformed a Sphere of Flaming Gases into the Beautiful World of To-day. (Library of Romance Series) Cr. 8vo. Pp 282+24 plates (London: Seeley, Service and Co, Ltd, 1926) *6s* net.

Rodker, John. The Future of Futurism. (To-day and To-morrow Series.) Pott 8vo. Pp. 92. (London: Kegan Paul and Co; Ltd; New York: E. P. Dutton and Co., 1926.) *2s 6d.* net.*

Schmalhausen, Samuel D. Humanizing Education: a Preface to a Realistic Education. Demy 8vo Pp. iv+343. (New York: The New Education Publishing Co., 1926.)

BROOKLYN BOTANIC GARDEN MEMOIRS

Volume I. : 33 contributions by various authors on Genetics, Pathology, Mycology, Physiology, Ecology, Plant Geography, and Systematic Botany. Price, $3.50 plus postage.

Volume II. : The Vegetation of Long Island. Part I. The Vegetation of Montauk, etc. Pub. 1923. 108 pp. Price, $1.

AMERICAN JOURNAL OF BOTANY

Devoted to All Branches of Botanical Science.

Established 1914. Monthly, except August and September. Official publication of the Botanical Society of America.

Subscription, $7 a year for complete volumes only. Volumes 1-13 complete, $106, post free. Single numbers, $1 each, post free. Prices of odd volumes on request. Foreign postage, [illegible]s.

ECOLOGY

[illegible]voted to All Forms of Life in Relation to Environment.

[illegible]ablished 1920. Quarterly.
[illegible]ficial publication of the Ecological Society of America.
[illegible]iption, $4 a year for complete volumes only. Back [illegible]lumes, 1, 2, and 4-7, $5 each, post free. Single numbers, [illegible]1.25, post free. Foreign postage, 20 cents.

GENETICS

A Periodical Record of Investigations in Heredity and Variation

Established 1916. Bi-monthly.
Subscription, $6 a year for complete volumes only. Single numbers, $1.25, post free. Back volumes, 2-9, $7 each. Foreign postage, 50 cents.

Orders should be placed direct with

The Secretary, Brooklyn Botanic Garden,
BROOKLYN, N.Y., U.S.A.

LEWIS'S
[illegible]IRCULATING LIBRARY

of Scientific, Technical, and Medical Books

covering the widest range of subjects, pure and applied.

NEW BOOKS and EDITIONS are added in UNLIMITED SUPPLIES, as long as the demand requires, delay or disappointment thus being prevented.

ANNUAL SUBSCRIPTION (Town or Country) FROM ONE GUINEA according to the number of books required at one time.

Subscriptions may commence from any date.
Books may be retained as long or exchanged as frequently as desired

The READING AND WRITING ROOM (first floor) is open daily.

Prospectus, with Monthly List of Additions, post free.

H. K. LEWIS & CO. Ltd.,
136 Gower Street, and Gower Place, London, W.C.1.
District Railway Euston Square Station All Tube Railways: Warren Street.

FROM CONSTABLE'S LIST

NOMOGENESIS or EVOLUTION DETERMINED BY LAW. L. S. BERG, D.Sc. With an Introduction by D'ARCY WENTWORTH THOMPSON. Demy 8vo. Illustrated. 28s. net.

FROM A REVIEW IN NATURE.

"This volume represents the mature thought of an accomplished ichthyologist and traveller who speaks from the point of view of a naturalist and field observer and marshals, in the first nine chapters, all the difficulties that have arisen through field observation in the original concept of Darwinism. . . . A thoughtful and, in large part, original contribution to the newer modern aspect of the evolution theory."—*Oct.* 30, 1926.

WIRELESS PICTURES AND TELEVISION. An Account of the Apparatus used and Experiments carried out for the Transmission of Photographs by Telegraphy and of Television, which will appeal alike to the highly technical and the lay reader. By T. THORNE BAKER, F.C.S., F.R.P.S. Crown 8vo. Illustrated. 6s. 6d. net.

FIELD ASTRONOMY. For Engineers and Surveyors. By DAVID CLARK, M.A., B.Sc., M.Inst.C.E. Crown 8vo. Illustrated. A manual for University and private students of surveying and geodesy. 10s. 6d. net.

PRINCIPLES OF HUMAN GEOGRAPHY. By P. VIDAL DE LA BLACHE. Edited by EMMANUEL DE MARTONNE. Demy 8vo. Illustrated. 18s. net.

PHOTOMETRY. JOHN W. T. WALSH, M.A., M.Sc., A.M.I.E.E., F.Inst.P. Royal 8vo. Illustrated. 40s. net.

SYSTEMATIC ORGANIC CHEMISTRY. A complete laboratory guide to the preparations and estimations of Organic Chemistry. W. M. CUMMING, D.Sc., F.I.C.; I. V. HOPPER, Ph.D., B.Sc., A.R.C.Sc.I., F.I.C.; and T. S. WHEELER, Ph.D., B.Sc., F.R.C.Sc.I., F.I.C. Demy 8vo. Illustrated. 25s. net.

THE STATES OF AGGREGATION: The Changes in the State of Matter in their Dependence upon Pressure and Temperature. GUSTAV TAMMANN, Director of the Institute of Physical Chemistry at the University of Göttingen. Authorised translation from the 2nd German Edition by R. F. MEHL, Ph.D. Demy 8vo. 308 pages. Illustrated. 24s. net.

INTRODUCTION TO THEORETICAL PHYSICS. ARTHUR HAAS, Ph.D. Translated by [illegible] VERSCHOYLE. 2 volumes. Demy 8vo. Illustrated. Vol. I., 21s. net.
Vol. II., 21s. net

10 & 12 ORANGE ST., LONDON, W.C.2

"In years to come the publication of this monumental work will rank as one of the milestones in British applied science."—*Nature.*

Sir Richard Glazebrook's
DICTIONARY
OF
APPLIED PHYSICS
Can NOW be purchased
on the Convenient System of
DIVIDED PAYMENTS

CONTENTS

Vol. I. Mechanics—Engineering—Heat.
" II. Electricity.
" III. Meteorology, Metrology, and Measuring Apparatus.
" IV. Light—Sound—Radiology.
" V. Aeronautics—Metallurgy—General Index.

THE COMPLETE WORK
IN 5 VOLUMES
Delivered
at once
FOR A FIRST PAYMENT OF
21/-
AND 14 FURTHER MONTHLY PAYMENTS OF 21/- THUS COMPLETING THE SUBSCRIPTION
PRICE - £15 15 0

Authoritative Reviews:

"This encyclopædic work differs from many that have preceded it in that it is produced by those who have worked strenuously and successfully to promote knowledge. Originality of treatment and masterly handling are everywhere exhibited."—*Engineering.* (Vol 1)

"A book which every electrical engineer ought to possess. . . . A mine of information in a field which, at present, is not adequately covered by any one work."—*The Electrician.* (Vol. 2.)

"As a summary of our present knowledge of certain aspects of meteorology, the work is of great value. It will perhaps be regarded in future as a milestone showing the stage reached by the science at the end of the great war."—*The Meteorological Magazine.* (Vol. 3.)

SINGLE VOLUME
ALSO SUPPLIED ON DIVIDE
MONTHLY PAYMENTS AS
FOLLOWS:
Immediate
Delivery
AGAINST A FIRST PAYMENT O
2/6
AND 13 FURTHER MONTHLY PAYMENTS OF 5/- THUS COMPLETING THE
SUBSCRIPTION PRICE
£3 7 6

7 DAYS
FREE ☛
EXAMINATION

To the GLOBE PUBLISHING COMPANY, LIMITED,
112 Strand, London, W.C.2.

Please send me for 7 days free examination

A complete copy of the "Dictionary of Applied Physics" in 5 volumes.
Volume.... .. ..of the "Dictionary of Applied Physics."
(Strike out lines not applicable.)

It is understood that I can examine the $\frac{\text{work}}{\text{volume}}$ for seven days after I receive it, and that I can return it to you on the eighth day if I decide not to keep it. Should I decide to retain the volume(s), I undertake to send you a first payment of $\frac{\text{21/- for the complete work}}{\text{2/6 for Volume .... only}}$ on the eighth day and to complete the purchase of the $\frac{\text{complete work}}{\text{Volume}}$ by remitting $\frac{14}{13}$ further monthly payments of $\frac{\text{21/-}}{\text{5/-}}$ until the full price $\frac{£15:15:0}{£3:7:6}$ is paid. (I am not under 21 years of age.)

NAME . ...

ADDRESS ....

N.260 .. ..